



**National Aeronautics and  
Space Administration  
Langley Research Center**

**Scientific and Technical  
Information Program Office**

# **Scientific and Technical Aerospace Reports**

# STAIR

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## NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA scientific and technical information (STI) program plays a key part in helping NASA maintain this important role.

The NASA STI program operates under the auspices of the Agency Chief Information Officer. It collects, organizes, provides for archiving, and disseminates NASA's STI. The NASA STI program provides access to the NASA Aeronautics and Space Database and its public interface, the NASA Technical Report Server, thus providing one of the largest collections of aeronautical and space science STI in the world. Results are published in both non-NASA channels and by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA Programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.

- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services also include creating custom thesauri, building customized databases, and organizing and publishing research results.

For more information about the NASA STI program, see the following:

- Access the NASA STI program home page at <http://www.sti.nasa.gov>
- E-mail your question via the Internet to [help@sti.nasa.gov](mailto:help@sti.nasa.gov)
- Fax your question to the NASA STI Help Desk at (301) 621-0134
- Phone the NASA STI Help Desk at (301) 621-0390
- Write to:  
NASA STI Help Desk  
NASA Center for AeroSpace Information  
7115 Standard Drive  
Hanover, MD 21076-1320

# Introduction

*Scientific and Technical Aerospace Reports (STAR)* is an online information resource listing citations and abstracts of NASA and worldwide aerospace-related scientific and technical information (STI). Updated biweekly, *STAR* highlights the most recent additions to the NASA Aeronautics and Space Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related research and development (R&D) results.

*STAR* subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

*STAR* includes citations to R&D results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

## The NASA STI Program

The NASA STI Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces, and disseminates both NASA's internal STI and worldwide STI. The results of 20th and 21st century aeronautics and aerospace research and development, a worldwide investment totaling billions of dollars, have been captured, organized, and stored in the NASA Aeronautics and Space Database. New information is continually announced and made available as it is acquired, making this a dynamic and historical collection of value to business, industry, academia, federal institutions, and the general public.

The STI Program offers products and tools that allow efficient access to the wealth of information derived from global R&D efforts. In addition, customized services are available to help tailor this valuable resource to meet your specific needs.

For more information on the most up-to-date NASA STI, visit the STI Program's Web site at <http://www.sti.nasa.gov>.

# NASA STI Availability Information

## NASA Center for AeroSpace Information (CASI)

Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at [help@sti.nasa.gov](mailto:help@sti.nasa.gov). Others should visit the program at [www.sti.nasa.gov](http://www.sti.nasa.gov). The 'search selected databases' button provides access to the NASA Technical Reports Server (NTRS) – the publicly available contents of the NASA Aeronautics and Space Database.

Each citation in *STAR* indicates a 'Source of Availability.' When CASI is indicated, the user can order this information directly from CASI using the [STI Online Order Form](#), e-mail to [help@sti.nasa.gov](mailto:help@sti.nasa.gov), or telephone the STI Help Desk at 301-621-0390. Before ordering you may access [price code tables](#) for STI documents and videos. When information is not available from CASI, the source of the information is indicated when known.

NASA STI is also available to the public through Federal information organizations. NASA CASI disseminates publicly available NASA STI to the National Technical Information Service (NTIS) and to the Federal Depository Library Program (FDLP) through the Government Printing Office (GPO). In addition, NASA patents are available online from the U.S. Patent and Trademark Office.

## National Technical Information Service (NTIS)

The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at <http://www.ntis.gov>.

## The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** to ensure access for the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal depository libraries at <http://www.gpoaccess.gov/index.html>.

## The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at <http://www.uspto.gov/patft/>.

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**[Subject Term Index](#)**

**[Personal Author Index](#)**

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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VOLUME 45, NUMBER 9

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## 01

### AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics, see categories 02 through 09. For information related to space vehicles see 12 Astronautics.

**20070014840** Japan Aerospace Exploration Agency, Tokyo, Japan

**Data Review and Analysis Program (DRAP) Flight Data Visualization Program for Flight Operations Safety**

Muraoka, K.; Okada, N.; Yamamoto, R.; Ichikura, H.; Mar. 2006; 73 pp.; In Japanese

Report No.(s): PB2007-103369; No Copyright; Avail.: National Technical Information Service (NTIS)

Japan Aerospace Exploration Agency (JAXA) and Japan Airlines International (JALI) have developed a flight data visualization program called DRAP (Data Review and Analysis Program) to enhance aviation safety. DRAP generates three-dimensional animations including a cockpit view, god's-eye view, flight instruments, etc. using flight data recorded by on-board flight recorders (ex. QAR: quick access recorder). It was designed to enable a pilot to improve his/her flight skills by reviewing his/her own flight as part of flight data analysis program activities such as FOQA (Flight Operational Quality Assurance) or DFOM (Daily Flight Operation Monitoring). This paper describes DRAP development and the results of evaluations performed by major Japanese airlines.

NTIS

*Aircraft Safety; Flight Operations; Flight Safety; Safety; Scientific Visualization*

## 02

### AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans, and other elements of turbomachinery. For related information see also 34 Fluid Mechanics and Thermodynamics.

**20070014861** NASA Dryden Flight Research Center, Edwards, CA, USA

**Phoenix Missile Hypersonic Testbed (PMHT): Project Concept Overview**

Jones, Thomas P.; March 1, 2007; 18 pp.; In English; SAE Aerospace Control and Guidance Systems Committee Meeting #99, 28 Feb. - 2 Mar. 2007, Boulder, CO, USA; Original contains color and black and white illustrations; No Copyright;

Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014861>

An over view of research into a low cost hypersonic research flight test capability to increase the amount of hypersonic flight data to help bridge the large developmental gap between ground testing/analysis and major flight demonstrator Xplanes is provided. The major objectives included: develop an air launched missile booster research testbed; accurately deliver research payloads through programmable guidance to hypersonic test conditions; low cost; a high flight rate minimum of two flights per year and utilize surplus air launched missiles and NASA aircraft.

Derived from text

*Ground Tests; Flight Tests; Air to Air Missiles; Payloads; Hypersonic Aircraft; Hypersonics*

**20070015727** Ohio Univ., Athens, OH USA

**Reactive Flow Control of Delta Wing Vortex (Postprint)**

Liu, Yong; Mu, Ming; Zhu, Jim; Lawrence, Douglas A; Gutmark, Ephraim J; Myatt, James H; May, Cameron A; Aug 2006; 27 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-A03D

Report No.(s): AD-A464389; AIAA-2006-6189; No Copyright; Avail.: CASI: [A03](#), Hardcopy

In this paper, the reactive flow control of delta wing leading edge vortices using along-core pulse width modulation (PWM) flow injection is presented. Leading edge vortices on the upper surface of a delta wing can augment lift. Manipulating breakdown points of leading edge vortices can effectively change the delta wing's lift and drag and generate attitude control torque. In this paper, a dynamic model of active flow control of vortex break down points is identified from wind tunnel data using a model scheduling method. Based on the identified model, a closed-loop active flow controller is developed. Simulation and real-time wind tunnel test show that the closed-loop controller can effectively manipulate the upper surface pressure of the delta wing, which indicates the closed-loop controller can effectively control vortex breakdown points.

DTIC

*Attitude Control; Delta Wings; Leading Edges; Reactivity; Vortices*

**20070015862** Manchester Univ., UK

**A Variable Stiffness Concept For Efficient Aircraft Vertical Tail Design**

Cooper, Jonathan E; Sensburg, O; Amprikidis, M; Sep 29, 2003; 30 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-02-1-3085

Report No.(s): AD-A464617; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report results from a contract tasking University of Manchester as follows: The contractor will investigate using a variable stiffness vertical tail attachment to control aeroelastic performance over a range of dynamic pressures. The contractor will (1) Develop an adaptive stiffness attachment for vertical tail aircraft; (2) Develop an analytical model of the attachment and predict aeroelastic performance; (3) Design build and test a vertical tail model with and without a rudder to demonstrate the concept and validate the theoretical predictions; and (4) Conduct wind tunnel testing at sub and supersonic Mach Numbers; and (5) Consider the extension of the design for full-size aircraft and to quantify the benefits.

DTIC

*Aerodynamics; Aircraft Design; Dynamic Pressure; Stabilizers (Fluid Dynamics); Stiffness; Tail Assemblies*

**20070016649** NASA Langley Research Center, Hampton, VA USA

**Trailing Vortex Management via Boundary Layer Separation Control**

Greenblatt, D., Inventor; May 19, 2005; 31 pp.; In English

Patent Info.: Filed 8 Jul. 2004; US-Patent-Appl-SN-10-890-842

Report No.(s): PB2007-100940; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016649>

A method and device utilizes boundary layer separation control for the purpose of wake vortex alleviation. Trailing vortices are manipulated by varying the spanwise vortex-sheet strength via either passive or active boundary layer separation control. Boundary layer separation can be diminished or promoted to vary vortex properties, such as locations and strengths, so as to generate wake signatures that are unstable, resulting in complex three-dimensional interaction and rapid destruction of vortex coherence in the wake. Separation control can be achieved in either a time-dependent or a time-invariant mode.

Author

*Boundary Layer Separation; Vortex Alleviation; Vortex Sheets; Vortex Flaps*

### 03

#### AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; airport ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety and 85 Technology Utilization and Surface Transportation.

**20070014907** NASA Langley Research Center, Hampton, VA, USA

**Safety and Performance Analysis of the Non-Radar Oceanic/Remote Airspace In-Trail Procedure**

Carreno, Victor A.; Munoz, Cesar A.; March 2007; 39 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 4111931.02.51.07.01.03

Report No.(s): NASA/TM-2007-214856; E-19322; Copyright; Avail.: CASI: [A03](#), Hardcopy

This document presents a safety and performance analysis of the nominal case for the In-Trail Procedure (ITP) in a non-radar oceanic/remote airspace. The analysis estimates the risk of collision between the aircraft performing the ITP and a



reference aircraft. The risk of collision is only estimated for the ITP maneuver and it is based on nominal operating conditions. The analysis does not consider human error, communication error conditions, or the normal risk of flight present in current operations. The hazards associated with human error and communication errors are evaluated in an Operational Hazards Analysis presented elsewhere.

Author

*Airspace; Collisions; Oceanography; Aircraft Safety*

**20070014960** National Transportation Safety Board, Washington, DC USA

**National Transportation Safety Board Aircraft Accident Report: Crash of Pinnacle Airlines Flight 3701, Bombardier CL-600-2B19, N8396A, Jefferson City, Missouri, on October 14, 2004**

Jan. 09, 2007; 174 pp.; In English

Report No.(s): PB2007-910402; NTSB/AAR-07/01; No Copyright; Avail.: CASI: [A08](#), Hardcopy

This report explains the accident involving a Bombardier CL-600-2B19, N8396A, which crashed into a residential area about 2.5 miles south of Jefferson City Memorial Airport, Jefferson City, Missouri. During the flight, both engines flamed out after a pilot-induced aerodynamic stall and were unable to be restarted. Safety issues discussed in this report focus on flight crew training in the areas of high altitude climbs, stall recognition and recovery, and double engine failures; flight crew professionalism; and the quality of some parameters recorded by flight data recorders on regional jet airplanes.

NTIS

*Accident Investigation; Airline Operations; Civil Aviation; Commercial Aircraft; Crashes; Peaks (Landforms); Safety Management; Transportation*

**20070015115** Air War Coll., Maxwell AFB, AL USA

**Ground Truth: The Implications of Joint Interdependence for Air and Ground Operations**

Roberts, L R; Mar 2006; 101 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463466; No Copyright; Avail.: CASI: [A06](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463466>

Joint interdependence grows out of the growing reliance of the Army on the Air Force as it becomes more agile and sheds some of its organic fires. Therefore, this research paper only addresses those areas where air and ground operations merge, on the battlefield. There are four questions addressed herein: What are the implications of joint interdependence? What are the doctrinal friction points? Where is the potential for operational seams? What might be the options for a way ahead? Organizing the services to become more interdependent makes sense operationally and strategically. Yet, experiences in Afghanistan and Iraq demonstrate that the services have much to accomplish to institutionalize joint interdependence despite the spirit of cooperation that now exists between the air and land services in both areas of operations. The simultaneous ground operations of the US Army's V Corps and the US Marine Corps' I MEF during Operation Iraqi Freedom provides a unique opportunity to evaluate the issues of joint interdependence and propose potential solutions towards creating mutually enabling air and ground operations. This recent experience combined with the historical accounts of past air-ground cooperation provides some of the answers to the questions posed above and is also indicative of the difficulty in actually institutionalizing the organizational, training, and doctrinal changes necessary to make an interdependent land and air force. This will be hard work. Understanding the implications of creating a truly interdependent force capable of withstanding the pressures of the next inter-war period is the first step.

DTIC

*Ground Operational Support System; Military Operations; Support Systems*

**20070015147** Naval War Coll., Newport, RI USA

**Global Vigilance, Reach, and Power? Made Possible only with a Robust Tanker Capability**

Uyehata, Stephen; May 17, 2005; 26 pp.; In English

Report No.(s): AD-A463679; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463679>

Today, aerial refueling is essential to quickly open or prepare air bases of operations and generate missions. It is also necessary to quickly deploy, efficiently sustain and maintain, and quickly redeploy forces. In short, without a robust, multi-service, aerial refueling capability, the combatant commanders (CC) will not be able to efficiently project power throughout their areas of responsibility (AOR). Therefore, the CCs should place aerial refueling capability and the recapitalization of the multiple tanker fleets at the top of their integrated priority lists and should also take sufficient personal

interest in 'shaping' their AORs to ensure that aerial refueling infrastructure requirements are developed and negotiated prior to the outbreak of hostilities. CCs should also push the services to develop and adopt technologies that increase the flexibility of the tanker fleet including multipoint refueling, defensive systems, and austere field capability.

DTIC

*Military Operations; Refueling*

**20070015154** Air Force Research Lab., Rome, NY USA

**A Semantic Web Application for the Air Tasking Order (ATO) (Briefing Charts)**

Frantz, Albert; Franco, Milvio; Jun 2005; 29 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463762; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463762>

The purpose of this in-house exploratory development was to investigate using Semantic Web technologies for Command and Control (C2) applications. This paper describes a Semantic Web application we developed for the Air Tasking Order (ATO), the document used to assign aircraft to perform specific missions. We used existing Semantic Web tools to construct an ATO knowledge base. The knowledge base is used to select potential air missions to reassign to strike time sensitive targets by the computer. This paper introduces Semantic Web technologies, followed by a discussion of the design and implementation of our ATO knowledge base. We conclude that the current Semantic Web tools are mature enough for computers to assist in fairly sophisticated C2 domain modeling and reasoning.

DTIC

*Aircraft; Charts; Command and Control; Semantics*

**20070015168** MAK Technologies, Inc., Cambridge, MA USA

**Visualization for Decision Superiority**

Summers, Valerie A; Normoyle, Aline; Flo, Robert; Jones, Richard L; Jun 2005; 40 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463817; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463817>

PURPOSE: Explain how different visualization techniques can aid decision makers in shortening the decision cycle, decreasing information uncertainty, and improving situational awareness.

DTIC

*Decision Making; Display Devices; Visual Perception*

**20070015191** Federal Aviation Administration, Washington, DC USA

**Human Error and Commercial Aviation Accidents: A Comprehensive, Fine-Grained Analysis Using HFACS**

Shappell, Scott A; Detwiler, Cristy A; Holcomb, Kali A; Hackworth, Carla A; Boquet, Albert J; Wiegmann, Douglas A; Jul 2006; 22 pp.; In English

Report No.(s): AD-A463865; DOT/FAA/AM-06/18; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463865>

The Human Factors Analysis and Classification System (HFACS) is a theoretically based tool for investigating and analyzing human error associated with accidents and incidents. Previous research has shown that HFACS can be reliably used to identify general trends in the human factors associated with military and general aviation accidents. The aim of this study was to extend previous examinations of aviation accidents to include specific aircrew, environmental, supervisory, and organizational factors associated with 14 CFR Part 121 (Air Carrier Operations) and 14 CFR Part 135 (Commuter/Air Taxi Operations) accidents using HFACS. The majority of causal factors were attributed to the aircrew and the environment, with decidedly fewer associated with supervisory and organizational causes. Comparisons were made between HFACS categories and traditional situational variables such as weather, lighting, and geographic region. Recommendations were made based on the HFACS findings presented.

DTIC

*Aircraft Accidents; Airline Operations; Classifications; Commercial Aircraft; Errors; Pilot Error*

**20070015194** Civil Aeromedical Inst., Oklahoma City, OK USA

**An Analysis of Preflight Weather Briefings**

Prinzo, O V; Hendrix, Alfred M; Hendrix, Ruby; Feb 2007; 24 pp.; In English

Report No.(s): AD-A463873; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463873>

Weather is often cited as a factor in general aviation (GA) accidents and mishaps. The type of weather information requested from, or provided by, automated flight service station (AFSS) specialists is dependent on weather conditions at the time the preflight briefing occurs. However, little is known about how this weather information is used by GA pilots. The purpose of this research was to document the types of AFSS weather information that GA pilots requested and received and how this information might influence flight planning and weather-based decisions. A content analysis was performed on 306 GA pilot telephone conversations with AFSS specialists who staffed the preflight position. Twenty-four hours of continuous recordings of one good, typical, and bad weather day at an AFSS in the New England, Northwest Mountain, and Southwest Region were obtained prior to the Federal Aviation Administration contracting out those services. The data show that more calls were made on days of bad weather than on days of good and typical weather within the vicinity serviced by the AFSS. Approximately 78% of the pilots requested a preflight briefing (they requested a standard weather briefing more often than any other), and about 15% declined a weather briefing when asked by the AFSS specialist. Of the pilot-requested preflight weather briefings, specialists relayed the following weather items: Weather synopsis, sky conditions (clouds), visibility, and weather conditions at the departure, en route, and destination point. When pilots declined preflight weather briefings, as they did in 15.4% of the calls (good weather 16.7%, typical weather 5.0%, bad weather 20.6%), AFSS still relayed weather synopsis and sky conditions (clouds) in addition to any other weather conditions that might prove to be significant during a flight.

DTIC

*Aircraft Accidents; Flight Plans; Forecasting; Planning; Weather Stations*

**20070015213** Space and Naval Warfare Systems Center, San Diego, CA USA

**Modeling Supervisory Control in the Air Defense Warfare Domain with Queueing Theory**

DiVita, Joseph; Morris, Robert; Osga, Glenn; Jun 2005; 56 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463905; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463905>

In this paper, we hypothesize that the performance of a supervisory control operator that must process tasks recommended by a system task manager is analogous to the performance of a vacationing server, M/Er/1 queue. Thus, we assume that the input process is Markovian and that service consists of  $r$ - stages of processing, each of which is exponentially distributed. In addition, we assume that when there are no tasks in the queue to process, the operator takes a vacation, i.e., goes off and performs other duties. The model assumed vacation time was exponentially distributed. We derive the queueing statistics for this system. These statistics include (1) the average number of customers, tasks, in the queue, (2) the average time a task spends in the queue, and (3) the average waiting time in the queue. We extend this model to a two-class priority M/Er/1 vacationing server system. The results of these predictions were compared to actual operator performance. This operator was also modeled using GOMSL. Both the GOMSL and queueing models provided effective prediction of actual operator performance.

DTIC

*Air Defense; Models; Personnel Management; Queueing Theory; Warfare*

**20070015227** Naval War Coll., Newport, RI USA

**Deception, Surprise and Attack: Operational Art for Air Superiority**

Phillips, Mark D; May 16, 2006; 28 pp.; In English

Report No.(s): AD-A463928; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463928>

U.S. doctrine calls for deception to be part of every tactical, operational and strategic plan. Unfortunately, this deception plan is often included as little more than an afterthought rather than an integrated part of whole planning process. Further, the deception plan frequently only focuses on operational security (OPSEC) of one's own plan. Despite U.S. operational commanders dependence on air superiority, their only guidance is often only the vague gain or achieve air superiority received as tasking in an operational order. A comprehensive and integrated deception plan, leading to a surprise attack of an enemy's air force on the ground is one historically successful method to achieve air superiority. With lessons from several historically successful air attacks and expanding practical deception methods beyond just OPSEC, operational art can provide the air superiority the commander requires.

DTIC

*Deception; Fighter Aircraft*

**20070015290** Anacapa Sciences, Inc., Santa Barbara, CA USA

**Conventional Training Versus Game-Based Training**

Mautone, Tricia; Spiker, Alan; karp, Ron; Mar 2006; 84 pp.; In English

Contract(s)/Grant(s): N00014-06-M-0241

Report No.(s): AD-A464043; ANACAPA-TR-1573; No Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464043>

Game-based training is a promising medium for training effectiveness, particularly in military training environments; however, there are few empirically-supported guidelines on how to best implement this approach. The development of a theoretically-driven, empirically-supported tool specifying when and how specific gaming elements can be effectively integrated into training would allow instructional designers in many domains to make informed decisions about how to use game-based training to enhance learning and performance. This report describes how we began developing and evaluating such a tool. We created a taxonomy of serious game elements and integrated it with a taxonomy of cognitive functions derived from a task analysis of a flight training environment. This game element-training competency crosswalk forms the foundation of the proposed tool. We applied principles outlined in the crosswalk to develop specifications for a real-world training game for a flight training program, which will then be used to test premises and tool feasibility in controlled studies. The report details how the findings and products can be applied to other training domains.

DTIC

*Education; Flight Training; Game Theory*

**20070015297** Link Simulation and Training, Mesz, AZ USA

**Depth of Focus and Perceived Blurring of Simultaneously-Viewed Displays**

Winterbottom, Marc D; Patterson, Robert; Pierce, Byron J; Covas, Christine; Winner, Jennifer; Feb 2007; 12 pp.; In English

Contract(s)/Grant(s): FA8650-05-D6502; Proj-1123

Report No.(s): AD-A464050; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464050>

Head-mounted displays (HMDs) have not previously been combined with flat-panel display systems and it was unknown whether viewing two displays at differing focal plane distances would lead to perceived blurring or visual discomfort. This is now a concern as the Joint Helmet Mounted Cueing System (JHMCS) is integrated with existing flat-panel display systems such as the Mobile Modular Display for Advanced Research and Training (M2DART). The degree of blurring that could occur would be dependent upon observers' depth of focus and the extent to which the two displays vary in focal plane distance. In previous research, we investigated whether blurring occurs when two displays are viewed simultaneously at independently varying focal plane distances. These conditions simulated those of a monocular HMD integrated with the M2DART. The results of that research suggested that blurring due to two differing focal planes was not likely to be a significant issue for the current configuration of the M2DART. We present here two additional experiments that extend these earlier results. In the first experiment, luminance levels were decreased, thus increasing pupil size and decreasing depth of focus and the degree of blurring was measured using psychophysical techniques. In the second experiment, blurring and visual discomfort were examined under more typical viewing conditions: observers performed a task similar to off-bore sight targeting in the M2DART using a monocular HMD. They identified the orientation of an aircraft target presented on the M2DART and a test letter presented on the HMD. Assessments of eyestrain and perceived blur were obtained during the performance of this task. The results of these two experiments indicated that depth of focus should not be an issue for standard-resolution displays and, further, that visual discomfort is not likely to be an issue for the integration of a monocular HMD with the M2DART.

DTIC

*Blurring; Depth; Display Devices; Flight Simulation*

**20070015302** Link Simulation and Training, Mesz, AZ USA

**Effect of Display Line Rate and Antialiasing on the Recognition of Aircraft Aspect Angle**

Winterbottom, Marc D; Geri, George A; Pierce, Byron J; Feb 2007; 7 pp.; In English

Contract(s)/Grant(s): F41624-97-D-5000; Proj-1123

Report No.(s): AD-A464056; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464056>

Increasing display line rate did not improve aspect-angle recognition performance beyond a level predicted by measured display resolution. Image antialiasing improved performance even though it did not increase the measured spatial resolution.

Finally, the threshold for aspect-angle recognition was found to be consistent with that obtained for other visual tasks dependent on target spatial detail.

DTIC

*Flight Simulation; Radar Tracking; Signal Processing*

**20070015326** Civil Aeromedical Inst., Oklahoma City, OK USA

**Mining for Information in Accident Data**

Milburn, Nelda J; Dobbins, Lena; Pounds, Julia; Goldman, Scott; Nov 2006; 11 pp.; In English

Report No.(s): AD-A464086; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464086>

Purpose. This project evaluated WinMine, an analytic tool developed by Chickering, Heckerman, Meek, Platt, and Thiesson (2000) to determine its usefulness for identifying higher-order relationships in research data from dynamic and high-consequence aviation events. Traditionally, researchers have relied on several types of analyses to better understand the relationships between factors related to an outcome. However, researchers need an analytic approach that can clearly illustrate the interactions among causal factors as probabilities associated with the chain of events. Method. A convenience sample of aviation accident data previously classified using the Human Factors Analysis and Classification System (HFACS; Shappell & Wiegmann, 2000; 2001) was used to evaluate WinMine in contrast to traditional methods, such as bar graphs, contingency tables, and odds ratios. Results. WinMine showed an advantage when compared with other methods because it graphs quantifiable interrelationships between factors and illuminates the underlying hierarchical structure of variables. Discussion. Each technique examined contributed toward understanding the causal factors; however, WinMine provided a better picture of the factor interrelationships than the other methods.

DTIC

*Aircraft Accidents; Computer Programs; Data Mining; Probability Theory*

**20070015328** Link Simulation and Training, Mesz, AZ USA

**Effect of Display Resolution and Antialiasing on the Discrimination of Simulated-Aircraft Orientation**

Geri, George A; Winterbottom, Marc D; Jan 2005; 14 pp.; In English

Contract(s)/Grant(s): F41624-97-D-5000; Proj-1123

Report No.(s): AD-A464093; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464093>

In Experiment 1, antialiasing was found to improve performance on an orientation-discrimination task, whereas increasing display pixel-count did not. The latter finding was attributed to a decrease in image contrast associated with driving the CRT beyond its effective bandwidth. In Experiment 2, it was found that display resolution is the primary determinant of orientation-discrimination performance. This performance was not significantly improved by increasing antialiasing beyond a minimal level, suggesting that greater image detail can be substituted for antialias filtering. Finally, data obtained from an objective target-size calibration showed that nominal target size often does not accurately reflect the size (and hence distance) of simulated targets.

DTIC

*Radar Tracking; Resolution; Signal Processing; Visual Perception*

**20070015811** Naval War Coll., Newport, RI USA

**Naval Helicopters and SOF: How Joint Are We**

McCall, Wes; Feb 14, 2005; 20 pp.; In English

Report No.(s): AD-A464524; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Little emphasis has been placed on Naval aviation's support of Special Operations Forces (SOF), although recent operations in the U.S. Pacific Command (USPACOM) and U.S. Central Command (USCENTCOM) areas of responsibility have proven the genuine requirement for a credible Special Operations capability within Naval helicopter communities. SOF personnel are routinely supported by conventional Naval helicopter assets; however no formal joint instructions or common standard operating procedures exist between U.S. Special Operations Command (USSOCOM) and the U.S. Navy. This undoubtedly, has opened the door for USSOCOM queries into issues of credibility, standardization, and safety. This paper will explore the historic bond between SOF and Naval aviation, describe inadequacies in joint training, and expose philosophical roadblocks and misconceptions regarding Naval aviation's Special Operations capabilities. Establishment of a Memorandum of Agreement between USSOCOM and the Chief of Naval Operations will standardize techniques, tactics, and procedures

(TTPs) and enable legitimate use of conventional helicopter assets to facilitate SOF training and limited operational missions in support of Operational Commander time-critical mission requirements. Achievement of Special Operations Capable designation prior to deployment will legitimize Naval unit capabilities in the joint environment, and restructuring the JAAAC process will dramatically improve SOF training deficiencies. Implementation of these recommendations will dramatically improve the operational effectiveness and efficiency of SOF operations while ensuring a smooth transition to a true joint SOF capability.

DTIC

*Helicopters; Military Aviation; Military Personnel*

**20070015941** Army Research Inst., Alexandria, VA USA

**Predictor Development and Pilot Testing of a Prototype Selection Instrument for Army Flight Training**

Bruskiewicz, Kenneth T; Katz, Lawrence C; Houston, Janis; Paullin, Cheryl; O'Shea, Gavan; Damos, Diane; Feb 2007; 47 pp.; In English

Report No.(s): AD-A464020; ARI-TR-1195; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464020>

As part of a project by the U.S. Army Research Institute for the Behavioral and Social Sciences Rotary Wing Aviation Research Unit (AR RWARU) to produce a selection instrument for Army flight training, several viable, existing predictor measures were identified and several new predictors were developed. The resulting prototype battery was pilot tested with 80 aviator candidates prior to beginning flight school, who provided performance data and subjective feedback. This pilot test resulted in revisions and decisions as to the predictors to be included in the prototype battery for preliminary validation.

DTIC

*Flight Training; Prototypes*

**20070015973** Air War Coll., Maxwell AFB, AL USA

**International Armament Cooperative Programs: Benefits, Liabilities, and Self-Inflicted Wounds - The JSF As a Case Study**

Di Domenico, Stephen G; Feb 2006; 86 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464091; No Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464091>

The Joint Strike Fighter international program is unique; indeed there is no other example of a U.S. major prime contractor co-developing and co-producing a U.S. combat aircraft with other foreign entities. Consequently, the program provides an excellent model to evaluate in view of the new Department of Defense international acquisition strategy requirements. This paper is a preliminary analysis that seeks to answer the questions: what are the benefits and liabilities of the JSF international acquisition approach thus far, and what are the necessary precursors or conditions that should exist for future international cooperative programs to have the best chance of success? Such answers are relevant given that DoD now looks to international armament cooperative programs as the first option for future weapon systems acquisition strategies. Finally, the paper will identify barriers that are hard-wired into our acquisition regulations, policies and statutes that restrict cooperation, fail to take advantage of the global defense industrial market, and are antithetical to our National Security Strategy coalition goals. The paper concludes with recommendations intended to improve the success for future international cooperative initiatives.

DTIC

*Acquisition; Liabilities*

**20070016006** Aptima, Inc., Woburn, MA USA

**Model-based Organization Manning, Strategy, and Structure Design via Team Optimal Design (TOD) Methodology**

Levchuk, Georgiy; Chopra, Kari; Paley, Michael; Levchuk, Yuri; Clark, David; Jun 2005; 47 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463981; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463981>

This paper describes a quantitative Team Optimal Design (TOD) methodology and its application to the design of optimized manning for E-10 Multi-sensor Command and Control Aircraft. The E-10 (USAF, 2002) is intended to consolidate command and control (C2), battle management (BM), intelligence, surveillance and reconnaissance (ISR), and selected information warfare (IW) functions and eventually replace elements of the current C2ISR force mix. Our TOD design

approach allows specification of team configurations (number and roles of operators) for efficiently operating E-10 to execute mission scenarios of various contingencies. The objective is to maximize the speed of mission execution while balancing the workload among team members, provided the decision-making, expertise, workload threshold and organization cost constraints are satisfied. In order to analyze and simulate the operations of E-10, we conducted mission decomposition to define functional responsibilities for the E-10 within the context of an operational mission. Working with subject matter experts, we developed functional process flows of E-10 by decomposing each stage into representative functions. Each of these functions is in turn decomposed into high level task responsibilities, defining a directed graph of tasks with precedence/information flow constraints.

DTIC

*Workloads (Psychophysiology); Personnel; Decision Making*

**20070016017** Texas Univ., Austin, TX USA

**Using Advanced Tabu Search Approaches to Perform Enhanced Air Mobility Command Operational Airlift Analyses - Phases II and III**

Barnes, J W; Oct 31, 2006; 16 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-03-1-0100; Proj-2304

Report No.(s): AD-A463631; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463631>

First, we focus on 'transitions' (cases where our work is slated for use in either an AMC technology application or in important application arenas essential to the economic and environmental well being of the nation). Second, we address the theoretical contributions associated with neighborhood and landscape theory. The last 12 months have been intriguing, challenging, and productive. Much has been accomplished and we eagerly look forward to the future challenges that will be met and overcome in achieving the Consortium project objectives.

DTIC

*Mobility; Technology Utilization*

**20070016027** Naval War Coll., Newport, RI USA

**Airpower's Emasculation? -- Non-lethal Weapons in Joint Urban Operations**

Nisbett, Donald A; Feb 14, 2005; 30 pp.; In English

Report No.(s): AD-A464450; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Presidential declaration of a Global War on Terror (GWOT) ensured that the future battlespace will occur in urban environments, in search of terrorist operatives and networks. Advancements in precision weapons have done much to allay concerns over minimizing collateral damage and reducing noncombatant casualties in Joint Urban Operations (JUO), however, the consideration in proposing airpower's use of non-lethal weapons (NLW) is the improvement in capability. This paper considers the efficacy of airpower in JUO with the addition of NLW, given the GWOT and future operations, proposing that overall capability could be enhanced. Considerations include costs, hearts and minds, and stability and support operations (SASO). Airpower with NLW capability could stem the tide of rising costs by reducing munitions and rebuilding expenses. Additionally, intelligence gathered from captured vice killed terrorists could lead to operations concluding sooner, thereby indirectly reducing the overall cost for a particular operation. The second consideration looks at how utilizing airpower with NLW could reduce the footprint of U.S. forces, while minimizing noncombatant casualties and collateral damage, and depreciate the negative effects of media coverage. The third position is as the future of likely military intervention points to conducting SASO in urban environments; NLW capability would mean a broader application of airpower in these missions.

DTIC

*Cities; Air Defense; Military Operations; Defense Program*

## AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications, Spacecraft Communications, Command and Tracking; and 32 Communications and Radar.

**20070014962** NASA Glenn Research Center, Cleveland, OH, USA

### **Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006**

Ponchak, Denise, Compiler; September 2006; 489 pp.; In English; 6th Integrated Communications, Navigation and Surveillance Technologies Conference and Workshop, 1-3 May 2006, Baltimore, MD, USA; See also 20070014963 - 20070015042

Contract(s)/Grant(s): WBS 411931.02.07.03.02

Report No.(s): NASA/CP-2006-214398; Copyright; Avail.: CASI: [C01](#), CD-ROM

The Integrated Communications, Navigation and Surveillance (ICNS) Technologies Conference and Workshop provides a forum for government, industry, and academic communities performing research and technology development for advanced digital communications, navigation, and surveillance security systems and associated applications supporting the national and global air transportation systems. The event's goals are to understand current efforts and recent results in near- and far-term research and technology demonstration; identify integrated digital communications, navigation and surveillance research requirements necessary for a safe, high-capacity, advanced air transportation system; foster collaboration and coordination among all stakeholders; and discuss critical issues and develop recommendations to achieve the future integrated CNS vision for the national and global air transportation system.

Author

*Surveillance; Avionics; Air Transportation; Air Traffic Control; Pulse Communication; Air Navigation; Systems Integration*

**20070014963** SENSIS Corp., NY, USA

### **A Trajectory-Based Probabilistic TFM Evaluation Tool and Experiment**

Ramamoorthy, Kris; Hunter, George; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 435-436; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A04](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A number of factors have contributed to a significant increase in air transportation demand in recent decades. With continued competition, cost containment, and air transportation product diversification, this demand is projected to continue to increase in future years. Planners are now assuming a doubling (2X) and even tripling (3X) of demand in the coming decades. As demand grows, capacity limitations cause significant congestion, especially in off-nominal conditions such as heavy weather. Future system improvements not only must significantly increase capacity, but also must be robust to off-nominal conditions. There are several emerging technology and infrastructure improvements that can enable future strategies in dealing with heavy weather in the NAS. This problem has both tactical and strategic components. In the tactical domain, traffic is represented by detailed trajectories, and weather is represented by the available meteorological products such as pixel-level reflectivity and echo tops data. In the strategic domain traffic is represented as forecasted airspace and airport loading, and weather is represented as its impact on airspace and surface capacity reductions. This transformation of forecasted weather phenomena to NAS capacity data converts the problem to a generalized traffic flow management formulation. This problem is, however, probabilistic since there are several sources of uncertainty, especially in the strategic domain. A key question is how flights should be guided in capacity-constrained scenarios. Pre departure gate holding, and pre- and post-departure rerouting are typical means of dealing with congestion. Several tools and procedures are available or under development but dealing with broadly congested scenarios remains a challenge. During the daytime hours many thousands of flights are departing or in the air at any one time. They are flying between hundreds of different airports and are using hundreds of different aircraft types and equipment. Because demand sometimes exceeds airspace or surface capacity, flight delays are inevitable. This makes for a high-dimensional nonlinear traffic planning problem. The problem is complicated by several additional factors. First, there is significant uncertainty in the takeoff times for pending departures and in the wind and storm forecasts. Therefore, both demand and capacity predictions are uncertain. Also, key aspects of the problem are difficult to generalize. Weather patterns may be classified, but only to a limited extent. Even patterns that appear similar often have



important differences. Likewise, while traffic patterns may be classified into a set of traffic flows, many flights do not easily fit within such an abstraction.

Author

*Air Transportation; Trajectories; Air Traffic Control; Probability Theory*

**20070014964** Department of Transportation, Cambridge, MA, USA

#### **Tandem Optical Sensors to Assist in Runway Incursion Prevention**

McGovern, Seamus M.; Creaghan, Stephen G.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 231-239; In English; See also [20070014962](#); Original contains color illustrations

Contract(s)/Grant(s): VNTSC #YC200 G044M; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Federal Aviation Administration is exploring airport surface surveillance technology as a means in preventing runway incursions. The air traffic controller is responsible for assuring safe separation on runways and orderly movement of aircraft on taxiways. The process of moving aircraft on the surface is dependent on visual observation of aircraft and ground vehicle movements. Interactions between aircraft on final approach and aircraft on the runway must be rapidly assessed. Low visibility can dramatically impede the controllers ability to safely direct aircraft on the surface. An optical system using two sets of optical beams and detectors at various taxiway checkpoints may aid in the detection and tracking of taxiing aircraft and other vehicles on the airport surface. The initial software for use in evaluating the concept is shown here to provide the following: aircraft location, speed, direction, wheelbase, and type (manufacturer and model). This concept is novel for the following reasons: use of more than one optical beam enabling the calculation of speed information, classification of aircraft by their wheelbase, and application of optical beams for the detection of taxiing aircraft and airport vehicles. The described software allows for the development of the basic algorithms and as a proof-of-concept to justify further research. The system is stand-alone; that is, it is airport-based requiring minimal integration and is not installed on individual aircraft or trucks (non-invasive to aircraft and vehicles and does not require vehicle participation). The concept should prove to be low risk (due to system components consisting of mature technologies from the security industry), low cost (due to off-the-shelf assemblies; also airport infrastructure modification should be minimal), and high payoff (as a stand-alone automated airport ground surveillance system that can provide position, speed, direction, and aircraft type; the potential for automated data collection and realtime conflict resolution; or for use in augmenting existing ground surveillance systems).

Author

*Optical Measuring Instruments; Sensors; Surveillance; Airports; Runway Incursions*

**20070014965** Department of Transportation, Cambridge, MA, USA

#### **Simple Methodology for the Stochastic Independent Event Calculation of Air Traffic Conflicts**

McGovern, Seamus M.; Creaghan, Stephen G.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 223-230; In English; See also [20070014962](#); Original contains color illustrations

Contract(s)/Grant(s): VNTSC #YC200 G044M; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The USA has one of the safest and most complex aviation systems in the world with the National Airspace System (NAS) handling more than 35,000 airline operations each day. An important step towards the future is the implementation of an integrated Safety Management System (SMS). The SMS integrates current Federal Aviation Administration safety-related operational policies, processes, and procedures, as well as introduces new elements necessary for a systems approach to managing the safety risk of providing air traffic control and navigation services. When new communication, navigation, and surveillance (CNS) equipment is added to the NAS, as part of a thorough SMS analysis it is of interest to quantify the likelihood of an aircraft conflict in the case of loss of some or all CNS functions. While this can and has been done in detail using simulation, it is often of value to be able to make a rapid and generalized calculation to enable a relative assessment when considering different flight regimes and infrastructure modifications. In this paper, a probabilistic methodology is presented for quickly and simply calculating conflict likelihoods using aircraft size and speed along with airspace type. These formulae may also be useful for other calculations, including those related to system availability, airspace capacity, allowable aircraft speed or size determination, and CNS equipment mean-time-between-failures. The formulae developed here treat aircraft locations as random, independent events and are shown in this paper to provide for the calculation of more than one aircraft occupying the same airspace under loss of communication and/or surveillance (but not navigation) for reasons that

may include basic system failures as well as due to denial of service, jamming, interference, and other causes.

Author

*Air Traffic Control; National Airspace System; Stochastic Processes; Surveillance; Telecommunication; Air Navigation*

**20070014966** Mitre Corp., USA

**Communications, Navigation, Surveillance and Avionics within the 2020 Future Vision**

Morgenstern, Robert; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 383-392; In English; See also [20070014962](#); Original contains color illustrations  
Contract(s)/Grant(s): DTFA01-01-C-00001; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing the navigation, communication, surveillance and avionics capability for the year 2020 is shown. The topics include: 1) Shared Separation Authority; 2) Shared Separation and Delegation; 3) Pair-wise Crossing Cockpit View; 4) Pair-wise Crossing CNS Impacts; 5) Sequencing & Merging; 6) Sequencing & Merging Cockpit View concept; 7) Sequencing & Merging Broadcast vs. Addressed; 8) Sequencing & Merging CNS Impacts; 9) Grouping/Streaming CNS Impacts; and 10) Summary

CASI

*Avionics; Navigation; Surveillance; Telecommunication*

**20070014967** Computer Sciences Corp., Rockville, MD, USA

**The Use of Collaborative Rerouting Procedures Instead of Miles-in-Trail (MIT) Restrictions for Managing National Airspace System (NAS) Choke Points**

Rigterink, Paul; Ellenberger, Ed; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 393-407; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation on the use of rerouting procedures instead of Miles-in-Trail (MIT) Restriction for Managing National Airspace System Choke Points is shown. The topics include: 1) Bureau of Transportations Statistics Data; 2) DOT Office of Aviation Enforcement and Proceedings (OAEP) Air Travel Consumer Report; 3) Current Use of Miles-in-Trail Restrictions; 4) Sample Choke Points; 5) Current Use of Rerouting; 6) Current Use of Ground Delay Programs (GDPs) and Ground Stops (GSs); 7) Obtaining the Proper Balance in the Use of MIT, Rerouting, GDP, and GS Initiatives; and 8) Sample Tool Set for Fully Planning a Rerouting Strategy.

CASI

*Air Transportation; National Airspace System; Systems Engineering; Civil Aviation*

**20070014968** Boeing Co., USA

**The Future of Required Total System Performance (RTSP)**

Shakarian, Arek; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 11 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

ICAO's Air Navigation Commission (ANC) formed the ATMCP, Air Traffic Management Concept Panel, in 1998. The panel was charged to develop the future (2025+) Global ATM Operational Concept. In November 2005 ICAO Document 9854 Global Air Traffic Management Operational Concept was released. One of the paradigmatic shifts envisioned for future operations is that the global air traffic system be performance based. Implicit in this vision is that the global air traffic in its totality be conceived as a system. At the September 2003 11th ANC meeting, Agenda Item 3, named RTSP, Required Total System Performance, was presented to the members of the ANC. The presentation was an encapsulation of work conducted by ATMCP introducing to the ANC a 5 level ATM Performance Hierarchy framework for future ATM/CNS operations. The layered framework describes how future Air Traffic Management services (e.g. Traffic Synchronization, Demand/Capacity Balancing, et al) would be enabled by a host of technologies or systems from a performance-driven rather than technology-driven perspective. A set of challenging tasks lie ahead regarding how RTSP may be further developed as a performance-based concept. It is imperative that any future emergence, roadmap, and implementation of so-called Operational Improvement (OI) at the local, regional, and global arenas be performance-based while enfolded and adopting the particular promises claimed from any new techniques, new procedures, new technologies, and new infrastructural configurations (e.g. network-centric). At the most fundamental level this requires a special appreciation of the following: 1) the historically

unprecedented fact that the ATM/CNS is being conceived of as a system, a system-of-systems, and indeed even as a complex-socio-technical-system-of-systems, 2) that any such system, whether conceived of as TSE, Traditional Systems Engineering, or be distinguished in the emerging field of so-called CSE, Complex Systems Engineering, needs to be represented or modeled beyond typically or traditionally established Systems Engineering paradigms, 3) This complex systems modeling would be an inseparable and intimately intertwined process in the development of RTSP in the context of the ICAO 5-level ATM/CNS Performance Hierarchy. Therefore, any future RTSP performance-based operations require that such an evaluation and eventual system design requirements be also model-based or in various levels of fidelity and dimensionality be modeled or represented a pre-design and implementation performance assessment. Finally, from ICAO's perspective, a so-called Performance Case is the expectation for any future ATM/CNS operational infrastructure. This signifies that a specific OI plan that is to be implemented at a specific ATM ground site (e.g. airport, TRACON, et al) or air site (e.g. aircraft avionics, et al) or space site (e.g. GBAS et al) satisfies at least three fundamental and interrelated performance criteria: 1) Safety, 2) Business or Economic, and 3) Technical or Operational. These interdependent qualitatively different performance dimensions are to be validated through a holistic and integrated assessment framework that would include safety, economic (i.e., investment), and technical performance that meet minimum local, regional, and global performance goals (e.g., efficiency, cost, and interoperability). Therefore, in another sense, the 5-level ATM/CNS Performance Hierarchy is posited as the basic performance framework for any model-based and performance-driven (or based) assessment of future ATM/CNS system performance in safety, cost-effectiveness, and technically enabled behavior in contradistinction to past practices where multiple and perhaps incoherent ATM/CNS system changes were primarily adopted from a technology-driven modus operandi.

Author

*Air Navigation; Systems Engineering; Aircraft Performance; Air Traffic Control; Avionics*

**20070014969** Federal Aviation Agency, USA

#### **FAA SWIM Acquisition Planning**

Hawthorne, Michael; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 14 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

SWIM is not a massive single acquisition with a single prime contractor and a 'switchover' type transition. It will be broken into useable segments, the first of which will be base lined in mid FY07. SWIM NAS capabilities must be developed as such from the ground up based in part upon what we learn from the demonstration projects. Demonstration systems can rarely (if ever) simply be 'hardened' and deployed. The success of SWIM is dependent upon diligent acquisition management that begins with well-defined requirements, is managed on risk-adjusted cost and schedule baselines, and is implemented in manageable pieces to meet the evolutionary needs of NGATS.

Derived from text

*Deployment; Schedules; Information Management; Planning*

**20070014970** Mosaic ATM, Inc., Leesburg, VA, USA

#### **The Remote Airport Traffic Services Concept: Opportunities and Requirements**

Brinton, Chris; Atkins, Stephen; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 263-271; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Operational activity decomposition provides a detailed requirements analysis approach for remote airport traffic services. Analysis of remote airport traffic services requirements, information needs, and possible solutions conducted. Results indicate that the requirements for remote airport traffic services are beyond the capabilities of today's electronic airport surveillance systems. However, a combination of capabilities may satisfy the remote airport traffic services requirements: a) electronic airport surveillance; b) optical surveillance; and c) advanced decision support tools. Significant benefits in increased efficiency and reduced operating costs may be possible.

Derived from text

*Air Traffic Control; Aircraft Approach Spacing; Cost Reduction; Surveillance; Air Traffic*

**20070014971** NASA Glenn Research Center, Cleveland, OH, USA

**Wireless Channel Characterization: Modeling the 5 GHz Microwave Landing System Extension Band for Future Airport Surface Communications**

Matolak, D. W.; Apaza, Rafael; Foore, Lawrence R.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 295-304; In English; See also [20070014962](#); Original contains color illustrations

Contract(s)/Grant(s): NNC04GB45G; Copyright; Avail.: CASI: [A04](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

We describe a recently completed wideband wireless channel characterization project for the 5 GHz Microwave Landing System (MLS) extension band, for airport surface areas. This work included mobile measurements at large and small airports, and fixed point-to-point measurements. Mobile measurements were made via transmission from the air traffic control tower (ATCT), or from an airport field site (AFS), to a receiving ground vehicle on the airport surface. The point-to-point measurements were between ATCT and AFSs. Detailed statistical channel models were developed from all these measurements. Measured quantities include propagation path loss and power delay profiles, from which we obtain delay spreads, frequency domain correlation (coherence bandwidths), fading amplitude statistics, and channel parameter correlations. In this paper we review the project motivation, measurement coordination, and illustrate measurement results. Example channel modeling results for several propagation conditions are also provided, highlighting new findings.

Author

*Wireless Communication; Characterization; Channels (Data Transmission); Air Traffic Control; Telecommunication; Airport Towers*

**20070014972** SENSIS Corp., East Syracuse, NY, USA

**NGATS CNS Test Bed: Proving Next Generation Technical Feasibility and Operational Viability in a Real World Environment**

Collins, Rod; Finnegan, Robin; Valovage, Ed; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 433; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing the Next Generation Air Transportation System (NGATS) Communication, Navigation, Surveillance (CNS) Test Bed is shown. The topics include: 1) Motivation for NGATS CNS Test Bed; 2) NGATS Test Bed Designed to Fully Support JPDO; 3) NGATS CNS Test Bed: A National Asset; 4) Testbed Communication Infrastructure; 5) Enabling the NGATS Transformation; and 6) Phased, Multi Year Testbed Program Schedule.

CASI

*Technology Assessment; Feasibility Analysis; Telecommunication; Air Transportation*

**20070014973** NASA, Washington, DC, USA

**The Path to NGATS**

Scardina, John; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 12 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

NGATS operational Improvements and benefits include: 1) Broad area and precision navigation to access and capacity; 2) Airspace access and management to capacity; 3) 4D trajectory based ATM to capacity and efficiency; 4) Reduced separation between aircraft to capacity; 5) Flight deck situational awareness and delegation to capacity and safety; 6) ATM decision support to capacity; 7) Improved weather data and dissemination to capacity and safety; 8) Reduced cost to deliver ATM services to cost; 9) Greatly expanded airport network and improved terminals to capacity.

Derived from text

*Situational Awareness; Area Navigation; Airspace; Flight Safety; Airports*

**20070014974** Frequentis G.m.b.H., Vienna, Austria

**Technical and Operational Aspects of Migration Concepts of a broadband VHF Communication System (B-VHF)**

Haindl, Bernhard; Sajatovic, Miodrag; Rihaceck, Christoph; Rokitansky, Carl-Herbert; Schnell, Michael; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 27-36; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation on the technical and operational aspects of migration scenarios of a Broadband Communication system (B-VHF) is shown. The topics include: 1) Current VHF Band Situation; 2) B-VHF System; 3) Overlay Concept; 4) Transition Aspects; 5) Migration Scenarios; 6) Simulation Results; and 7) Conclusions.

CASI

*Broadband; Very High Frequencies; Air Traffic Control; Avionics*

**20070014975** William J. Hughes Technical Center, Atlantic City, NJ, USA

**Airborne Networking Multi-Aircraft Network Capability Demonstration**

Yost, Ralph; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 5; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

I will talk about the planned Multi-Aircraft Airborne Networking Demonstration to be performed at the William J Hughes FAA Technical Center in June. The flight tests will utilize three aircraft and evaluate two separate airborne networking capabilities which will simultaneously be operated. Network connectivity will be established between all three aircraft and the ground and between all three aircraft. Data rates of up to 45 MB/s in each direction and at the same time are planned for one of the systems. We will demonstrate how future capabilities of the Next Generation Air Transportation System (NGATS) might take place over net centric communications for aircraft, enabling the free flow of information and shared situational awareness.

Author

*Air Transportation; Flight Tests; Airborne Equipment; Communication Networks*

**20070014976** ViaSat, Inc., Carlsbad, CA, USA

**Qualification Challenges for Software Defined Radios**

Kocin, Michael J.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 7-16; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Both the Military and Commercial segments of the aviation marketplace are looking to Software Defined Radios to solve the problem of rapidly changing technology and more efficient implementation of new waveforms. Airlines and avionics manufacturers are facing increased costs for new system development. This occurs because of the rapidly changing avionics waveform environment and the associated risk of development and qualification. This qualification process is time consuming and costly due to the high complexity of many of the new waveforms. Additionally, the cost of re-qualification of hardware and software for upgrades and modifications makes the fielding of new or upgraded systems less attractive. At the same time, the operational environment for communication systems is becoming increasingly complex with the rapid growth and expansion of military, civil, and commercial wireless technology. New Software based radio systems will be required to provide compatibility and inter-operability with existing waveforms, meet IEEE, EuroCAE and ARINC standards, Inter-operate with Military aircraft and meet new Software interface and architecture standards. As such SDR architectures are proposed as an agent for change in the commercial avionics arena. The driving requirements include an open architecture structure with independent software modules. This allows the architecture to become extensible. It is independent function by function with future growth added without impacting basic hardware, software or architecture. This design will also carry the ability of graceful degradation during failures through the use of redundant functionality and re-configurability. Finally, Life Cycle cost will drive the overall approach, manufacturing and deployment of the Software Defined Radio. This paper/presentation will describe how a representative SDR architecture with independent software modules and how this architecture certification may need to be approached to deploy a cost efficient design. Certification strategy is not limited to initial qualification of the system and functions but hinges on the ability of the system to accept future changes and upgrades and be re-certified without major schedule, cost or design impact to previously fielded systems.

Author

*Radio Communication; Software Engineering; Avionics; Telecommunication; Systems Engineering*

**20070014977** Federal Aviation Agency, USA

**Spectrum Issues and WRC 07 Preparation**

Biggs, Michael; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 12 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Evolving applications in civil aviation necessitate additional spectrum for safety communications. Portions of the

spectrum already allocated to the Aeronautical Radionavigation Service (ARNS) offer a partial solution to those AM(R)S needs. Civil aviation has an interest in maintaining viable and fully-utilized spectrum. ITU actively pursuing new allocations for 3-G wireless in other aviation bands (e.g., 2700-2900 MHz radar band). Civil aviation safety-of-flight requirements make sharing with commercial services difficult. Need to optimize use of current aviation bands.

Derived from text

*Aircraft Safety; Civil Aviation; Radio Navigation; Flight Safety*

**20070014978** Old Dominion Univ., VA, USA

**Wireless Spacecraft Bus: A Radio Frequency Based Data Communication Architecture**

Song, Min; Shetty, Sachin; Ash, Bob; Bone, Kenneth; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 45-46; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

RF-based data communications in terrestrial environments have found widespread success. This is due to their license-free robust and secure high-data rate commercial RF data communications incorporating spread spectrum techniques. We believe that deploying a space certified commercial robust RF wireless onboard a spacecraft in a fairly traditional Telemetry-Telecommand (TM-TC) data-handling scenario is completely feasible. The main motivations for developing a wireless spacecraft bus are mass reduction, layout simplification, saving in assembly, integration and testing labour, security enhancement and fault tolerance. Spacecraft harnessing (wiring) accounts for up to 10% of spacecraft dry mass, and therefore represents an opportunity for overall mass reduction. Mass reduction would reduce cable mass and bulk, and simplify harness production. The wiring for the data harness accounts for more than half of the total harness weight. By adopting a wireless spacecraft bus, data communication wiring can be significantly reduced, which would bring down the cost of the whole spacecraft mission. Potential benefits resulting from wireless interfaces during integration and testing are extremely high. Currently, the test harness requirements introduce significant risks and cost impacts at a critical stage of spacecraft development. A very strong financial case for the development of wireless technologies can be made on the potential benefits during integration and test alone. In addition, recent experiments with wireless systems and especially with RF-based sensor networks have demonstrated that wireless systems can have enhanced reliability when compared to typical wired networks. Thus we propose a RF-based intra-spacecraft inter-network to harness data communication onboard spacecraft.

Author

*Bus Conductors; Wireless Communication; Radio Frequencies; Data Transmission; Communication Equipment; Radio Communication*

**20070014979** Federal Aviation Administration, Cambridge, MA, USA

**Cyber Security Research Plans for a Secure Aircraft Data Network (SADN)**

Harnett, Kevin; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 191-200; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The DOT/Volpe Center was tasked by the National Aeronautics and Space Administration (NASA) Glenn Research Center (GRC) Secure Aircraft System for Information Flow (SASIF) Program to develop a baseline of the cyber security requirements for a Secure Aircraft Data Network (SADN) on next generation aircraft and provide Research and Development (R&D) recommendations to leverage related SADN programs. Advances in technology have made it feasible to enable new cost-effective connectivity between aircraft and airline ground networks which will bring about extensive enhancements in Aircraft Data Networks (ADN). These changes will provide significant benefits for the airlines and passengers but will also introduce new cyber security vulnerabilities. Cyber security vulnerabilities in the ADN will be irrevocably bound to the safety of flight. Unmitigated, these vulnerabilities will have a definite negative effect on the safety of flight. Airbus and Boeing are making modifications to their existing lines of aircraft and developing new aircraft with enhanced ADNs that will facilitate increased connectivity to ground networks. The airlines and avionics manufacturers are developing similar network-centric systems and equipment for their existing fleet of aircraft. Airlines will use the improved connectivity to develop business cases to provide for reduced costs, operational efficiencies and new revenue opportunities. The airlines will also require that the network be made available to passengers. The sale of network-enabled services to passengers will provide essential revenue to fund the cost of the enhancements. Along with the increased connectivity there will also be significant new cyber security vulnerabilities and risks introduced due to these new technology enhancements. This paper will focus on the cyber security aspects of an enhanced Aircraft Data Network (ADN) and will provide recommendations for potential research and

development (R&D) that will be needed to insure the development and implementation of a Secure Aircraft Data Network (SADN).

Author

*Security; Airline Operations; Avionics; Computer Networks; Civil Aviation; Information Flow*

**20070014980** Boeing Phantom Works, USA

**Network-Enabled Operations (NEO) Security Demonstration**

Lewis, Michael S.; Hayman, Gene C.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 201-203; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Besides the capacity limitations of current aviation infrastructure, the tragic events of 9-11 have heightened the urgency of the need for a transformational approach to developing and deploying our future air transportation system. Shortfalls in interoperability, information sharing, and shared situational awareness and in our ability to rapidly respond to and resolve potential security incidents [illustrated by the 9 June 2004 DC incident with the Kentucky Governor's aircraft] have provided ample evidence that a balanced approach to security must be embedded in both aviation system design and operations, while ensuring the efficient and effective movement of people and goods. In 2005, to help address the complexities of national airspace agility and capacity in a national security context, the Joint Planning and Development Office (JPDO) sponsored an initiative known as the Joint Network-Enabled Operations (NEO) Security Demonstration (henceforth referred to as the NEO Demo). In the spirit of the multi-agency JPDO, four of its core members collaborated on this project. NASA provided the funding, FAA managed the program, and DoD and DHS provided security expertise. Boeing led the formation of a Joint Industry Partnership that included three other major ATC/ATM suppliers, Computer Sciences Corporation (CSC), Lockheed Martin, and Raytheon. During this project both government and industry recognized the value of 'cooperation' and public/private partnerships in dealing with the complex issues associated with information sharing and collaborative decision-making in a national security context.

Derived from text

*Systems Engineering; Situational Awareness; Security; Air Traffic Control; Decision Making; Airspace; Interoperability*

**20070014981** George Mason Univ., Fairfax, VA, USA

**Day's Weather in the NAS**

Klein, Alexander; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 437-445; In English; See also [20070014962](#); Original contains color illustrations Contract(s)/Grant(s): DTFAWA-04-D-00013; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In this paper, we present new methods for visualizing and quantifying the impact of inclement weather on the National Airspace System (NAS). A new version of previously developed metric, Weather Impacted Traffic Index (WITI), is introduced, in which the impact of en-route convective weather is assigned to the affected airports. Local airport weather is also accounted for. The new visualization method for a day-in-the-NAS uses a matrix whose rows represent major airports and columns represent hours of the day. The airports are arranged in a geographically continuous way, by compressing the US map into a single horizontal line. The same approach can be used for a multi-month seasonal matrix where the columns represent daily WITI averages for major airports. Delays can be visualized like this as well. In order to compare weather-impacted days and identify similar, we use N-dimensional vectors comprised of averaged daily WITI values for major airports; the cosine between the two daily vectors and the ratio of their lengths reflect the degree of similarity between the two days weather impact. Future work will concentrate on making the enhanced WITI a reasonably accurate NAS- and regional level weather related delay predictor. The techniques developed here can be used in NAS analyses, traffic flow management, and future NAS projections.

Author

*National Airspace System; Weather; Visual Observation; Airports*

**20070014982** ViaSat, Inc., Carlsbad, CA, USA

**Commercial Link 16 for ATC Application**

Kocin, Michael J.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 17-25; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Current air traffic control (ATC) systems rely heavily on Voice waveforms for control of the air space. This is severely limited by the principal of one controller per sector at one frequency. Voice has a limited spectrum and the present set of frequencies in both the US and Europe is extremely congested. This limits the number of aircraft that can safely operate in a sector, increases the probability of operational errors by controllers, and adds to the overall high stress environment of the controllers. A more flexible approach to ATC will increase airspace capacity while keeping safety at the highest standards. One approach to solve this problem is the utilization of a commercialized version of Link 16 to provide a seamless worldwide network for air traffic management. The Link 16 application can provide Traffic Situational Awareness, Conflict Detection and Prediction and ultimately Conflict Resolution. These features allow more aircraft to safely occupy the current air space sectors. Future ATC will not only have to support additional aircraft capacity but will also require security for data transfers that control the route and path of an aircraft. The Link 16 approach allows anti-hijack and anti-spoofing provisions as part of the basic network. This enables positive identification between aircraft and controller when exchanging flight path messages. The Link 16 approach supports a concept which utilizes data as a compliment to voice with the best available path (data or voice) chosen for each transaction between the controller and pilot. The waveform and spectrum for Link 16 also support more efficient use of the spectrum allowing multiple controllers on one data frequency. The availability of this increased data will enable new services to be introduced that will yield benefits across the airspace community. This paper/presentation describes how a representative Link 16 architecture implemented in a Software Defined Radio format can be implemented to support ATC. Utilizing this approach has the potential to reduce development costs by leveraging previous design approaches, reducing development risk through the use of established designs, and reducing the cost and risk of qualification by leveraging testing from a government sponsored program. Deployment of a Link 16 system for ATC application addresses top level network application as well as equipment approaches deployed in order to meet the changing requirements of this environment.

Author

*Air Traffic Control; Data Links; Air Transportation; Waveforms; Technology Utilization*

**20070014983** Johns Hopkins Univ., Laurel, MD, USA

**An IEEE 802.16/802.11 Hybrid Terminal Area Networking Architecture for the Next-Generation National Airspace System**

Burbank, Jack; Kasch, William; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 305-313; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper presents a terminal-area networking concept based upon the popular commercial IEEE 802.11 wireless local area network (WLAN) and IEEE 802.16 broadband wireless network standards. Future aviation applications and increasing air density will significantly change the National Airspace System (NAS) and result in a need to develop and adopt new communications technologies. Due to the achieved economy of scale, ease-of-use, and demonstrated capability, IEEE 802.11 Wireless Local Area Network (WLAN) technology is appealing as a component of an advanced aviation communications and is a naturally strong candidate for terminal area communications. Additionally, emerging IEEE 802.16 Wireless Metropolitan Area Network (WMAN) technology is attractive due to its high degree of capability, and superior QoS technology. It is contended by this paper that 802.11 and 802.16 are technologies that could compliment each other in a powerful way within the terminal area (and surrounding areas) domain of the NAS problem space. This paper describes an overview of the proposed 802.11/802.16 hybrid terminal network architecture, and describes various dimensions of performance, including scalability, QoS, interference, and interoperability. Another key issue that is discussed is topology management and handover between radio technologies in the hybrid 802.11/802.16 architecture.

Author

*National Airspace System; Communication Networks; Architecture (Computers); Wireless Communication; Technology Utilization*



**20070014984** Raytheon Co., Marlborough, MA, USA

**NGATS Dynamic Architecture**

Arkind, Kenneth; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 373; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing the dynamic architecture of the Next Generation Air Transportation System (NGATS) is shown. The topics include: 1) Dynamic Architecture; 2) Architecture Provides Blue Prints, or Views to Communicate with the Builder; 3) Enterprise Architecture also provides Views; 4) Utilizing DoDAF Products; 5) Today's Air Transportation System Top Level Operational Activities; 6) OV-5 Hierarchy - ATS Activities; 7) Information Used by each Operational Activity; 8) Information Exchange OV-3; 9) Analysis scale; 10) High Fidelity - Business Process Modeling (BPM); 11) Airspace Concepts Evaluation System; 12) Mapping ACES to EA; 13) Updating ACES; 14) 2025 NGATS Concept; 15) JPDO's Architecture Development; 16) Architecture Based Process; 17) Scenario Walkthrough s; 18) Block to Block Capabilities; 19) Mapping NGATS Architecture to ACES; and 20) NGATS Enterprise a Global solution.

CASI

*Air Transportation; Systems Engineering; Avionics; Architecture (Computers)*

**20070014985** NASA Glenn Research Center, Cleveland, OH, USA

**Airport Surface Network Architecture Definition**

Nguyen, Thanh C.; Eddy, Wesley M.; Bretmersky, Steven C.; Lawas-Grodek, Fran; Ellis, Brenda L.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 243-253; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Currently, airport surface communications are fragmented across multiple types of systems. These communication systems for airport operations at most airports today are based dedicated and separate architectures that cannot support system-wide interoperability and information sharing. The requirements placed upon the Communications, Navigation, and Surveillance (CNS) systems in airports are rapidly growing and integration is urgently needed if the future vision of the National Airspace System (NAS) and the Next Generation Air Transportation System (NGATS) 2025 concept are to be realized. To address this and other problems such as airport surface congestion, the Space Based Technologies Project's Surface ICNS Network Architecture team at NASA Glenn Research Center has assessed airport surface communications requirements, analyzed existing and future surface applications, and defined a set of architecture functions that will help design a scalable, reliable and flexible surface network architecture to meet the current and future needs of airport operations. This paper describes the systems approach or methodology to networking that was employed to assess airport surface communications requirements, analyze applications, and to define the surface network architecture functions as the building blocks or components of the network. The systems approach used for defining these functions is relatively new to networking. It is viewing the surface network, along with its environment (everything that the surface network interacts with or impacts), as a system. Associated with this system are sets of services that are offered by the network to the rest of the system. Therefore, the surface network is considered as part of the larger system (such as the NAS), with interactions and dependencies between the surface network and its users, applications, and devices. The surface network architecture includes components such as addressing/routing, network management, network performance and security.

Author

*Air Transportation; Airports; Aircraft Communication; Communication Networks*

**20070014986** Boeing Phantom Works, USA

**Flight Trial Architectures Supporting Migration to Broadband Internet Protocol (IP) for Airline Operations Communications (AOC) and Air Traffic Services (ATS) Communications**

Griep, Karl; Mead, Rob; Morse, Dave; Taylor, Mark; Harkness, Duane; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 375-382; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing the migration of Airline Operational Control (AOC) to Broadband Internet Protocol (IP) for Airline Operations Communications (AOC) and Air Traffic Services Communications (ATS) is shown. The topics include: 1) Background; 2) Operational Architectures; and 3) Lab Demonstration/Flight Trial Architecture Alternatives.

CASI

*Airline Operations; Broadband; Internets; Protocol (Computers); Aircraft Communication; Air Traffic Control; Architecture (Computers); Flight Tests*

**20070014987** Lockheed Martin Corp., USA

**Enhanced Common Situational Awareness via SWIM-Based Applications**

Rudolph, Sid; Dehn, Jon; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 91-97; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

To achieve the efficiency gains necessary to support the increasing demands on the National Airspace System (NAS), common situational awareness is mandatory for all Airspace Users and Air Navigation Service Providers (ANSPs). System Wide Information Management (SWIM) initiatives will provide the backbone for sharing information throughout the NAS. New applications and decision support tools must take advantage of the timely, accurate information that is shared on the SWIM infrastructure to provide users with common situational awareness for optimum use of the airspace. SWIM has many elements of a Service Oriented Architecture (SOA). In SOA terms, data sharing services are created for the primary data categories of Flight, Aeronautical, Weather, Surveillance and NAS Status. Following that paradigm further, there are key algorithmic services that can also be shared. In this way, existing application functions and decision support tools can be exposed to the outside world, leading to re-use of existing resources and to a more accurate common situational awareness. Like any enterprise that is moving to an SOA-based infrastructure, the transition must be carefully planned and taken in incremental steps. Ideally, the infrastructure that must be put in place for each step is paid for by the user benefits and reduced infrastructure costs that accompany that step. This paper explores selected SWIM-based applications that Lockheed Martin has prototyped under Independent Research and Development (IR&D), to focus on methods for improving information sharing and common situational awareness. The resulting set of data, functional services, and end-user applications can provide necessary benefits with infrastructure cost reductions as a possible first step towards SWIM-enabled operations.

Author

*Information Management; National Airspace System; Situational Awareness; Systems Engineering*

**20070014988** Topia Technology, Tacoma, WA, USA

**Design, Architecture, the National Airspace System, System Wide Information Management, Network-Centric Operations, and Service-Oriented Architecture**

McGrady, Michael; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 99-108; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Service Oriented Architecture (SOA) is sometimes seen as identical to Web Services. This is not surprising because Web Services is by far the most prevalent implementation of SOA. Most will not have seen another implementation. Web Services and SOA, however, merely overlap, yielding the diagram shown. Restricting Web Services to SOA architectural principles would hobble its importance as an emergent technology. Conversely, SOA can easily be implemented without Web Services. The intersection of Web Services and SOA is limited. The preceding is important, but the issue has more depth than is immediately apparent. Even when Web Services is used as an implementation of SOA they should not be thought of as identical. Web Services and SOA are not only distinct in extension (denotation) but also in intension (connotation). In terms of architecture, Web Services and SOA are fundamentally different. They are, literally, as different as coming home in a taxi and coming home in a roar of gaiety and merriment. They are different kinds of things. Even when they happen together. To see them as theoretically or practically identical, ever, is to be fundamentally, in principle, confused about one or both of them in important and ultimately hazardous respects. Confusion in this area leads significant projects off course, towards architectural shoals, and to likely if not inevitable ruin. Clarity in this area will yield great rewards in quality evaluation criteria and change management. This paper principally discusses: (1) SOA; (2) Web Services; and most importantly, (3) performance and change management opportunities available if the architectural insights from (1) and (2) are utilized in Network-Centric Operations (NCO), System Wide Information Management (SWIM), and the National Airspace System (NAS) consistent with the goals of the Office of Management and Budget Federal Enterprise Architecture (FEA) Program (FEA PMO 2005).

Derived from text

*Information Management; National Airspace System; Communication Networks; Architecture (Computers)*

**20070014989** SELEX Sistemi Integrati S.p.A., Italy

**SWIM-SUIT: SWIM Supported by Innovative Technologies**

DeAngelis, M.; Porfiri, S.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 16 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The early introduction of System-Wide Information Management (SWIM) capability is necessary to the ATM community to make their systems move from an essential distributed network of independent units to an efficient network of integrated co-operators. The feasibility to develop SWIM in all its aspects shall be performed through: a) information models; b) information management processes; c) system architectures; d) technologies enabling its successful implementation; e) information access and security mechanisms; and f) organizational, legal and financial implications.

Derived from text

*Information Management; Feasibility; Security; Systems Integration*

**20070014990** Mitre Corp., USA

#### **Future Communications Study: Roadmap Status**

Lamiano, Dean; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 135; In English; See also [20070014962](#); Original contains color illustrations  
Contract(s)/Grant(s): DTFA01-01-C-00001; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The FAA, NASA, and Eurocontrol, are conducting a cooperative research and investigation, called the Future Communications Study (FCS), into new communications technologies for aviation. These new communications capabilities will help support increased air traffic capacity beyond 2015 in high density environments by enabling emerging operational concepts while providing for the requirements for safety and regularity of flight communications. The technical element of this study designed to outline the transition to new communication technologies and infrastructure is called the Communications Roadmap. This presentation describes the current status in the development of the Communications Roadmap, highlighting the timeframe in which operational needs, aviation spectrum, and potential new technologies intersect.

Author

*Air Traffic Control; Telecommunication; Air Traffic; Regularity*

**20070014991** EUROCONTROL, France

#### **Overview of Current Eurocontrol Communications Activities**

Pouzet, Jacky; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 139; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

2005 was a record year for aviation in Europe with over 10.5 million flights and more than 700 million passengers. Between 2004 and 2005, the number of flights grew by 4.5%. Growth was particularly notable in Eastern Europe. According to the current forecast, this trend is set to continue, with the number of flights predicted to grow by around 3% in Europe in 2006 and to reach 17.2 million a year by 2020 and carrying over 1.5 billion passengers. A key enabler for the future growth of the ATM system is the provision of additional communication capacity meeting strict Quality of Service (QoS) requirements to support the new operating concepts that are expected to be developed to support the estimated traffic increase. The Eurocontrol communication domain provides technical support to current communication means implementation such as 8.33 KHz, VDL-2 for CPDLC, voice and data ground ground communications and prepare the future in conjunction with several stakeholders to converge to a common Future Communication Infrastructure (FCI). The term FCI refers to the communications equipment required to support the end to end communications requirements of ATM in the 2020+ timeframe. The FCI includes the avionics systems, a/g and a/a voice and data links and the essential elements of the ground infrastructure in the context of the end to end connectivity. Therefore, the FCI is an amalgam of several technologies, including the legacy technologies that will still be operational in the future and new components, ground or satellite based, operating in a transparent way to the user. The Eurocontrol Agency together with the European commission have launched the SESAR program, the results of current FCI studies will be provided as inputs to the SESAR consortium and Eurocontrol will coordinate the SESAR activities with international stakeholders.

Author

*Data Transmission; Voice Communication; Air Traffic Control; Avionics; Communication Equipment; Data Links; Europe*

**20070014992** Aviation Management Associates, Inc., Springfield, VA, USA

#### **Air-to-Air Avionics Integration**

Harrison, Michael J.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 205-211; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

While today we are implementing RNAV and RNP procedures, using data link, and attaining precision positioning with GNSS, it is time to look out into the future to a new class of operational capabilities that combines 4D trajectory-based separation with unprecedented situational awareness between aircraft and between aircraft and the ground. The Next Generation Air Transportation System postulates the equivalent of visual operations in weather, paired approaches, tailored arrivals, better runway utilization, multiple aircraft on the landing runway at the same time, significantly reduced separation between aircraft, and even formation operations. It is time to think about a form of formation flying that will go well beyond 4-D intent information and actually allow aircraft to station keep on each other during takeoff, flight, and even landing. It is time to examine the possibilities of linking aircraft air-to-air in a way that the leading and following aircraft are sharing flight control inputs. This paper explores some of the concepts and opportunities that can be created in a much more rich exchange of information.

Author

*Avionics; Systems Integration; Area Navigation; Radio Navigation; Air Transportation; Aircraft Communication; Data Links*

**20070014993** Computer Networks and Software, Inc., Springfield, VA, USA

**Identifying and Addressing Emerging Global Air Transport Issues and Risks: Improving the Future Air Transport Systems by Using Next Generation Innovative Modeling and Simulation Tools and Technologies**

Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 44 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.:

CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing innovative wireless and information exchange solutions to improve the future air transport systems by applying simulation, modeling, surveillance, net-centric architecture, and web services is shown.

CASI

*Air Transportation; Computerized Simulation; Risk; Technology Utilization; Models; Wireless Communication*

**20070014994** Next Generation Air Transportation System, Washington, DC, USA

**Network Enabled Information Access for NGATS**

Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 21 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.:

CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Workshop Objective: To achieve the vision of NGATS through a Net-centric architecture what are the key research tasks required in CNS? Vision: Enable the development of an information sharing environment (framework), globally compatible, accessible, and secure when required, that allows Air Transportation System communities of interest to share relevant up-to-the second, accurate, and credible information to make possible informed decision making for routine, planned, or crisis events. Objective: Interoperable, Interagency Net-Centric Architecture Leverage: DoD, FAA, DHS, DOC commitments to net-centric architectures Industry initiatives in information technology and spectrum availability Opportunity exists now to synchronize: Data interoperability Compatible network-to-network interface mechanisms.

Derived from text

*Communication Networks; Information Systems; Decision Making; Interoperability; Air Transportation*

**20070014995** ITT Advanced Engineering and Sciences, Herndon, VA, USA

**FCS Technology Investigation Overview and Status**

Dyer, Glen; Platt, Phil; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 133; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper describes the technology evaluation activities of the Future Communications Study. The technology investigation is a planned multi-year activity to include technology pre-screening, technology evaluations, and technology simulation activities. An overview of the technology evaluation objectives and work plan is provided. All of the work activities (past, present and future) are described. For the work activities that have been completed, a brief overview of the work results is provided. Feedback from FAA and NASA sponsors, Eurocontrol and members of ICAO ACP Working Group C to these results and subsequent shaping of the technology investigation efforts is also explored.

Author

*Aircraft Communication; Air Traffic Control; Feedback*

**20070014996** Federal Aviation Administration, USA

**Automatic Dependent Surveillance: Broadcast (ADS-B)**

Capezzuto, Vincent; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 20 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The ADS-B system is a crucial component of the Next Generation Air Transportation Systems (NGATS). It provides surveillance and situational awareness simultaneously to pilots and air traffic control facilities. ADS-B is designed to improve the safety, capacity, and efficiency of the National Airspace System (NAS) while providing a flexible and expandable platform to accommodate future air traffic growth.

Derived from text

*Air Traffic Control; Surveillance; Situational Awareness; National Airspace System; Integrated Mission Control Center; Ground Based Control; Air Transportation*

**20070014997** Federal Aviation Administration, USA

**Surveillance and Broadcast Services**

Castaldo, Rick; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 20 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The program objective is to develop a multi-segment, life cycle managed, performance based ADS-B strategy that aligns with the Next Generation Air Transportation System (NGATS) vision and generates value for the National Airspace System (NAS). Integrate Concept of Operations for Portfolio of ADS-B Applications. Develop Application Life Cycle Management Approach. Portfolio Management for Applications. Requirements Management Across the Applications. Performance Criteria Management. Establish Infrastructure. Continuously Monitor Value and Adjust Investments.

Derived from text

*Air Transportation; Broadcasting; Surveillance; National Airspace System*

**20070014998** Federal Aviation Administration, USA

**Future Communications Study Overview**

Phillips, Brent; Pouzet, Jacky; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 129; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Overall, ANC/11 agreed that the aeronautical mobile communication infrastructure had to evolve in order to accommodate new functions and to provide the adequate capacity and quality of services required to support evolving air traffic management (ATM) requirements within the framework of the global ATM operational concept. In addition, ANC/11 reflecting the airlines (IATA) position stressed the importance of harmonization and global interoperability particularly for air/ground communications. In ANC/11 there was a strong signal and request for international cooperation in order to achieve the stated objectives and goals. In line with these intentions, FAA and EUROCONTROL decided to set up a dedicated working arrangement (Action Plan 17 of the EUROCONTROL-FAA Memorandum of Cooperation) to progress this work in a consistent manner in Europe and US. The activities performed in the context of AP17 are also coordinated with ICAO and IATA. The initial AP17 is foreseeing a two year cooperation program from 2004 up to end 2006 and included several technical and business themes: Improvement of current systems, Identify the Mobile Communication operational concept, Investigate new technologies for mobile communication, Identify the communication roadmap, Identify the Spectrum bands for new system, Create Multi National Framework, Create Industry interest, and build a business Model. On the basis of the good cooperation performed during the execution of AP17, FAA and EUROCONTROL intend to continue their activities for the studies related to the Future Communication Infrastructure.

Author

*Aircraft Communication; International Cooperation; Interoperability; Air Traffic Control; Civil Aviation; Commercial Aircraft; Europe*

**20070014999** NASA Glenn Research Center, Cleveland, OH, USA

**Use of Virtual Mission Operations Center Technology to Achieve JPDO's Virtual Tower Vision**

Ivancic, William D.; Paulsen, Phillip E.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 273-280; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Joint Program Development Office has proposed that the Next Generation Air Transportation System (NGATS) consolidate control centers. NGATS would be managed from a few strategically located facilities with virtual towers and TRACONS. This consolidation is about combining the delivery locations for these services not about decreasing service. By consolidating these locations, cost savings in the order of \$500 million have been projected. Evolving to spaced-based communication, navigation, and surveillance offers the opportunity to reduce or eliminate much of the ground-based infrastructure cost. Dynamically adjusted airspace offers the opportunity to reduce the number of sectors and boundary inconsistencies; eliminate or reduce 'handoffs;' and eliminate the distinction between Towers, TRACONS, and Enroute Centers. To realize a consolidation vision for air traffic management there must be investment in networking. One technology that holds great potential is the use of Virtual Mission Operations Centers to provide secure, automated, intelligent management of the NGATS. This paper provides a conceptual framework for incorporating VMOC into the NGATS.

Author

*Virtual Properties; Air Traffic Control; Air Transportation; Automatic Control; Telecommunication; Surveillance; Navigation*

**20070015000** Mitre Corp., USA

**Challenges in Implementing Performance-Based Systems**

Hamrick, David; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 4 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing the challenges affecting performance-based systems is shown.

CASI

*Air Traffic Control; Systems Engineering; Aircraft Performance; Automatic Control*

**20070015001** Federal Aviation Administration, USA

**Communications Operational Concept and Requirements**

Anderson, Gregg; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 131; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

His presentation is on the efforts to develop the Communications Operating Concept & Requirements for the Future Radio System and a high level summary of the key findings. The COCR, as we call it, sets the baseline requirements for communications out to around 2030 which the future technologies under consideration by the Future Communications Study umbrella are evaluated.

Author

*Telecommunication; Requirements; Technology Utilization; Civil Aviation*

**20070015002** ITT Advanced Engineering and Sciences, USA

**FCS Technology Evaluation Process and Interim Results**

Dyer, Glen; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 149; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation on the technology assessment and interim results of Future Communications Studies (FCS) is shown. The topics include: 1) Background & Previous Work; 2) Modified Evaluation Process; 3) Example Application; and 4) Concluding Remarks.

CASI

*Technology Assessment; Civil Aviation; Air Transportation; Systems Engineering; Telecommunication*

**20070015003** Mitre Corp., Washington, DC, USA

**A Method for Estimating Air/Ground Data Capacity Requirements**

Hung, Brian; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 153-167; In English; See also [20070014962](#); Original contains color illustrations  
Contract(s)/Grant(s): DTFA01-01-C-00001; Copyright; Avail.: CASI: [A04](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper presents a method using priority-queueing analysis to estimate data capacity requirements for an air/ground communications system. Two types of priority-queueing are analyzed: non-preemptive and preemptive resume. The results are presented and summarized.

Author

*Ground Tests; Queueing Theory; Data Acquisition; Estimating; Telecommunication*

**20070015004** Aviation Management Associates, Inc., Springfield, VA, USA

**Weather Integration on the Flight Deck: A Concept of Use Based on Operational Need**

Tauss, James W.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 213-220; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

General Aviation VFR flight into instrument meteorological conditions causes a disproportionately large percentage of fatalities. It has been known for some time that guidance to avoid such conditions must be made available to the flight deck. The effectiveness of such guidance, however, has been the subject of many studies and simulations. Human factors issues play a large role in the lack of effectiveness as does the lack of understanding of weather decision information of value. Increased weather product resolution, increased pilot access to weather information, integrated displays and increased training have all been examined with mixed results. It is time to take a step back and reevaluate the concept of effective weather information use while in an operational environment. Less may be more, improved timing (i.e., weather information when it is needed as opposed to all the time) and smart on-board functionality may serve as the basis for further exploration into specific integration designs. This paper presents such a novel approach to the need for and use of weather information for General Aviation decision making.

Author

*General Aviation Aircraft; Human Factors Engineering; Decision Making; Weather*

**20070015005** Boeing Phantom Works, USA

**Transforming the NAS Through System Wide Information Management and Network Enabled Operations**

Meserole, Chip; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 87-88; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Continued dramatic growth in air traffic will press our National Airspace System (NAS) to the scalability limits of the radar-based traffic control procedures on which the current NAS was founded five decades ago. The technologies of the information revolution that are fueling robust national economic growth and vigorous air traffic growth are also the means for transforming the technical infrastructure underpinning our present air transportation system. In a transformed system, network enabled operations will embody trajectory-based traffic control procedures to greatly boost system capacity, efficiency, and security. The NAS of the future will be fundamentally more agile and more responsive to stakeholder needs. Transformation of the NAS will emerge through a growing integration among the airspace management, strategic management, traffic management, and separation management functions of the air traffic management (ATM) system. Network communications are the foundation for this; complemented with standards and an over-arching functional architecture for system-wide information management (SWIM), they will enable widespread information sharing across the NAS, including aircraft. The scalability limits of the current air transportation system are products of geographically defined long-distance point-to-point communications lines, data processing centers, and control facilities. Modern technology offers opportunities to overcome these legacy limitations and fundamentally transform air traffic operations by enabling a shift in focus from domain-specific programs and platforms to a system of systems that benefits the entire enterprise that is, a shift from viewing aircraft, sectors, and terminals as independent actors to viewing them as indigenous parts of the NAS as a whole. The ATM functions evolve into network enabled operations, and the transformed NAS is able to be dynamic and agile because it is integrated and widely coherent. Managing air traffic requires the skills of many people and the capabilities of many automated functions. The people and automation require information from disparate sources to perform their tasks, and often, in turn, they provide information for others. SWIM implements a common infrastructure and set of processes for sharing and managing data within the NAS.

Once data are published on SWIM, they are available for any authorized user to discover and use. SWIM will significantly reduce the costs of developing new applications and sharing data within the NAS. Its common approach to information security should significantly reduce the cost of implementing information security and responding to emerging information security requirements. SWIM is a key enabler for many future capabilities envisioned by the FAA, including facility backup, continuity of operations, platform convergence, 4D trajectories, multiagency information sharing, and improved response to weather disruptions. Communications networks and SWIM are the infrastructure foundation for NAS-wide integration of ATM functions and, hence, for network-enabled ATM operations the core of NAS transformation. These operations comprise trajectory-based traffic management; true dynamic airspace configuration; integrated procedures across the en route, oceanic, terminal, and flow management domains; and coordinated multi-agency responses to airspace security incidents. They will transform ATC performance by doubling or tripling controller productivity and system capacity and by making the system highly robust to disruptions.

Author

*Air Transportation; Communication Networks; Information Management; National Airspace System; Systems Engineering*

**20070015006** Boeing Phantom Works, USA

#### **Data Distribution and Access Techniques for FAA System Wide Information Management**

Comitz, Paul; Pinto, Avinash; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 89; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

System Wide Information Management requires a flexible, scalable and upgradeable infrastructure that allows communication, and subsequently collaboration, between heterogeneous information processing and computing environments. The challenge is significantly increased in real time environments. This presentation describes some of the work that is being done on the FAA SWIM program and at Boeing Advanced Air Traffic Management to address these challenges. The use of industry standard distributed processing and computing techniques is examined through the use of experiments performed over wide area networks. Evaluation of support, documentation, cost, ease of use, platform, development environment, compliance with industry standards, and scalability is compared for several distributed processing technologies. The application of these technologies was demonstrated during the Joint Network Enabled Operations Security Demonstration in the late 2005. The lessons learned during this demonstration, and the resulting engineering work packages going forward, are described.

Author

*Air Traffic Control; Data Processing; Distributed Processing; Information Management*

**20070015007** Frequentis G.m.b.H., Vienna, Austria

#### **Service Oriented Communication Architectures in Safety Critical Environments**

Prinz, Johannes; Kampichler, Wolfgang; Haindl, Bernhard; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 119-124; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Today, every modern organization aspires to improve its performance through better use of information technology. Organizations seek to increase their agility and make better, more adaptive responses to changing circumstances. As communication technology improves, organizations can operate over wider distances and can even assemble operational components on an ad hoc basis to meet requirements of a specific objective. Voice over Internet Protocol (VoIP), has rapidly becoming a familiar term and technology that is invading enterprise organizations. While the benefits of a well-suited VoIP system are significant, selecting a VoIP solution for ATC can be a complex decision. As voice service is critical to ATC, one can't afford to implement a technology that compromises quality or reliability. Otherwise, traditional VCS systems are best described as service islands, as they provide most of their features within one site. Only a limited number of services are shared between those sites (e.g. national ACCs), which can be summarized as G/G communication services and radar or flight plan data exchange. Some of the voice communication services base on digital communication standards (e.g. ATS-QSIG) but the majority is still analogue (MFC-R2). Naturally, the data exchanged between sites is limited. As air-traffic increases the decision making cycles have to be significantly shortened, which indeed needs more information shared between sites. Not only the amount of data but also the criticality and timeliness of data delivery have more importance. This paper discusses a communication architecture that reduces the network distance between sites as it offers service access from any place via different network infrastructures. Further the paper elaborates mechanisms needed for a robust and globally interconnected network environment (including infrastructure, systems, processes, and people) in which data is shared timely and seamlessly



among users, applications, and platforms. Such an environment enables substantially improved situational awareness and shortened decision making cycles. Stepping ahead, the second topic of our contribution discusses methods to expose services using standard based interfaces. Although multiple methods exist to make services via networks accessible, our suggested policy is adopting but not changing commercial standards for specifying and accessing service interfaces, which is commonly seen as the best approach to achieve service oriented architectures. Open standards are essential, as are the advertisement of the service interfaces in well known and widely accessible service registries or discovery services. Access to these registries will be enabled via a set of services available on the network resulting in a loosely coupled service environment. In general, services focus on high-level business processes using standard interfaces.

Author

*Internets; Protocol (Computers); Telecommunication; Voice Communication; Flight Safety; Architecture (Computers); Programming Environments*

**20070015008** SENSIS Corp., East Syracuse, NY, USA

#### **An Experimental Airport Surface Wireless Network**

DeHart, Steve; Neumiller, Phil; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 255-256; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Next Generation Air Transportation System (NGATS) Communications, Navigation and Surveillance (CNS) Research and Development Lab will be used for demonstrating and validating transformational ATM technologies and concepts. This is a Sensis program administered through NASA Glenn Research Center, to be deployed at Cleveland Hopkins and Burke Lakefront Airports. An airport surface wireless network is part of the core infrastructure for the Lab. A portion of the wireless network will operate in the Extended MLS band (5.091 5.15 GHz). It will transport a wide mix of traffic ranging from safety critical Air Traffic Control (ATC) sensor data to voice communications and telemetry data supporting airport and airline operations. This portion of the network will also serve as the overall wireless system s backbone. We call this the Blue Network. The other portion of the network (the Red Network) will operate in the unlicensed commercial portion of the spectrum. The Blue and Red combination is able to provide wireless network coverage over the entire airport surface for both fixed and mobile platforms. Blue network nodes are collocated with multilateration surveillance sensors. Due to the nature of multilateration, these sensors are distributed across the airport surface and are likely suitable sources for the communication system nodes as well.

Derived from text

*Airports; Wireless Communication; Communication Networks; Air Traffic Control; Telecommunication*

**20070015009** EUROCONTROL, France

#### **Augmented and Virtual Reality Research for Tower Control at Airports**

Bourgois, Marc; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 257-262; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper gives an overview of virtual and augmented reality research within the domain of Air Traffic Control (ATC). Starting from potential drivers for this research and from an overview of past work, we focus on the challenges of the airport tower environment and conclude by revisiting the original vision of the ‘virtual tower’

Derived from text

*Airport Towers; Virtual Reality; Augmentation; Airports; Air Traffic Control*

**20070015010** Pennsylvania State Univ., University Park, PA, USA

#### **Laser Communications to Beam Optical Band to Distant Points**

Hamzeh, Belal; Kavehrad, Mohsen; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 39-44; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

For ground-to-air and air-to-air communications, clouds form a main element of the communication channel. In wireless optical communications, clouds induce temporal and spatial dispersion, causing power loss and bandwidth constraints; critical parameters for reliable communication system design. In this paper, we focus on the temporal dispersion induced by the

clouds, and provide a statistical estimate of the available bandwidth for cloud-obscured channels based on a two-year observation period for the continental USA.

Author

*Channels (Data Transmission); Optical Communication; Wireless Communication; Bandwidth*

**20070015011** Mitre Corp., USA

**CNS/ATM Planning: Modeling USAF and Civilian Air Traffic Interactions in European Airspace**

Wigfield, Edward; Connolly, Kelly; Alshtein, Alexander; DeArmon, James; Flournoy, Richard; Hershey, William; James, John; Mahoney, Paula; Mathieu, Jennifer; Maurer, John; Ostwald, Paul; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 347-356; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

On April 3, 1996 an Air Force CT-43 crashed in bad weather while attempting a landing at Dubrovnik, Croatia. Thirty-five people, including U.S. Secretary of Commerce Ronald H. Brown and a trade delegation of a dozen U.S. business executives, were killed. Two months later, CNN reported that an Air Force investigation had found poor navigation equipment partly to blame for the accident. As a result of this incident, the Secretary of Defense mandated enhancements to navigation safety for U. S. military aircraft and in May 1997, the Chief of Staff of the Air Force established the Global Access, Navigation, and Safety (GANS) program. General T. S. Moorman, Vice Chief of Staff stated: The purpose of GANS is to serve as a focal point for Air Force requirements, acquisition, and funding policy recommendations for GANS-related programs. In March 2001, Air Force Policy Directive 63-13 was issued to ensure that all Air Force acquisitions and modifications conform to the appropriate civil communication, navigation, surveillance/air traffic management (CNS/ATM) performance standards to guarantee access to worldwide controlled airspace. The directive goes on to note the following. Aircraft not meeting CNS/ATM standards may be relegated to longer delays on the ground, directed to operate on less optimum routes, or restricted from some airspace altogether [3]. One of the key roles of GANS is to bridge the civilian and military communities. Integrated Product Teams (IPTs) were set up to focus on CNS/ATM requirements, acquisition, and funding policies for the Air Force enterprise. The GANS Integrating IPT (I-IPT) directs their activities and is co-chaired by the two-star Generals responsible for Air Force requirements and acquisition. In November 2003, the GANS I-IPT directed the Electronic Systems Command (ESC/GA) to conduct a CNS/ATM impact analysis with the goal of identifying the operational, cost, and safety impacts of CNS non-capable aircraft. Between March 2004 and September 2004, a model-based analysis focused on impacts to mission operations resulting from non-compliance with current CNS/ATM mandates. The results of the first phase of the study were approved in November 2004 with a recommendation to mature the new analysis capability to support enterprise decision making. This paper documents the results of the second phase of the impact study

Derived from text

*Air Traffic Control; Surveillance; Navigation Aids; Telecommunication; Decision Making; Airspace*

**20070015012** Federal Aviation Administration, USA

**Operational Evaluation of FAROS Final Approach Runway Occupancy Signal**

Figuroa, Jaime; Schmidt, Noel; Swanson, Kirk; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 221; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The FAROS Concept: a) Provides a direct indication of runway occupancy status to flight crews on final approach, increasing their situational awareness; b) Notifies them of potentially dangerous situations; c) Augments other information, e.g. CTAF broadcasts; d) Requires no controller or other human input; and e) Signal could be visual (lights) or aural (e.g. via CTAF).

Derived from text

*Runways; Approach; Controllers; Situational Awareness; Luminaires*

**20070015013** SENSIS Corp., East Syracuse, NY, USA

**Automated Arrival Traffic Flow Management Using 4D Trajectories**

Schleicher, Dave; Sweet, Doug; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 283; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent JPDO and NASA future air traffic management concept development work has targeted the introduction of 4D trajectories as a revolution in future air traffic management operations. The increased air-ground trajectory intent precision and efficiency of airborne and ground computer-to-computer interactions represent the potential for large increases in airspace capacity. However, despite previous research in this area, recent industry efforts to standardize 4D trajectory messages, and the equipage by revenue-carrying airline flights of 4D Flight Management Systems, the practicality of such 4D trajectory-based integrated air-ground operations is not well understood. We develop a novel 4D trajectory-based air traffic management concept that supports electronic incorporation of user-preferred 4D trajectories into more efficient and effective arrival traffic flow management. Our concept utilizes existing 4D Flight Management Systems and emerging ground-based air traffic automation systems as well as a secure, high-bandwidth, time-critical datalink and a net-centric surveillance network. The concept of use and some related scenarios are discussed. A viable near-term system architecture and plans to conduct future concept-based flight experiments are detailed.

Author

*Air Traffic Control; Trajectories; Automatic Control; Flight Management Systems; Ground Operational Support System; Time Dependence; Airline Operations; Airspace*

**20070015014** SENSIS Corp., East Syracuse, NY, USA

**'Airspace' Surveillance Transformation, Stovepipe to Service Oriented Architecture (SOA)**

Smith, Chris; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 73; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Sensis Corporation will present a framework for transforming today's stove-piped (Airspace) Surveillance Assets to a Service Oriented Architecture (SOA). Since 9/11, there continues to be an overwhelming demand for surveillance information, including, aeronautical, weather, and flight plans, by many government agencies. Entities including the Federal Aviation Administration (FAA), USA Air Force (USAF), Bureau of Immigrations and Customs Enforcement (BICE), and other organizations that operate existing command and control nodes are requiring access to more airspace information. Additionally, many organizations that do not currently have command and control systems are now seeking to build them. Today's approach to satisfying their surveillance asset needs is to replicate the information, and route it to each consumer on a dedicated point-to-point circuit. The obvious problem with this approach is the aggregate cost of duplicating the surveillance information on these point-to-point circuits, in addition to the increasing operations and maintenance of the service. The vision is to transition all Surveillance assets observing the National Air Space (NAS) from closed, point-to-point connectivity to an open, flexible and scalable infrastructure based on a SOA. This includes providing an open, standards-based messaging protocol which enables the decoupling of surveillance assets from applications. In addition, eliminate the duplication of services within COI. This vision will enable technology refresh and new services deployment with reduced system impacts at lower cost.

Author

*Airspace; Surveillance; Flight Plans; Deployment; Command and Control*

**20070015015** Johns Hopkins Univ., Laurel, MD, USA

**Development of a Portable ADS-B Avionics Transmissions Evaluation Tool**

Sleight, Randall T.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 51-56; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

With the growing number of Automatic Dependent Surveillance Broadcast (ADS-B) equipped aircraft in the National Airspace System there becomes a need for initial compliance and continued airworthiness monitoring. One tool that can help meet this need is a portable onsite analysis tool focusing on the timely identification of problematic ADS-B installations. During 2005, the number of ADS-B equipped aircraft has significantly increased, to where estimates indicate that over one thousand aircraft are now transmitting ADS-B Messages. The Johns Hopkins University Applied Physics Laboratory (JHU/APL) has developed a portable ADS-B receiver test-bed, named the Compact Local Avionics Monitor (CLAM) capable of recording, extracting, and analyzing ADS-B Message traffic. Currently, the CLAM has the capability to receive and analyze Universal Access Transceiver (UAT) messages. Future versions will incorporate a 1090Mhz Extended Squitter receiver. This tool monitors the ADS-B messages for valid fields including: 24-bit aircraft address, position, barometric altitude, and others. This paper describes development of the Avionics Evaluation Test-Bed, and recommendations for future evaluation tools.

Author

*Avionics; Automatic Control; Broadcasting; National Airspace System; Surveillance; Portable Equipment; Data Transmission*

**20070015016** NASA Glenn Research Center, Cleveland, OH, USA

**Communications, Navigation, and Surveillance Models in ACES: Design Implementation and Capabilities**

Kubat, Greg; Vandrei, Don; Satapathy, Goutam; Kumar, Anil; Khanna, Manu; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 413-421; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Presentation objectives include: a) Overview of the ACES/CNS System Models Design and Integration; b) Configuration Capabilities available for Models and Simulations using ACES with CNS Modeling; c) Descriptions of recently added, Enhanced CNS Simulation Capabilities; and d) General Concepts Ideas that Utilize CNS Modeling to Enhance Concept Evaluations.

Derived from text

*Surveillance; Telecommunication; Navigation; Simulation; Systems Engineering*

**20070015017** Boeing Phantom Works, USA

**Required Total System Performance (RTSP): An Emerging Model-Based and Performance-Driven ATM/CNS Concept**

Shakarian, Arek; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 369-370; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

ICAO's Air Navigation Commission (ANC) formed the ATMCP, Air Traffic Management Concept Panel, in 1998. The panel was charged to develop the future (2025+) Global ATM Operational Concept. In November 2005 ICAO Document 9854 Global Air Traffic Management Operational Concept was released. One of the paradigmatic shifts envisioned for future operations is that the global air traffic system be performance based. Implicit in this vision is that the global air traffic in its totality be conceived as a system. At the September 2003 11th ANC meeting, Agenda Item 3, named RTSP, Required Total System Performance, was presented to the members of the ANC. The presentation was an encapsulation of work conducted by ATMCP introducing to the ANC a 5 level ATM Performance Hierarchy framework for future ATM/CNS operations. The layered framework describes how future Air Traffic Management services (e.g. Traffic Synchronization, Demand/Capacity Balancing, et al) would be enabled by a host of technologies or systems from a performance-driven rather than technology-driven perspective. A set of challenging tasks lie ahead regarding how RTSP may be further developed as a performance-based concept. It is imperative that any future emergence, roadmap, and implementation of so-called Operational Improvement (OI) at the local, regional, and global arenas be performance-based while enfolded and adopting the particular promises claimed from any new techniques, new procedures, new technologies, and new infrastructural configurations (e.g. network-centric). At the most fundamental level this requires a special appreciation of the following: 1) the historically unprecedented fact that the ATM/CNS is being conceived of as a system, a system-of-systems, and indeed even as a complex-socio-technical-system-of-systems, 2) that any such system, whether conceived of as TSE, Traditional Systems Engineering, or be distinguished in the emerging field of so-called CSE, Complex Systems Engineering, needs to be represented or modeled beyond typically or traditionally established Systems Engineering paradigms, 3) This complex systems modeling would be an inseparable and intimately intertwined process in the development of RTSP in the context of the ICAO 5-level ATM/CNS Performance Hierarchy. Therefore, any future RTSP performance-based operations require that such an evaluation and eventual system design requirements be also model-based or in various levels of fidelity and dimensionality be modeled or represented a pre-design and implementation performance assessment. Finally, from ICAO's perspective, a so-called Performance Case is the expectation for any future ATM/CNS operational infrastructure. This signifies that a specific OI plan that is to be implemented at a specific ATM ground site (e.g. airport, TRACON, et al) or air site (e.g. aircraft avionics, et al) or space site (e.g. GBAS et al) satisfies at least three fundamental and interrelated performance criteria: 1) Safety, 2) Business or Economic, and 3) Technical or Operational. These interdependent qualitatively different performance dimensions are to be validated through a holistic and integrated assessment framework that would include safety, economic (i.e., investment), and technical performance that meet minimum local, regional, and global performance goals (e.g., efficiency, cost, and interoperability). Therefore, in another sense, the 5-level ATM/CNS Performance Hierarchy is posited as the basic performance framework for any model-based and performance-driven (or based) assessment of future ATM/CNS system performance in safety, cost-effectiveness, and technically enabled behavior in contradistinction to past practices where multiple and perhaps incoherent ATM/CNS system changes were primarily adopted from a technology-driven modus operandi.

Derived from text

*Air Navigation; Air Traffic Control; Systems Engineering; Avionics; Airports*

**20070015018** NASA Glenn Research Center, Cleveland, OH, USA

**Airspace Concept Evaluation System (ACES), Concept Simulations using Communication, Navigation and Surveillance (CNS) System Models**

Kubat, Greg; Vandrei, Don; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 423-431; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Project Objectives include: a) CNS Model Development; b Design/Integration of baseline set of CNS Models into ACES; c) Implement Enhanced Simulation Capabilities in ACES; d) Design and Integration of Enhanced (2nd set) CNS Models; and e) Continue with CNS Model Integration/Concept evaluations.

Derived from text

*Navigation; Telecommunication; Surveillance*

**20070015019** Johns Hopkins Univ., Laurel, MD, USA

**Aircraft Mobility Within an Internet Protocol-Based National Airspace System**

Haberman, Brian K.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 109-117; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The current airspace architecture relies heavily on stove-piped applications. However, the commercial networking industry is developing IPbased networks that are capable of not only supporting functionality equivalent with the legacy applications but also new applications that can deliver critical information to network entities in a timely manner. By transitioning to an IP networking architecture, novel solutions to existing problems can be developed. Similar to the Network-Centric Warfare model developed by the U.S. Department of Defense, the Federal Aviation Administration should support an IP-based architecture to support voice, video, and data services across the airspace network. A key component to this model is the efficient support of the movement of network elements (e.g. airplanes or personnel) between the sub-networks. While many mobility models exist, few open research projects have focused on the mobility characteristics of fast moving aircraft traveling through multiple independent sub-networks. Understanding these characteristics is a first step in developing a mobile-aware infrastructure that can support fixed network elements such as control towers, and highly mobile aircraft that require network connectivity.

Author

*Internets; National Airspace System; Protocol (Computers); Communication Networks; Mobility; Civil Aviation*

**20070015020** Wichita State Univ., Wichita, KS, USA

**IPv6 Based Aircraft Data Networks and Voice Services**

Thanthry, Nagaraja; Bhatia, Anuj; Shingvi, Swapnil; Pendse, Ravi; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 371; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Internet connectivity within an aircraft which was in the experimental stages only a few years ago is a reality today. The Federal Aviation Administration (FAA) envisions that, in the next 25 years, more than 100,000 aircrafts will be internet enabled. Each aircraft can be considered as a moving network with a number of hosts active within the network. With this growth in mind, the FAA has suggested the usage of Internet Protocol version 6 (IPv6). ARINC standards (ARINC 664 Part 4) also recommend usage of IPv6. IPv6 has several features that are suited for Aircraft Data Networks (ADN). One of the major advantages is the expanded address space. Compared to IPv4 (32 bit address space), IPv6 provides 128 bit address space. Using the expanded address space, all the devices connected within the ADN can obtain a global Internet address. Current implementations use private address space within the ADN. This eliminates the necessity of address translation technologies like NAT or NAPT. IPv6 also has built-in support for Quality of Service (QoS) and security (Support for IPSec is mandatory in IPv6 implementations) which makes it a better choice for ADN. The stateless and statefull address configuration and hierarchical routing supported by IPv6 reduces the routing complexity and improves the performance. Current implementations allow passengers to access the internet for pleasure, and, in some cases, secure VPN access is provided to corporate networks. One of the future possibilities could be to provide voice and multimedia services within an aircraft equipped with an internet connection. Voice communication over the internet requires certain network support in terms of quality of service. Due to the small payload size, it is important that, when sending voice traffic over the internet, the payload-to-header ratio is maintained as high as possible. IPv6 based ADN introduces a large overhead for voice traffic in

terms of IP header alone. In this paper, the authors investigate the effect of the IPv6 overhead on voice quality and explore the workarounds to achieve better voice quality in a given scenario.

Author

*Internets; Protocol (Computers); Voice Communication; Payloads; Translating*

**20070015021** Mitre Corp., USA

**Compatibility Analysis of Airport Wireless Local Area Networks and Satellite Feeder Links in the 5091-5150 MHz Band**

Gheorghisor, Izabela; Hoh, Yan-Shek; Box, Frank; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 37; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The 5000-5250 megahertz (MHz) frequency band is allocated to the aeronautical radionavigation service (ARNS) on an international basis. The Federal Aviation Administration (FAA) is considering the use the 5091-5150 megahertz (MHz) subband for the future Airport Network and Location Equipment (ANLE) system. ANLE is visualized as a high-integrity, safety-rated wireless local area network (WLAN) for the airport area, with terminals on the ground and on taxiing aircraft. The same frequency band, 5091-5150 MHz, has also been allocated, on a co-primary basis, to non-geostationary (non-GSO) mobile-satellite-service (MSS) Earth-to-space feeder uplinks. This presentation shows the results of a compatibility analysis that was performed for an ANLE architecture based on the IEEE 802.16e standard, and two different types of non-GSO MSS satellite systems, namely the low-earth-orbit (LEO) LEO-D and LEO-F systems. The height of the satellite orbit is 1414 km for LEO-D and 10390 km for LEO-F. The IEEE 802.16e standard supports non-line-of-sight (NLOS) wideband communications in the 2-11 GHz band of licensed and unlicensed spectrum. In the bands below 6 GHz the standard allows for networking between users that could be either fixed or mobile (moving at vehicular speeds). The IEEE 802.16e standard allows for the use of various channel bandwidths and achieves high data rate transmissions by using advanced coding and modulation schemes. Our results show that sufficient interference protection to the MSS feeder links is feasible by controlling the output power of the ANLE transmitters, limiting their duty cycle, and distributing their frequency assignments among the three channels available in the band.

Author

*Compatibility; Local Area Networks; Wideband Communication; Bandwidth; Communication Satellites; Data Links; Radio Navigation; Satellite Networks; Transmitters*

**20070015022** AeroSat Corp., USA

**Transformational Aircraft Communication Using a Broadband Mesh Network**

McNary, William S.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 321; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This presentation describes current progress on the implementation and testing of equipment to achieve broadband communication to aircraft via airborne mesh networking. A network architecture will be presented which includes connectivity for both higher flying commercial aircraft and lower flying general aviation aircraft. Current status of flight testing on FAA Technical Center aircraft will also be discussed.

Author

*Broadband; Aircraft Communication; Communication Networks; General Aviation Aircraft; Grid Generation (Mathematics)*

**20070015023** NASA Glenn Research Center, Cleveland, OH, USA

**Flight Test Results of VDL-3, 1090ES, and UAT Datalinks for Weather Information Communication**

Griner, James; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 319; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This presentation describes final test results for the Weather Information Communications (WINCOMM) program at the NASA Glenn Research Center on flight testing of the 1090 Extended Squitter (1090ES), VDL Mode 3, and Universal Access Transceiver (UAT) data links as a medium for weather data exchange. It presents an architectural description of the use of 1090ES to meet the program objectives of sending turbulence information, the use of VDL Mode 3 to send graphical weather images, and the use of UAT for transmitting weather sensor data. This presentation provides a high level definition of the

changes made to both avionics and ground-based receivers as well as the ground infrastructure used to support flight testing and future implementation. Summary of results from flight tests of these datalinks will also be presented.

Author

*Avionics; Data Links; Flight Tests; Transmitter Receivers; Telecommunication; Meteorological Radar*

**20070015024** Mitre Corp., USA

### **L-Band Channel Modeling**

Wilson, Warren; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 169-175; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

ICAO is considering the use of L-Band (960- 1024 MHz) to employ the next generation aeronautical communication system. In order to assess the viability of proposed communication systems in this frequency band, the multipath dispersion behavior of the aeronautical air-ground channel at L-Band must be characterized. While extensive research has been conducted for the land-mobile and the satellite channels at L-Band, very little research has been conducted for the aeronautical air-ground channel. This paper describes a methodology for characterizing the aeronautical air-ground channel at L-Band (960-1024 MHz). Included is a description of the MATLAB simulation used to estimate the propagation effects of the channel. Representative output data is presented and data reduction techniques are also described. The paper concludes with suggested channel models for the aeronautical air-ground channel in L-Band.

Author

*Telecommunication; Multipath Transmission; Aircraft Communication; Data Reduction; Ultrahigh Frequencies; Land Mobile Satellite Service*

**20070015025** EUROCONTROL, France

### **Flexible Airborne Architecture**

Pouzet, Jacky; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 16 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The objectives are: a) Review the evolution in aircraft architectures to ease accommodation of future communication systems; b) Identify changes taking place on large/medium size aircraft to ensure flexibility for aircraft manufacturers and aircraft operators; c) Review enabling technologies that will assist in achieving a flexible aircraft architecture; d) Describe a vision of the likely avionics architecture explaining how it integrates with the wider CNS infrastructure; and e) Recommend areas for further work.

Derived from text

*Architecture (Computers); Aircraft Communication; Avionics; Telecommunication*

**20070015026** Rannoch Corp., Alexandria, VA, USA

### **System Wide ADS-B Back Up and Validation**

Smith, A.; Cassell, R.; Breen, T.; Hulstrom, R.; Evers, C.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 59-67; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Automatic Dependent Surveillance - Broadcast (ADS-B) is a new standard adopted by many aviation authorities worldwide and offers a great leap forward in aircraft surveillance capabilities. More information is made available through ADSB than with conventional primary and secondary radar technologies and, as ADS-B does not require expensive radar infrastructure, the cost of implementation is far lower. Whether ADS-B will allow substantial decommissioning of conventional radar is the subject of ongoing debate; however, most air traffic management service providers see the benefits in the implementation of a relatively low cost flight tracking technology. Countries with vast tracts of land or mountainous terrain not viable for conventional radar see the new technology as highly cost beneficial. Other countries, with significant investment in conventional radar, such as the USA, see major benefits and savings in operations and maintenance costs in upgrading to ADS-B technology.

Derived from text

*Broadcasting; Surveillance; Air Traffic Control; Secondary Radar*

**20070015027** SENSIS Corp., NY, USA

**The NGATS-CNS National Testbed**

Collins, Rod; Finnegan, Robin; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 6 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Next Generation Air Transportation System Communications, Navigation, and Surveillance Research and Development Laboratory (NGATS CNS R&D Lab) is a collaborative, multi-year research and demonstration initiative that will bring together next-generation technologies likely to play a key role in the transformation of the National Airspace System. The key objective of the NGATS CNS R&D Laboratory is to provide an environment that allows experiments that build from a technology focus to an application focus and exercise emerging concepts capable of delivering the flexibility required from the next generation NAS. The laboratory resides at the NASA Glenn Research Center, auspiciously located at Cleveland Hopkins International Airport. The Cleveland site is an ideal location for this project since it is home to the NASA Glenn Research Center and it also has a group of airports (a main hub airport and several towered and non-towered potential reliever airports) in proximity to the city, a trait typical of major metropolitan areas. In addition to the airport mix, this region also serves the one of the heaviest volumes of en route air traffic in the USA. The NGATS CNS R&D Lab will be established through the deployment of various systems at Cleveland Hopkins as well as two other area airports (Lorain County Regional and Burke Lakefront) in order to provide a shadow capability suitable for exploring transformational air traffic management concepts. The NGATS CNS R&D Lab is intended to exercise viable, next generation ATC concepts which are critical to NAS transformation. The final paper and presentation will further detail the various technology thrusts currently being planned for development, implementation, and demonstration into the laboratory including the deployment of wireless network technology to demonstrate the ability to serve multiple applications over a single network while providing prioritization, security, and sufficient bandwidth for airport applications. Many of the concepts currently being explored to handle the projected 2-3X traffic growth over the next two decades include leveraging reliever airports that surround major cities as well as providing remote air traffic services to smaller airports.

Author

*Air Transportation; Technology Utilization; Air Navigation; Telecommunication; Surveillance; Air Traffic Control*

**20070015028** EUROCONTROL, France

**Development of Technology Shortlist for Future Investigations**

Pouzet, Jacky; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 151; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A viewgraph presentation describing a list of promising technologies for future Air Traffic Management (ATM) investigations is shown. The contents include: 1) Recall previous and current activities on technology evaluations; 2) Detail EUROCONTROL/European activities; 3) Present some initial results; and 4) Next steps.

CASI

*Air Traffic Control; Technology Assessment; Air Transportation; Aircraft Communication; Avionics*

**20070015029** ITT Advanced Engineering and Sciences, Herndon, VA, USA

**FCS Evaluation Criteria for Technology Assessment**

Gilbert, Tricia; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 141-148; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This briefing describes the work supporting NASA, the FAA and EUROCONTROL to develop technology evaluation criteria for evaluation of new technologies for mobile aeronautical communications as part of the FCS.

Derived from text

*Air Traffic Control; Mobile Communication Systems; Technology Assessment; Avionics; Criteria*

**20070015030** Wichita State Univ., Wichita, KS, USA

**Extended LAN Services and Aircraft Data Networks**

Thanthry, Nagaraja; Kulkarni, Sudha; Pendse, Ravi; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 409; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document



Internet connectivity can be used to download data from aircraft to the ground station. Traditional data transfer mechanisms do not work well. LAN extension is one of the options. Layer 2 tunnel based LAN extension is better for ADN. Extended LAN allows easier data sharing between the aircraft and ground station. a) Mirroring of control network traffic; b) Downloading video data; and c) Sharing of network resources:1) Custom applications; 2) VoIP devices.

Derived from text

*Local Area Networks; Video Data; Internets; Aeronautics*

**20070015031** DCS Corp., USA

**Sea Trial/LTE for ADS-B STIMS 21-22**

McNamara, Dave; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 26 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

CFFC will incorporate concept development and technology insertion into the experimentation process. CD&E Plan will mature pillars, codify to doctrine, plug into acquisition via a POR. Sea Trial Emphasis on: a) Speed - rapid transition into doctrine and programs; b) Comprehensive - single point for Navy experimentation; c) Jointness - Max incorporation of JCD&E; d) Relevance - Applicability to mission capability gaps; and e) Economy - Max effectiveness/efficiency from CD&E.

Derived from text

*Aircraft Communication; Surveillance; Navigation; Performance Tests*

**20070015032** SENSIS Corp., East Syracuse, NY, USA

**Enhanced ADS-B**

Valavage, Edward; Samuelson, Kenneth; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 57-58; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Automatic Dependent Surveillance-Broadcast (ADS-B) is emerging as an advanced aviation technology that provides improved air traffic surveillance in the cockpit and on the ground. Pilots and ground personnel have begun to benefit from this technology but further benefits from technological enhancements can still be realized. These enhancements include security, increased data capacity, and advanced applications (4D trajectory and data exchange). The goal of the enhancements is to provide them as selectable options which have varying levels of impact to the existing link, from minimal to extensive. In this way the capabilities may be used as appropriate to the situation and operational needs. To this end research is currently being performed by Sensis Corporation in cooperation with NASA Glenn Research Center to provide enhancements to the ADS-B UAT (Universal Access Transceiver) data link. The primary enhancements provide message authentication as well as message encryption. Authentication is a cryptographic means to assure that the originator of a broadcast is truly who it is claimed to be. It uses a Message Authentication Code (MAC) computed using standard cryptographic algorithms. The MAC is conveyed in currently unused portions of the message format. This MAC is created from the ADS-B message content plus pilot identification, a pilot personal identification number, secret key and a ground initiated challenge to thwart replay attacks. By using the MAC, a specific airframe and its pilot may be uniquely identified by an appropriate entity that holds a valid security key. This authority may then grant or deny access to a flight restricted area such as around the Washington, DC area. Further, application of this technology enables flight restricted areas to be set up quickly and dynamically in any location on an as-needed basis. The encryption allows any data to be encrypted using a secret key and an encryption algorithm. The result is a message which is undecipherable by any recipient who does not hold the secret key. Such protected data could include flight plan changes, security key updates, FMS directives, or 4D trajectory exchanges. Additional enhancements include increase in message capacity for use by CNS applications. To increase capacity in the UAT protocol there are two areas of focus, modulation changes and change of access protocol. The modulation of UAT has been studied and it was found that two additional frequency states could be overlaid on the existing modulation creating four distinct states while remaining backward compatible with existing equipment. This effectively doubles the capacity of each message. There is a loss of performance in noise related to such a change which relates to reception range but it is believed that this capability could still be effective at close ranges where additional capacity is needed. Another enhancement to increase capacity which is being studied is a change to the access protocol, or method of assigning message transmission time.

Derived from text

*Surveillance Radar; Automatic Control; Air Traffic Control; Broadcasting; Technology Utilization*

**20070015033** Thales, USA

**GPS/Galileo Performance Assessment for Aircraft Navigation and Approach**

Blomenhofer, Helmut; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 71; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

GPS and Galileo are expected to serve as navigation sources for a variety of applications. The most stringent performance requirements are derived from safety critical applications including aviation precision approach operations. GPS integrity is determined by RAIM and/or augmentation systems like WAAS (Wide Area Augmentation System) and EGNOS (European Geostationary Navigation Overlay Service). GPS based RAIM fulfills the performance requirements from En-Route down to the lateral guidance for non-precision approach operations globally. On a regional scale, the augmentation systems WAAS, EGNOS and others will also provide vertical navigation guidance down to APV-I and APV-II. The Galileo baseline architecture specifies a global integrity concept which will fulfill APV-II requirements. This means e.g. that the accuracy and integrity performance must be achieved globally keeping the Time-To-Alert thresholds. Further major performance challenges are the availability of the Accuracy and Integrity figures while keeping the Continuity of Service. The combination of GPS with Galileo signals at user level will provide further improvements in terms of navigation performance and safety. Using a regionally augmented GPS/Galileo in combination, then CAT-I precision approach requirements seem to be achievable within the regional service area. The higher precision approach requirements are expected to be fulfilled using local augmentation based on combined GPS and Galileo within the local service range. The GPS augmentation systems provide wide area differential corrections and also related residual errors which are used to compute the respective Protection Levels. The Galileo integrity monitoring concept uses error predictions (caused by satellite, clock, signal and or non-precise navigation message) which are validated in real-time. The predicted component which is transmitted with the navigation message is called SISA (Signal In Space Accuracy) and is an estimation of the orbit and clock prediction of the Galileo Control Centre which is updated with every clock update in a fault free case. If an error occurs in the satellites, clocks, signal, navigation message or in the processing itself, then it has to be detected by the Integrity Processing Facility (IPF) in real-time and a warning flag IF has to be sent to the user within the necessary Time-to-Alert. As the check in the IPF has to be performed nearly instantaneous (fraction of the Time to Alert), there has to be a sufficient number of Sensor Stations to get a statistically significant test, which allows even to identify and to exclude Sensor Stations with local disturbances in the observations.

Author

*Galileo Spacecraft; Global Positioning System; Real Time Operation; Errors; Navigation*

**20070015034** CSSI, Inc., Washington, DC, USA

**Investigation of Operator Benefits from Reducing Horizontal Separations in North Atlantic Organized Track System**

Williams, Almira; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 47; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

NASA Glenn Research Center commissioned CSSI, Inc. to conduct research into the potential savings that air carriers might realize in the North Atlantic Organized Track System if their flights were appropriately equipped to take advantage of reduced horizontal separations. The study did not address the issue of equipage requirements; rather, it focused on fuel and time savings, and potential for additional cargo revenue. A total of 72 scenarios were developed to comprehensively analyze the benefits potential as a function of traffic demand, equipage levels and procedures that could be used to manage the traffic flows in an oceanic track environment with mixed equipage. This presentation summarizes the analytical reasoning and approach underlying the study, and the results obtained from the analysis and simulations.

Author

*Air Transportation; Cargo; Revenue*

**20070015035** Federal Aviation Administration, USA

**Performance Based Navigation: RNAV and RNP - FAA Program Update**

Williams, Jeff; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 18 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Approximately 90% of 1350 daily IFR departures are RNAV capable. Structured 'lanes' to en route airspace. Over 4,000 routine daily pilot/controller voice transmissions eliminated (30% reduction). Validated model estimates of annualized benefits are approx.\$39M. Realized from delay and capacity benefits.

Derived from text

*Radio Navigation; Area Navigation; Airspace; Controllers*

**20070015036** Mitre Corp., USA

**Departure Efficiency Benefits of RNAV SID Operations - DFW and ATL Examples**

Mayer, Ralf H.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006; 16 pp.; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

ETMS-based departure demand subject to stochastic variability. RNAV participation rates: 84% (current), 92%, and 100%. Additional spacing between some RNAV and non- RNAV departures. ATC sequence optimization rate: 80%. Traffic increased by 13%, 24%, and 36%, Corresponding to 2010, 2015, and 2020 forecasts. Observed operational changes indicate that departure separation efficiency benefits were largely realized within the first two months after implementation

Derived from text

*Radio Navigation; Air Traffic Control; Stochastic Processes; Area Navigation*

**20070015037** Mitre Corp., USA

**L-Band Digital Link for Air Traffic Services Data Communications**

Wilson, Warren J.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 177-185; In English; See also [20070014962](#); Original contains color illustrations

Contract(s)/Grant(s): DTFA01-01-C-00001; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The FAA and EUROCONTROL are conducting a joint Future Communications Study (FCS) to investigate a range of possibilities for providing Air Traffic Communications (ATC) in the future (2015-2030). An idea under consideration is to provide additional data communications in part of the L-band extending from 960 to 1024 MHz. One of the L-band systems being studied is called the L-band Digital Link (LDL). This system is based on the upper layers already specified as part of the VDL Mode 3 system; however, the physical layer of LDL is tailored to the L-band environment. It is hoped that, by incorporating much of the link layer structure of VDL Mode 3, this approach can take advantage of existing VDL standards and short-circuit a good deal of the development and specification cycle that would be incurred by an entirely new system. This paper provides a description of changes to the physical layer of VHF Digital Link Mode 3 (VDL3) that will facilitate operation in the L-band (960-1024 MHz). Some minor changes to link layer protocols are also suggested. Additional protocol changes that would allow enhancements to improve performance (over what is achievable in the VHF band) are also described

Derived from text

*Air Traffic Control; Ultrahigh Frequencies; Very High Frequencies; Short Circuits; Data Transmission*

**20070015038** Lockheed Martin Corp., USA

**Enhancing Airspace Security in the Washington ADIZ**

Landriau, Scott; Markiewicz, Patrick; Zuna, John; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 189-190; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In response to the events of September 11th, the National Capitol Region Coordination Center (NCRCC) was created as the focal point for coordinating airspace security in the Baltimore/Washington, D.C. metropolitan area. Numerous government agencies having an interest in airspace security in this region are represented by liaison staff on-site at the National Capital Region Coordination Center. The liaison staffs coordinate with one another but also with supervisory staff in their respective operational facilities. Today there is limited automated support for a common situational view, coordination, and collaboration among the participating agencies. The Enhanced Airspace Security (EAS) Proof of Concept effort explored the use of network centric technologies for enhancing the common situational view. In addition, it examined new techniques that support coordination and collaboration, leading to heightened awareness of the air security situation among the liaison staff. Under contract to the Federal Aviation Administration (FAA), the Enhanced Airspace Security effort was conducted using spiral development approach consisting of 5 iterations scheduled on three month centers. The development of incremental capability was phased such that each iteration built on the results gained in previous iterations. Each iteration concluded with a demonstration of the system in a simulated operational context. The resulting Enhanced Airspace Security system integrates four legacy air surveillance monitoring systems that are currently in operational use. An Enterprise Service Bus built using commercially available products facilitates information sharing among those systems. The integrated configuration uses publish/subscribe techniques to share aircraft position (track) information among the legacy systems. In addition, the system can share 'pointouts' which highlight particular aircraft needing special attention. Pointouts can be either manually generated by a human user or automatically generated by the system in response to defined criteria. Further, shared pointout information

can be escalated to a higher threat status and annotated as the operational situation evolves.

Author

*Airspace; Security; Warning Systems; Information Systems; Aerial Reconnaissance*

**20070015039** EUROCONTROL, France

**Shift the Current Air Traffic Management Paradigm: From Means to Objectives Management**

Guichard, Laurent; Guibert, Sandrine; Dohy, Didier; Grau, Jean-Yves; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 325-335; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

As stressed by Air Traffic Management (ATM) community, current ATM system will not be able to cope with traffic increase planned over the years to come. The aim here is to propose in the frame of the Paradigm SHIFT project a new paradigm for an innovative ATM, based on a new operational concept: Contract of Objectives. This concept introduces a new way of managing ATM by objectives instead of by means. It defines an operational link between air and ground services to perform efficiency due to the increasing of the predictability of the air transport system. The Contract of Objectives is drafted during a negotiation phase called the Operational Plan in which all actors are involved (i.e. airlines, airports, Air Navigation Service Provider (ANSP), military units, etc.). The objective assignment and negotiation can be performed through collaborative decision making process to establish the operational agreement assuming the right balance between productivity and safety. The Contract of Objectives is associated with one flight and is a guarantee of results offered to the airline by the air traffic system to respect punctuality. Nevertheless it contains built-in margins for flexibility and adjustment in order to manage disruptive factors. The margins are called Target Windows. For controllers, the incorporation of the Contract of Objectives into their activities brings an additional task. It is clear that respecting the Contract of Objectives becomes a key issue in their activities but, safety remaining the controllers top priority.

Author

*Air Navigation; Air Traffic Control; Air Transportation; Civil Aviation*

**20070015040** Lockheed Martin Corp., USA

**Architecture and Requirements Development for the Next Generation Air Transportation System**

Avjian, Bob; Rosen, Steve; Mettus, Paul; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 337-346; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper describes our ongoing survey and correlation of global operational requirements of the future ATC systems and the enterprise architectures that support those requirements. This material is contained within a DOORS database and supported by Department of Defense Architecture Framework (DoDAF) compliant operational and system views. The operational requirements database also contains reference links to air traffic system stakeholder documents that describe the operational needs of the stakeholders. The operational requirements and architecture views will be linked to each other to provide requirements substantiation for candidate NGATS architectures. The operational requirements database categorizes the operational requirements according to time and ICAO key result areas desired. As a participating member of the NGATS Joint Planning & Development Office (JPDO) Agile Air Traffic System Integrated Product Team, we directed our work to be aligned with the overall JPDO NGATS approach. Our approach is based on the experience of applying activity-based methods on other DoD C4ISR programs. The activity based methodology consists of an approach to developing fully integrated, unambiguous and consistent DoDAF operational, system and technical views. As the name implies, activity-based means targeting the activities that the NGATS architecture must support. The NGATS architecture will have both static and dynamic architecture viewpoints. For example, the static views depict the logical and physical structure and relationships of the architecture whereas the dynamic views depict the behavioral aspects (e.g., transitions, timing, messaging, etc.) of the architecture under various scenarios or use cases. Developing an air transportation system enterprise architecture consistent with architectures of other government agencies in accordance with Federal Enterprise Architecture mandates will drive synergism and aid in the identification of interoperability shortfalls amongst interfacing systems in concert with the standards and regulations upon which those interfacing systems must interoperate.

Author

*Air Transportation; Systems Engineering; Air Traffic Control; Architecture (Computers); Requirements*

**20070015041** Blue Rock Research, Asheboro, NC, USA

**Research on Advanced Displays for Self-Separation and Sequencing at Non-Towered Airports**

Kelly, Wallace E.; Snow, Paul; Alter, Keith W.; Williams, Louis J.; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 285-294; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A04](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Advanced cockpit displays, datalink, and intelligent systems offer an excellent opportunity to increase the utilization of small, non-towered, non-radar airports during instrument conditions. In one concept, the NASA Small Aircraft Transportation System (SATS) program investigated the use of a Self-Controlled Area (SCA) around the airport. Aircraft operating within the SCA received sequencing information from a ground based Airport Management Module and used advanced cockpit displays to provide the ability to operate autonomously within the SCA. This paper describes the research avionics system developed by the North Carolina and Upper Great Plains (NC&UGP) SATSLab team, which participated in a demonstration of the feasibility of the NASA SCA concept. The aircraft avionics system includes a Synthetic Vision System (SVS) component and a Traffic Situation Display (TSD) component which can be depicted in multiple formats on the two display devices in the research system. This system was installed in the team's Piper Aztec aircraft for the flight demonstration at Danville, VA last June.

Author

*Display Devices; Airports; Avionics; Sequencing; Flight Tests; Enhanced Vision; Data Links*

**20070015042** Raytheon Co., McKinney, TX, USA

**The Future of Terminal Airspace: An Airportal for 2025**

Miller, Mary Ellen; Proceedings of the Sixth Integrated Communications, Navigation and Surveillance (ICNS) Conference & Workshop 2006; September 2006, pp. 281; In English; See also [20070014962](#); Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper focuses on the Terminal domain which includes the following core ideas: a) Very Closely Spaced Parallel Runways (VCSPR) and 4D automation enable paired arrival/departure operations in both Instrument Meteorological Conditions (IMC) and Visual Meteorological Conditions (VMC) at major airports; b) Expanded terminal area 'metropolex' includes routing and approach/departure procedures to both Point-to-Point (PTP)/auxiliary and Hub/major airports; c) Auxiliary airports consist of fully automated, virtual-tower, and non-towered airports; d) A ground-based automation system performs separation assurance; e) Net-Centric systems enable NAS-wide information exchange to optimize operations between Surface/Terminal/En Route/National domains; f) Ground-based sensors monitoring for wake vortices, advanced data fusion/weather prediction, and improved aircraft position and intent data enable reduced aircraft-aircraft separation and longitudinal wake vortex spacing; g) Aircraft are provided services and assigned arrival/departure routes based on level of equipage; h) Anchor points are dynamically allocated to provide flexible traffic management into terminal areas and around weather constraints; and i) Use of noise-optimal approaches.

Derived from text

*Airports; Automatic Control; Multisensor Fusion; Runways*

## 05

### AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance and evaluation, and aircraft and flight simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Technology Utilization and Surface Transportation.

**20070015102** Analysas Corp., Oak Ridge, TN USA

**Site Health and Safety Plan for the Helicopter Hangar Area, Fire Training Area, and Ordnance Demolition Area at Fort George G. Meade, Maryland**

May 31, 1995; 66 pp.; In English

Contract(s)/Grant(s): DAAA15-93-D-0010

Report No.(s): AD-A462286; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA462286>

The U.S. Army Environmental Center (USAEC) policy is to provide a safe and healthful workplace for all employees and subcontractors. The accomplishment of this policy requires that operations at the Fort George G. Meade Fire Training Area

(FTA), Helicopter Hangar Area (HHA), and Ordnance Demolition Area have an overall plan and consistent proactive approach to health and safety issues.

DTIC

*Education; Fire Control; Fires; Hangars; Health; Helicopters; Ordnance; Safety; Training Devices*

**20070015120** General Accounting Office, Washington, DC USA

**Defense Acquisitions. Issues Concerning Airlift and Tanker Programs**

Solis, William M; Sullivan, Michael J; Mar 7, 2007; 25 pp.; In English

Report No.(s): AD-A463572; GAO-07-566T; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463572>

The Department of Defense (DOD) has continuing efforts to modernize its airlift and tanker fleets by investing billions of dollars to modify legacy airlift systems, such as the C-5 and C-130, and procure new aircraft, such as a tanker replacement. Acquisition has been on GAO's list as a high risk area since 1990. Past GAO reports, including two recently issued, raise concerns about the quality of analyses underpinning the programmatic decision-making surrounding DOD's airlift requirements. GAO has reported that elements contributing to a sound business case for an acquisition are missing or incomplete as DOD and the services attempt to acquire new capabilities. Those elements include firm requirements, mature technologies, a knowledge-based acquisition strategy, a realistic cost estimate, and sufficient funding. Acquisition problems that include failure to limit cost growth, schedule delays, and quantity reductions persist, but fiscal realities will not allow budgets to accommodate these problems any longer. This testimony addresses (1) the analyses supporting the Department of Defense's (DOD) mobility capabilities and requirements and (2) actions that are needed to improve the outcomes of weapon system acquisitions.

DTIC

*Armed Forces (United States); Budgeting; Federal Budgets*

**20070015132** Clemson Univ., SC USA

**Vision-Based Tracking for Unmanned Aerial Vehicles**

Chitrakaran, Vilas K; Dawson, Darren M; Kannan, Hariprasad; Feemster, Matthew; Jan 2006; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463641; CU/CRB/2/27/06/1; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463641>

This paper presents the design of a vision-based controller for an underactuated, unmanned aerial vehicle (UAV) equipped with a pan-tilt camera unit (PTCU) to achieve the objective of following a leader vehicle autonomously. The relative position and orientation information is obtained from the monocular camera utilizing homography-based techniques. The proposed controller, built upon Lyapunov design methods, achieves uniform ultimate bounded (UUB) tracking. As an extension, it is also demonstrated that the approach used in the development of the control strategy for the leader-follower problem can be applied, with a few modifications, to the problem of trajectory tracking, where the desired trajectory is described as a sequence of images taken, for example, by the on-board camera during a previous flight.

DTIC

*Drone Vehicles; Pilotless Aircraft*

**20070015159** NDE Computational Consultants, Dublin, OH USA

**Effect of Adhesive Material Properties on Induced Stresses in Bonded Sensors (Preprint)**

Martin, Steven A; Blackshire, James L; Jul 2006; 10 pp.; In English

Contract(s)/Grant(s): F33615-03-C-5220

Report No.(s): AD-A463772; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463772>

An analysis of the stresses induced in adhesively bonded sensors from a biaxial stress field in the underlying substrate is presented. Recent Structural Health Monitoring work has looked at using surface bonded sensors to detect and characterize damage in aircraft structures. In addition to the proper design of these systems, it is important that they be able to survive in a sometimes hostile operating environment in terms of weather, vibration, temperature, and mechanical loading of the structural members of the airframe. The analysis first considers the load transfer mechanism from the substrate through the adhesive layer into the sensor. The partitioning of the load between the substrate and sensor is found to depend on the substrate stiffness, the sensor thickness, and the shear modulus and thickness of the adhesive. The analysis then shows that for an

elliptically shaped sensor whose maximal dimension is small compared to the substrate in-plane dimensions the stress induced by a biaxial state of stress can be determined using inclusion theory. It is further shown that the stresses in a circular sensor on a substrate subjected to a hydrostatic state of stress can be calculated using equations derived from those used to determine the interfacial pressure for an interference fit between annular cylinders. Finally, the analysis considers induced bending stresses caused by the asymmetric change in thickness in the region where the bonded sensor resides.

DTIC

*Adhesion; Adhesive Bonding; Piezoelectric Gages; Stress Analysis*

**20070015178** Naval Research Lab., Stennis Space Center, MS USA

**Moving Map Composer - Personal Computer (MMCPC) for the Finnish Air Force, Software Design Document, Version 1.0**

Myrick, Stephanie A; Trenchard, Michael E; Layne, Geary; Gendron, Marlin L; Lohrenz, Maura C; Mar 2, 2007; 87 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463833; NRL/FR/7440--07-10121; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463833>

The Moving Map Composer - Personal Computer (MMCPC) software is specifically designed and configured to support Finnish Air Force (FiAF) F/A-18 mission planners and pilots in the field. Previous versions of the MMC were installed on Digital Equipment Corporation (DEC) Alpha workstations, which used the OpenVMS operating system and supported the AN/ASQ-196 Honeywell digital map system. MMCPC is a Microsoft (MS) Windows-based software application that provides data processing and mission/theater map data load support for the Tactical Aircraft Moving-Map Capability (TAMMAC) Digital Map System (DMS). This software release of MMCPC, in sole support of the FiAF F/A-18 program, contains substantial software modifications to meet specific FiAF requirements.

DTIC

*Computer Programs; Computers; Data Processing; Digital Data; Maps; Personal Computers; Software Engineering*

**20070015192** Civil Aeromedical Inst., Oklahoma City, OK USA

**Unmanned Aircraft Pilot Medical Certification Requirements**

Williams, Kevin W; Feb 2007; 14 pp.; In English

Report No.(s): AD-A463867; DOT/FAA/AM-07/3; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463867>

This research addressed the medical requirements necessary for unmanned aircraft (UA) pilots for successful flight in the National Airspace System (NAS). Given that an existing medical certification was recommended, the question of which class of certification to propose was based on the perceived level of risk imposed by the potential incapacitation of the UA pilot. A second-class medical certification was judged to be the most acceptable, considering that there were several factors that mitigated the risk of pilot incapacitation relative to those of manned aircraft. First, factors related to changes in air pressure could be ignored, assuming that control stations for non-military operations would be on the ground. Second, many of the current UA systems have procedures that have been established for lost data link. Lost data link, where the pilot cannot transmit commands to the aircraft, is functionally equivalent to pilot incapacitation. Third, the level of automation of a system determines the criticality of pilot incapacitation because some highly automated systems (e.g., Global Hawk) will continue normal flight whether a pilot is or is not present. The effort consisted of the convening of a panel of subject matter experts and interactions with groups engaged in the process of establishing unmanned aircraft pilot guidelines. The results of this effort were a recommendation and justification for the use of the second-class medical certification.

DTIC

*Aerospace Medicine; Certification; Health; Pilotless Aircraft; Pilots; Remotely Piloted Vehicles; Requirements*

**20070015222** Naval War Coll., Newport, RI USA

**Unmanned Aircraft Systems: The Road to Effective Integration**

Petrock, Christopher T; Huizenga, Thomas D; Feb 13, 2006; 29 pp.; In English

Report No.(s): AD-A463921; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463921>

As the global campaign against terrorism continues, the contributions of unmanned aircraft systems (UAS) have reached unprecedented levels. Some claim that these assets are essential to the armed forces ability to conduct modern warfare. Due

to these systems capabilities, combatant commanders are requesting ever-greater numbers of unmanned vehicles. However, the employment of more UAS in the theater of operations comes at a price: there are tremendous challenges associated with unmanned aircraft (UA) sharing airspace with manned assets. There have been at least two recent collisions between unmanned and rotary-wing aircraft at lower altitudes in Iraq, as well as numerous near misses with fixed-wing aircraft at higher altitudes. Existing airspace management problems will be further compounded by introduction of additional assets into congested airspace. The effective integration of unmanned aircraft into the battlespace will only occur with concurrent changes in doctrine, organization, training, and materiel. The synergy created by a blended force of manned and unmanned assets will be of great benefit to the Joint Force Commander (JFC).

DTIC

*Aircraft Configurations; Airspace; Altitude; Collision Avoidance; Collisions; Drone Vehicles; Fixed Wings; Pilotless Aircraft; Roads; Rotary Wing Aircraft*

**20070015273** NCI Information Systems, Inc., Fairborn, OH USA

**Aircraft Maintenance Intuitive Troubleshooting (AMIT)**

Botello, Charles; Jernigan, Johnnie; Stimson, Darryl; Marquardt, Scott W; Kancler, David E; Curtis, Christopher K; Barthol, Derrick R; Burneka, Christopher M; Whited, Vaughan T; Dec 2006; 111 pp.; In English

Contract(s)/Grant(s): FA8650-04-C-6406; Proj-2830

Report No.(s): AD-A464018; 9323-A001-02-02; No Copyright; Avail.: CASI: [A06](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464018>

The Aircraft Maintenance Intuitive Troubleshooting (AMIT) program was a 37-month, 6.3 funded research and development effort sponsored by the Air Force Research Laboratory's Human Effectiveness Directorate, Logistics Readiness Branch (AFRL/HEAL). Its purpose was to research and design an electronic maintenance aid for on-aircraft maintainers as they troubleshoot difficult system malfunctions. The goals were to reduce troubleshooting time and increase troubleshooting accuracy, thereby increasing aircraft availability. Program execution occurred in three phases: 1) Explore the user environment, aircraft maintenance processes, expert technician troubleshooting strategies and resource utilization, and other past and current research work in pertinent areas in order to derive program requirements. 2) Design and develop the maintenance aid, evaluate and select applicable CDTS tools, and validate the program requirements and associated design through end-user evaluations. 3) Plan and conduct a field demonstration test and analyze the results. Three hypotheses were proven during the 4-month field test at Luke AFB AZ: 1) Subjects using AMIT required less troubleshooting task time as compared to current processes, 2) Subjects using AMIT committed fewer errors compared to current processes, and 3) Novices using AMIT performed at or near the level of current experts not using AMIT.

DTIC

*Aircraft; Maintenance*

**20070015305** Massachusetts Univ., Amherst, MA USA

**Proceedings of the Antenna Applications Symposium (30th) Held in Monticello, Illinois on 20-22 September, 2006. Volume 2**

Schaubert, Daniel; Feb 26, 2007; 267 pp.; In English

Contract(s)/Grant(s): F33615-02-D-1283

Report No.(s): AD-A464059; No Copyright; Avail.: CASI: [A12](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464059>

The Proceedings of the 2006 Antenna Applications Symposium is a collection of state-of-the art papers relating to antenna arrays, millimeter wave antennas, simulation and measurement of antennas, integrated antennas, and antenna bandwidth and radiation improvements.

DTIC

*Antennas; Conferences*

**20070015306** Army Command and General Staff Coll., Fort Leavenworth, KS USA

**Operationalizing Special Operations Aviation in Indonesia**

Messner, Garrett K; Dec 15, 2006; 110 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464060; No Copyright; Avail.: CASI: [A06](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464060>

This study researched the possible roles and missions conducted by the USA Special Operation Aviation (SOA)



community, particularly rotary-wing, fix-wing, unmanned aerial vehicles' roles, as well as SOA's role in Foreign Internal Defense. After determining the roles and missions of SOA, a center of gravity analysis was conducted on the Jemaah Islamiah, Southeast Asia's most dangerous terrorist group with global reach, to determine how SOA can be used to defeat the violent extremist organizations in Indonesia. The research concluded that SOA would have an important, but limited role in the global war on terror in Indonesia.

DTIC

*Drone Vehicles; Indonesia; Military Operations*

**20070015384** Pacific Science and Engineering Group, Inc., San Diego, CA USA

**ISR Reach-Back: A Human-Systems Integration Assessment from Trident Warrior 2004**

St John, Mark; Gwynne, John W; Kelly, Richard T; Smillie, Robert J; Jun 2005; 23 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464228; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464228>

During Trident Warrior 2004, a net-centric initiative was evaluated for demonstrating reach-back Image, Surveillance, and Reconnaissance (ISR) video exploitation. Specifically, the initiative examined the concept of remote, but timely, support provided by a small team of extremely capable personnel. While information, in the form of images, was successfully pushed from the reach-back facility to the afloat forces, and all technical requirements were met, a number of problems were identified with the process. There are important issues the lie beyond technical connectivity. Enabling proactive actions at a reach-back facility requires achieving shared situation awareness, which in turn requires effectively addressing the procedural and cognitive requirements for supporting shared situation awareness. Human-System Integration can play a prominent role in defining and guiding this solution.

DTIC

*Aerial Reconnaissance; Drone Vehicles; Surveillance; Systems Integration*

**20070015394** Bolt, Beranek, and Newman, Inc., Cambridge, MA USA

**UAV Operator Human Performance Models**

Deutsch, Stephen; Sep 2006; 28 pp.; In English

Contract(s)/Grant(s): Proj-2830

Report No.(s): AD-A464246; BBN 8460; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464246>

The Distributed Operator Model Architecture (D-OMAR) was used as the software environment in which to build an Unmanned Aerial Vehicle (UAV) test bed. Using D-OMAR, models were developed for UAVs each with a sensor package that included daytime-TV and infrared cameras. Human performance models were developed for the Aerial Vehicle Operator (AVO) and the Sensor Operator (SO) The modeled workplace from which the AVO and SO managed a mission included positions for the AVO's control of the vehicle the SO's use of the sensor package. With the basic elements of the test bed defined, a use case was developed based on a scenario (Petkosek, Warfield, and Carre;Lta, 2005) at a commercial airport. The AVO model maintained the UAV flight path and the SO, reading from a list of Essential Elements of Information (EEI), conducted and interpreted the sensor observations of the modeled airport scene coordinating them with a Multi-Function Operator (MFO), the third member of the UAV mission team. The operations of the AVO and MFO are described and additional detail is provided on the SO model that describes multitasking, the modeling of individual difference, the modeling of episodic and declarative memory, and model robustness. The report concludes with suggestions that the UAV test bed might be employed to examine workplace design and operating procedures with the goal of improving UAV mission performance, and reducing staffing and required training time.

DTIC

*Drone Vehicles; Human Performance; Operator Performance; Performance Prediction; Situational Awareness; Workloads (Psychophysiology)*

**20070015448** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**A Study of Bi-Directional Reflectance Distribution Functions and Their Effect on Infrared Signature Models**

Harkiss, Samuel I; Mar 2007; 153 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464331; AFIT/GE/ENP/07-01; No Copyright; Avail.: CASI: A08, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464331>

Since 2004, AFIT has been developing a trend-analysis tool to assess large commercial aircraft infrared (LCAIR) signatures. In many cases, this code predicted signatures to within 10% of measured data. However, other results indicated that the single-bounce, specular-reflection algorithm being used failed to adequately simulate interactions between aircraft parts where either the specular component is dominated by diffuse reflection or part-to-part multiple-bounce reflections contribute significantly to the signature. This research incorporates Bi-Directional Reflectance Distribution Functions (BRDF's) and multiple-bounce calculations into the LCAIR model. A physical aircraft model was constructed from aluminum, and measurements were taken before and after a surface treatment in gloss black paint. The Sandford-Robertson model is used to parameterize the BRDF's of both the bare aluminum and gloss black paint. Since the most efficient method of integrating a BRDF depends upon the reflectance distribution of the aircraft material, the sampling resolution of the BRDF integral is crucial to an accurate simulation. Additionally, care is taken to ensure that the integration of the hemispherical irradiance onto each facet of the computational model is sampled at a sufficient resolution to achieve convergence in the solution. Simulations in the mid-wave infrared (MWIR) and long-wave infrared (LWIR) bands validate both the previous specular reflectance simplification for the gloss black simulations and the failure of the previous algorithm for the highly reflective bare aluminum. The necessity of considering multiple bounces in the simulation is also demonstrated amongst part-to-part reflections near the wing root, where three or four bounces are required for the solution to converge. Finally, three scenarios simulating a man-portable air defense system (MAN-PADS) system engaging an Airbus A340-300 aircraft landing at a generic airport are performed.

DTIC

*Bidirectional Reflectance; Distribution Functions; Infrared Signatures; Reflectance; Signatures*

**20070015465** General Accounting Office, Washington, DC USA

**Defense Acquisitions: Analysis of Costs for the Joint Strike Fighter Engine Program**

Sullivan, Michael; Mar 22, 2007; 23 pp.; In English

Report No.(s): AD-A464361; GAO-07-656T; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464361>

Continuing the alternate engine program for the Joint Strike Fighter would cost significantly more than a sole-source program but could, in the long run, reduce costs and bring other benefits. The current estimated life cycle cost for the JSF engine program under a sole-source scenario is \$53.4 billion. To ensure competition by continuing to implement the JSF alternate engine program, an additional investment of \$3.6 billion to \$4.5 billion may be required. However, the associated competitive pressures from this strategy could result in savings equal to or exceeding that amount. The cost analysis we performed suggests that a savings of 10.3 to 12.3 percent would recoup that investment, and actual experience from past engine competitions suggests that it is reasonable to assume that competition on the JSF engine program could yield savings of at least that much. In addition, DOD-commissioned reports and other officials have said that nonfinancial benefits in terms of better engine performance and reliability, improved industrial base stability, and more responsive contractors are more likely outcomes under a competitive environment than under a sole-source strategy.

DTIC

*Acquisition; Cost Analysis; Costs; Fighter Aircraft; Jet Aircraft; Jet Engines*

**20070015700** Army Research Lab., White Sands Missile Range, NM USA

**Weather Impacts on the Aerostar Unmanned Aircraft System Based on Climatology over the U.S./Mexico Border**

Sauter, Barbara; Mar 2007; 60 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464136; ARL-TR-4055; No Copyright; Avail.: CASI: A04, Hardcopy

Unmanned Aircraft Systems (UASs) are becoming more prevalent performing both military and non-military functions. One potential function for a UAS is monitoring along the U.S./Mexico border. This report documents the percentage of time various weather parameters might be expected to degrade the performance of an Aerostar or similar UAS over the border regions based primarily on Advanced Climate Modeling and Environmental Simulations (ACMES) modeled climatology as

well as other climatology data from the Air Force Combat Climatology Center (AFCCC). Many details are provided on the probability of Aerostar weather limitations being exceeded for specific border locations, months, and times of day. Similar inputs could be used in the future to run an automated decision aid to assist in long-term planning for effective use of particular UAS types, locations, and purposes... united states and mexico.

DTIC

*Climatology; Drone Vehicles; Pilotless Aircraft; United States*

**20070015712** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Dynamic Coupling of the KC-135 Tanker and Boom for Modeling and Simulation (Postprint)**

Smith, Austin L; Kunz, Donald L; Aug 2006; 16 pp.; In English

Contract(s)/Grant(s): Proj-2403

Report No.(s): AD-A464364; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Current Automated Aerial Refueling (AAR) research requires precision modeling and simulation of the refueling process between a KC-135 tanker aircraft and an unmanned aircraft. In order to meet this requirement, both steady-state and dynamic interactions between the tanker aircraft, the refueling boom, and the receiver aircraft must be accurately represented. Boom orientation and motion is known to change the trim of the tanker aircraft, which in turn influences the formation flying and station keeping tasks involved in current Air Force AAR concepts of operation. This paper describes the development of the coupled equations of motion for the refueling boom, which model its motion and its dynamic interactions with the tanker. For the purposes of this investigation, and to validate the boom model dynamics, the coupled boom model is first implemented as a boom-only simulation. The coupled model is compared to two existing boom-only models: one of which has been used for aerial refueling improvement studies, and the other is currently being used for boom operator training. Steady-state and dynamic responses to control inputs to the boom are calculated by the coupled boom model, then compared to those calculated using the existing models.

DTIC

*C-135 Aircraft; Drone Vehicles; Equations of Motion; Refueling; Simulation; Tanker Aircraft*

**20070015714** General Accounting Office, Washington, DC USA

**Joint Strike Fighter: Progress Made and Challenges Remain**

Mar 2007; 36 pp.; In English

Report No.(s): AD-A464367; GAO-07-360; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The JSF program has delivered and flown the first development aircraft. However, cost and schedule goals established in the fiscal year 2004 rebaselined program have not been met. Total JSF program acquisition costs (through 2027) have increased by \$31.6 billion and now DOD will pay 12 percent more per aircraft than expected in 2004. The program has also experienced delays in several key events, including the start of the flight test program, delivery of the first production representative development aircraft, and testing of critical missions systems. Delays in the delivery of initial development aircraft were driven by incomplete engineering drawings, changes in design, manufacturing inefficiencies, and parts shortages. Despite these delays, the program still plans to complete development in 2013, compressing the amount of time available for flight testing and development activities. Also, the program projects it will meet all but one key performance requirement line of sight communications---that is currently dependent on other capabilities being developed outside the JSF program.

DTIC

*Acquisition; Fighter Aircraft; Jet Aircraft; Warfare*

**20070015754** Naval Research Lab., Washington, DC USA

**Real Time Video Transfer Using Multiple Quantum Well Retromodulators**

Gilbreath, G C; Rabinovich, W S; Meehan, Timothy J; Vilcheck, Michael J; Stell, Mena; Mahon, Rita; Goetz, Peter G; Oh, Eun; Vasquez, John; Cochrell, Kerry; Jan 2002; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464423; No Copyright; Avail.: CASI: [A02](#), Hardcopy

This paper is an update in the progress of the development of NRL's Multiple Quantum Well retromodulators for compact, low power communications. We report results for data-in-flight on a small unmanned aerial vehicle at up to 5 Mbps in preparation for real-time video transfer using an array of devices. This data was taken at Chesapeake Bay Detachment. We

also report transference of color video using wavelet compression at 15 and 30 frames per second. at 4 to 6 Mbps in lab. at eye safe intensity levels. The unit is a cornercube modulator using a 980 nm shutter. A five-element array was used for the data-in-flight. First results of our 1550 nm devices are also presented as is progress in a 'Cats Eye Retromodulator'

DTIC

*Drone Vehicles; Free-Space Optical Communication; Modulators; Quantum Wells; Real Time Operation; Reflectors; Video Signals*

**20070015803** Naval Research Lab., Washington, DC USA

**Large-Aperture Multiple Quantum Well Modulating Retroreflector for Free-Space Optical Data Transfer on Unmanned Aerial Vehicles**

Gilbreath, G C; Rabinovich, W S; Meehan, T J; Vilcheck, M J; Mahon, R; Burris, Ray; Ferraro, M; Sokolsky, I; Vasquez, J A; Cochrell, K; Jul 2001; 10 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464509; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We describe progress in the development of a multiple quantum well modulating retroreflectors including a description of recent demonstrations of an infrared data link between a small rotary-wing unmanned airborne vehicle and a ground-based laser interrogator using the device designed and fabricated at the Naval Research Laboratory (NRL). Modulating retroreflector systems couple an optical retroreflector, such as a corner cube, and an electro-optic shutter to allow two-way optical communications using a laser telescope and pointer-tracker on only one platform. The NRL modulating retroreflector uses a semiconductor-based multiple quantum well shutter capable of modulation rates greater than 10 Mbps depending on link characteristics. The technology enables the use of near-infrared frequencies, which is well known to provide covert communications immune to frequency allocation problems. This specific device has the added advantage of being compact, lightweight, covert, and requires very low power. Up to an order of magnitude in onboard power can be saved using a small array of these devices instead of the radio frequency equivalent. In the described demonstration a Mbps optical link to an unmanned aerial vehicle in flight at a range of 100 to 200 feet is shown. Near real-time compressed video was also demonstrated at the Mbps level and is described.

DTIC

*Apertures; Data Links; Modulation; Pilotless Aircraft; Quantum Wells; Retroreflectors*

**20070015972** Test Wing (0046th), Wright-Patterson AFB, OH USA

**Evaluation of Skin-Spar Joint Resistance to Hydrodynamic RAM**

Czarneck, Greg; Maxson, Michele; Sawdy, J; Miller, M; Hinrichsen, R; Mar 2006; 357 pp.; In English

Contract(s)/Grant(s): Proj-JZZE

Report No.(s): AD-A464155; OL-AC-DPR-07-08; No Copyright; Avail.: CASI: [A16](#), Hardcopy

This paper presents the application of a new dynamic joint loading methodology that uses a RamGun device. Projectile-induced hydrodynamic ram can generate fuel-tank pressures in excess of 10,000 psi. This event is potentially catastrophic for aircraft fuel tanks designed to survive sustained pressures of little more than 50 psi. While the magnitude of ram pressure is dictated by a combination of fuel-level and projectile threat, skin-spar joint design is the primary means by which damage can otherwise be controlled. Damage resistant joints restrict the spread of damage and assist aircraft survival. Joint resistance to ram is conventionally evaluated using a combination of two methods: a) T-joint pull-off tests and b) ballistically-tested wingboxes. While T-joint tests are a low-cost method of ranking skin-spar joints according to their load at failure, realism is traded away in favor of an economical and easily understood test. T-joint pull-off tests are symmetrically performed quasi-statically at a strain rate of less than 0.01 in/in-sec, whereas projectile-generated ram events involve asymmetric high-rate loading conditions on the order of 100 in/in-sec. Contrary to T-joint pull-off tests, wingbox ram tests with actual threat projectiles are fully realistic, but these tests come with a price tag in excess of \$250,000 (inclusive of tooling, structural materials, test costs, and labor). This is too expensive for wholesale evaluation of competing joint concepts. When attempting to model high-strain rate events associated with ram, conventional static failure criteria has proven inadequate. The required dynamic failure criterion is typically 2-4 times that of the static case. This test series demonstrated that the RamGun can be used with confidence to perform comparative testing, design downselection, and failure metrics for competing joint concepts.

DTIC

*Aircraft; Fuel Tanks; Metal Joints; Skin Resistance*

## 06

### AVIONICS AND AIRCRAFT INSTRUMENTATION

Includes all avionics systems, cockpit and cabin display devices, and flight instruments intended for use in aircraft. For related information see also 04 Aircraft Communications and Navigation; 08 Aircraft Stability and Control; 19 Spacecraft Instrumentation and Astrionics; and 35 Instrumentation and Photography.

**20070014891** Old Dominion Univ., Norfolk, VA, USA

**Performance Analysis and Validation of a Recoverable Flight Control System in a Simulated Neutron Environment**

Zhang, Hong; Gray, W. Steven; Gonzalez, Oscar R.; FROM; August 18, 2005; 14 pp.; In English; AIAA Guidance, Navigation, and Control Conference and Exhibit, 15-18 Aug. 2005, San Francisco, CA, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC1-03026; NNL04AA03A; NSF CCR-0209094

Report No.(s): AIAA Paper 2005-6430; Copyright; Avail.: CASI: **A03**, Hardcopy

This paper introduces a class of stochastic hybrid models for the analysis of closed-loop control systems implemented with NASA's Recoverable Computer System. Such Recoverable Computer Systems have been proposed to insure reliable control performance in harsh environments. The stochastic hybrid models consist of either a stochastic finite-state automaton or a finite-state machine driven by a Markov input, which in turn drives a switched linear discrete-time dynamical system. Their stability and output tracking performance are analyzed using an extension of the existing theory for Markov jump-linear systems. For illustration, a stochastic hybrid model is used to calculate the tracking error performance of a Boeing 737 at cruising altitude and in closed-loop with a Recoverable Computer System subject to neutron-induced single-event upsets. The upsets are modeled with a Markov process. The results are validated using experimental data obtained from a simulated neutron environment in NASA's SAFETI Laboratory.

Author

*Flight Control; Feedback Control; Neutrons; Reliability Analysis; Stochastic Processes; Computers*

## 08

### AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities, piloting, flight controls, and autopilots. For related information see also 05 Aircraft Design, Testing and Performance; and 06 Avionics and Aircraft Instrumentation.

**20070015435** Ohio Univ., Athens, OH USA

**Integrated Flight Control and Flow Control Using Synthetic Jet Arrays (Postprint)**

Liu, Yong; Ciuryla, Marcus; Amitay, Miki; Kwan, Chiman; Myatt, James H; Zhang, Xiaodong; Ren, Zhubing; Casey, John P; Aug 2006; 23 pp.; In English

Contract(s)/Grant(s): FA8650-05-M-3539; Proj-A08W

Report No.(s): AD-A464299; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464299>

This document was developed under a SBIR contract. In this paper, a novel integrated flight control and flow control system using synthetic jet arrays is presented. In the proposed system, a novel active flow control actuator, synthetic-jets-instrumented-wingtips were designed to enhance or replace traditional roll control of a specified airplane. Wind tunnel experiments were conducted to obtain the dynamic model of the synthetic-jets-instrumented-wing-tips. A closed-loop active flow control system was developed to reattach the flow at high angle of attacks. A high fidelity dynamic model for the airplane with the designed synthetic-jets-instrumented-wing-tips was developed based on wind tunnel experiments. A nonlinear integrated flight control and flow control system was developed and tested in simulations. Simulation results showed that the synthetic-jets-instrumented-wing-tips, in conjunction with the elevator and rudder, can effectively control the Cessna's attitude.

DTIC

*Angle of Attack; Attitude Control; Flight Control; Synthetic Arrays; Wind Tunnel Tests*

**RESEARCH AND SUPPORT FACILITIES (AIR)**

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see *03 Air Transportation and Safety*. For astronautical facilities see *14 Ground Support Systems and Facilities (Space)*.

**20070014821** Swedish Defence Research Establishment, Linköping, Sweden

**Experimental Procedure During the Evaluation of ACES**

Berggren, P.; Oskarsson, P. A.; Naehlinger, S.; Borgvall, J.; Jun. 2005; 14 pp.; In English

Report No.(s): PB2007-103413; FOI-R-1688-SE; No Copyright; Avail.: National Technical Information Service (NTIS)

This report gives an all-embracing description of the integrated experimental setup of the simultaneously performed studies of ACES (Air Combat Evaluation System). The studies investigated presence, fidelity, embedded pedagogical tools, potential VR-symptoms, and use of the HMD (Head Mounted Display). ACES and technical equipment used for measures of postural stability are also briefly described. Thus the purpose of this report is to describe the whole experimental setup, as the study comprised several research objectives reported elsewhere.

NTIS

*Combat; Flight Simulators; Helmet Mounted Displays*

**20070015196** Civil Aeromedical Inst., Oklahoma City, OK USA

**Relationship of Sector Activity and Sector Complexity to Air Traffic Controller Taskload**

Manning, Carol A; Pfeleiderer, Elaine M; Dec 2006; 12 pp.; In English

Report No.(s): AD-A463881; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463881>

This study compared the relative effectiveness of two constructs, sector activity and sector complexity, in predicting air traffic controller taskload. Sector activity was defined as the activity associated with aircraft moving through the sector and was measured by counting the number of aircraft under the control of the sector during a traffic sample. Sector complexity describes a set of factors presumed to affect the difficulty experienced by a controller when controlling traffic. Sector complexity was measured in two ways. The first measure of complexity was a subjective rating made by supervisors and controllers to describe the complexity associated with specific traffic samples. The second was a composite variable that included measures reflecting several of the complexity variables found in the literature. Taskload was defined as controller activity and was measured by counting the number of data entries made by a controller during a traffic sample. The results appear to suggest that our hypothesis, that sector activity predicted controller taskload better than sector complexity, was incorrect. However, interpretation of these results depended on consideration of what each of the variables measured. The Complexity Rating predicted controller activity better than the number of aircraft alone, but the Complexity Value (based on a set of variables identified through previous research) did not contribute at all to that prediction. Additional analyses suggested that the Complexity Rating measured something very different than the Complexity Value. We believe that the Complexity Ratings estimated the workload that observers believed the controller at the sector experienced instead of the complexity of the situation. On the other hand, the complexity measures used here did not appear to be not good measures of the construct. This may have occurred because the

DTIC

*Air Traffic Control; Air Traffic Controllers (Personnel); Measurement*

**20070015713** Applied Research Associates, Inc., Tyndall AFB, FL USA

**Expeditionary Rubber Removal Capability**

Cotter, Brian; Smith, Scott; Dec 31, 2006; 40 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F08637-03-C-6006; Proj-4915

Report No.(s): AD-A464365; No Copyright; Avail.: CASI: A03, Hardcopy

The Airfield Operating Surfaces team from the Air Force Research Laboratory (AFRL/MLQD) conducted research to examine the feasibility of using a small lightweight airfield rubber removal equipment package that could be used in expeditionary environments. The equipment package was built around detergent rubber removal techniques. An equipment package consisting of a single Toolcat with broom and sprayer attachments augmented with a 1,000 gal water trailer and 1,500 gal water truck achieved a production rate of 91,000 sf in 5.75 hrs on asphalt and 75,000 sf in 6.5 hrs on concrete while removing 90% to 95% of the rubber deposits. These rates are equivalent to 95% and 70% of the production rates of commercial companies with large equipment packages. A detailed parts list of all the equipment used to reach these rates is

included in appendix A. The cost of one fully equipped Toolcat is approximately \$45,000. The cost of one water tender trailer with wash down nozzles is approximately \$20,000. A set of bristles for the broom costs approximately \$1500 plus shipping. The Avion 50 costs between \$530 and \$630 plus shipping for a 55 gallon drum. Avion 50 can be obtained in air shippable 5 gallon pales for approximately \$90 per pale plus shipping. A C-130 transportable package is proposed. This package contains two Toolcats with brooms and spray booms, bladders, pumps, hoses, and enough Avion 50 to clean 360,000 sf. The bladder, pumps and hoses will be placed on four host vehicles/trailers to create sufficient water support.

DTIC

*Rubber; Runways*

## 12

### ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see *categories 13 through 20*. For extraterrestrial exploration see *91 Lunar and Planetary Science and Exploration*.

**20070015136** Naval War Coll., Newport, RI USA

#### **Space Support Fully Integrated into All Phases of a Conflict: Ensuring Space Dominance for the Operational Commander**

Ingnoli, Joseph L; Oct 23, 2006; 24 pp.; In English

Report No.(s): AD-A463656; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463656>

Space Support Fully Integrated into All Phases of a Conflict: Ensuring Space Dominance for the Operational Commander. While Space Dominance has become a given for U.S. commanders in recent conflicts, emerging threats and the growth of complex space systems make the maintenance of that dominance a growing challenge. Numerous nations now have (or are developing) space capabilities and could challenge us in the next decade. In order to properly utilize and manage the various assets and threats facing our forces, operational commanders must be able to fully integrate space into all levels of their planning for a campaign. From Shaping Efforts, long before the fighting starts, through Enabling Civil Authorities, after the fighting ends, there are numerous capabilities which we must understand and master to win in the battle space of tomorrow.

DTIC

*Aerospace Systems; Dominance; Military Operations; Planning*

**20070015144** Naval War Coll., Newport, RI USA

#### **Space OPCON: Who's Watching Zeus?**

Zachary, Todd; May 16, 2006; 36 pp.; In English

Report No.(s): AD-A463673; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463673>

Over the past decades operations from and through space have given U.S. forces tremendous advantages on the battlefield. However, the high demand for space resources has always outstripped the available capacity, inevitably leading to a debate in regard to the command and control of space operations. Given the nature of the space environment, current space doctrinal roles and missions, and the capabilities space systems bring to the battlespace this paper contends that command and control of space operations needs to remain within U.S. Strategic Command rather than in an operational theater. In examining this thesis, the paper defines the considerations that operational planners must take into account when conducting operations in and through space. It explains the composition and nature of current command organizations and relationships in the execution of space operations. It explores current and near-term space capabilities and its impact on joint space command and control doctrine. Finally, the paper draws conclusions concerning the most effective space command structure and recommends areas for further research and analysis in the continued evolution of joint space doctrine.

DTIC

*Command and Control; Space Missions*

**20070015785** Naval Research Lab., Washington, DC USA

#### **Multiple Quantum Well Retromodulators for Spacecraft-to-Spacecraft Laser Interrogation, Communication, and Navigation**

Jan 2001; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464478; SSC01-VI-6; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper describes a novel concept for laser-based interrogation, communication, and navigation between multiple spacecraft platforms using a gimballed laser source on a pursuer spacecraft and a target board populated with retromodulators (modulating retroreflectors) integrated on a host spacecraft. The combined laser source and retroreflectors can provide centimeter-level relative positioning between each vehicle, as well as spacecraft-to-spacecraft laser communication via semiconductor-based Multiple Quantum Well retromodulators. Additionally, strategies are developed for utilizing the target board retromodulator array to provide relative attitude between each vehicle. In this scenario, each reflector has its own unique modulating code sequence, allowing the returned signals to be discriminated and processed by the pursuer spacecraft to determine the relative orientation. Based on additional attitude sensing capability, three classes of host spacecraft are considered: fully-cooperative, partially-cooperative, and non-cooperative. Numerical simulations using a five-sensor target board demonstrate the potential of the concept, and preliminary test results demonstrate reflector discrimination capability.

DTIC

*Interrogation; Navigation; Optical Communication; Quantum Wells; Space Communication*

**20070015951** Air War Coll., Maxwell AFB, AL USA

**Reusable Launch Vehicles: Rethinking Access to Space (cover title: Reusable Launch Vehicles and Space Operations)**

Ward, Jr, John E; May 2000; 85 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464543; No Copyright; Avail.: CASI: [A05](#), Hardcopy

As a result of technological progress, the USA is now on the verge of developing cost-effective reusable launch vehicles (RLV) for space. This study reviews the strategic implications of the emerging vision within the U.S. Department of Defense for using these vehicles. Although the U.S. Air Force is making the transition to a force that relies increasingly on space, the best path does not necessarily involve replicating the traditional air missions in space. This study of potential missions for RLVs concludes that, while these vehicles are capable of numerous missions (e.g., reconnaissance, global strike, cargo and personnel transport), the most important mission for the immediate future for both the U.S. military and commercial firms is in the area of traditional spacelift. The two broad conclusions that emerge from this study are as follows: (1) the U.S. military should move away from the spacelift business by obtaining spacelift through commercially procured launch services, and (2) the U.S. military should not develop militarized RLVs that are designed to perform traditional air operations in space.

DTIC

*Cost Effectiveness; Defense Program; Launch Vehicles; Launching; Organizations; Reusable Launch Vehicles; Space Commercialization; Space Missions; Space Transportation; Spacecraft Launching*

**20070015963** Aerospace Corp., El Segundo, CA USA

**The Position of Software in the Work Breakdown Structure (WBS) for Space Systems**

Eslinger, S; Dec 20, 2006; 26 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8802-04-C-0001

Report No.(s): AD-A464270; ATR-2006(8550)-3; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464270>

This report addresses the issue of where software should reside in the Work Breakdown Structure (WBS) for a space system. The report describes the various software activities that must be performed for space system development and provides recommendations as to where these activities belong in the standard product-oriented space system WBS structure, with specific focus on the very important cross-product software activities that must be accomplished on complex, software-intensive space systems. The report also recommends a specific organizational structure with responsibility for these cross-product software activities.

DTIC

*Aerospace Systems; Computer Programming; Failure; Product Development; Software Engineering*

**20070016001** Naval War Coll., Newport, RI USA

**Effectively Integrating Counterspace Operations - A Challenge for the Combatant Commander**

Parker, Dewey; Goldizen, Derrill; May 17, 2005; 25 pp.; In English

Report No.(s): AD-A463917; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463917>

Space power enables the modern American way of war. Counterspace operations allow the joint force to exploit space capabilities while negating an adversary's ability to do the same. Combatant Commanders are not yet effectively integrating counterspace operations into operational planning and execution. This failure is primarily due to classification and command



and control issues and an inability of their staffs to maintain pace with recent advances in counterspace capabilities and doctrine. Ineffective integration of offensive and defensive counterspace operations in theater war plans and operations may create combat inefficiencies and vulnerabilities by failing to preserve space superiority as a U.S. asymmetric advantage. Combatant Commanders should 1) advocate the development and implementation of both service and joint counterspace and space control doctrine 2) support and enhance joint space education and training efforts 3) create and formalize a Joint DIRSPACEFOR position 4) direct that counterspace operations integrate directly into their deliberate and crisis action planning processes and 5) direct that the designated space coordinating authority component provide space liaison officers to U. S. Strategic Command and Air Force Space Command, and request liaison officers in return.

DTIC

*Command and Control; Combat*

## 14

### GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also *09 Research and Support Facilities (Air)*.

**20070016578** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Autonomic Computing for Spacecraft Ground Systems**

Li, Zhenping; Savkli, Cetin; Jones, Lori; [2007]; 22 pp.; In English; Space Mission Challenges for Information Technology 2006, 17-20 Jul. 2006, Pasadena, CA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NNG04DA01C; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016578>

Autonomic computing for spacecraft ground systems increases the system reliability and reduces the cost of spacecraft operations and software maintenance. In this paper, we present an autonomic computing solution for spacecraft ground systems at NASA Goddard Space Flight Center (GSFC), which consists of an open standard for a message oriented architecture referred to as the GMSEC architecture (Goddard Mission Services Evolution Center), and an autonomic computing tool, the Criteria Action Table (CAT). This solution has been used in many upgraded ground systems for NASA's missions, and provides a framework for developing solutions with higher autonomic maturity.

Author

*Spacecraft Maintenance; Autonomy; NASA Programs; Computers*

## 15

### LAUNCH VEHICLES AND LAUNCH OPERATIONS

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing and Performance*; and *20 Spacecraft Propulsion and Power*.

**20070015215** Air Command and Staff Coll., Maxwell AFB, AL USA

#### **Using Near Space Vehicles in the Pursuit of Persistent C3ISR**

Knoedler, Andrew J; Jun 2005; 45 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463909; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463909>

US Air Force leaders issued a challenge to create a battlespace of the future that does not want for situational awareness. In this future, the warfighter can access up-to-date information through a network of sensors that are on duty 24/7 around the battlespace. The persistence of command, control, and communication as well as intelligence, surveillance, and reconnaissance (C3ISR) available today does not meet the 24/7 dream. Even the US dominance in the high ground of space could not meet the current appetite. A combination of manned and unmanned C3ISR platforms supported operations in Afghanistan and Iraq but they could not provide round-the-clock information to the commanders and the warfighters. To correct those gaps, the USAF chief of staff and others propose to exploit the relatively unused portion of the vertical dimension: near space. This paper explores how near space vehicles (NSV) traversing altitudes from 20 km (65,000 feet) up to 150 km (lower confines of earth orbit) generate the C3ISR effects future warfighters require. First, the current manned and unmanned platforms are compared for effects, cost, and persistence. Manned platforms include AWACS, JSTARS, and Rivet Joint. Typical unmanned platforms include Predator, Global Hawk, and representative low earth orbit satellites. The second

part of the paper looks at modifying state of the art technologies to reach and operate in the near space region. The paper compares adapted balloon, lighter-than-air craft (airships), and aircraft designs for operation in near space. The comparison continues to the physical architecture to provide persistent C3ISR effects. Constellations for several of the NSV designs are detailed with respect to various communication, electro-optical, radar, and signal gathering payloads. The paper concludes with a final emphasis on the persistence gaps the warfighters face and the potential for Near Space Vehicles to close the gaps to meet the 24/7 appetite of tomorrow's warfighter.

DTIC

*Aerospace Environments; Command and Control*

**20070015239** Ball Aerospace and Technologies Corp., Albuquerque, NM USA

**Modeling Laser Effects on Imaging Spacecraft using the SSM**

Buehler, Patrick; Smith, Joshua; Jan 2006; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463946; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463946>

The Satellite Survivability Module (SSM) is an end-to-end, physics-based, performance prediction model for directed energy engagement of orbiting spacecraft. Two engagement types are currently supported: laser engagement of the focal plane array of an imaging spacecraft and Radio Frequency (RF) engagement of spacecraft components. For laser engagements, the user creates a spacecraft, its optical system, any protection techniques used by the optical system, a laser threat, and an atmosphere through which the laser will pass. For RF engagements, the user creates a spacecraft (as a set of subsystem components), any protection techniques, and an RF source. SSM then models the engagement and its impact on the spacecraft using four impact levels: degradation, saturation, damage, and destruction. Protection techniques, if employed, will mitigate engagement effects. SSM currently supports two laser and three RF protection techniques. SSM allows the user to create and implement a variety of 'what if' scenarios. Satellites can be placed in a variety of orbits. Threats can be placed anywhere on the Earth. Satellites and threats can be mixed and matched to examine possibilities. Protection techniques for a particular spacecraft can be turned on or off individually and can be arranged in any order to simulate more complicated protection schemes. Results can be displayed as 2-D or 3-D visualizations, or as textual reports.

DTIC

*Imaging Techniques; Laser Damage; Lasers; Satellite Imagery*

**20070015293** Northrop Grumman Corp., Albuquerque, NM USA

**Fiber Laser Component Testing for Space Qualification Protocol Development (Postprint)**

Falvey, Suzanne; Buelow, Marisol; Nelson, Burke; Starcher, Yuji; Thienel, Lee; Rhodes, Charley; Drape, Thomas; Westfall, Caleb; Jan 2006; 14 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F29601-01-D-0078

Report No.(s): AD-A464046; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464046>

A test protocol for the space qualifying of Ytterbium (Yb)-doped diode-pumped fiber laser (DPFL) components was developed as a deliverable on the Bright Light program. A literature search was performed and summarized in a conference paper that formed the building blocks for the development of the test protocol. The test protocol was developed from the experience of the Bright Light team, the information in the literature search, and the results of a study of the Telcordia standards. Based on this protocol developed, test procedures and acceptance criteria for a series of vibration, thermal vacuum, and radiation exposure tests were developed for selected components. Northrop Grumman in Albuquerque led the effort in vibration and thermal (no vacuum) testing of these components at the Aerospace Engineering Facility (AEF) on Kirtland Air Force Base (KAFB), NM. The results of these tests have been evaluated. Aerospace Corporation led the effort in destructive physical analysis and radiation testing of these components at their facility in El Segundo, CA. This paper discusses the vibration and thermal testing that was executed to validate the test protocol. The lessons learned will aid in future assessments and definition of space qualification protocols.

DTIC

*Aerospace Environments; Fiber Lasers; Fiber Optics; Project Management; Protocol (Computers); Semiconductor Lasers; Tests*

**20070015742** Air Force Research Lab., Rome, NY USA

**C2 of Space: The Key to Full Spectrum Dominance**

Phister, Paul W; Plonisch, Igor; Jan 1999; 19 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464409; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Air Force Research Laboratory's Information Directorate (AFRL/IF) has a long and distinguished history of providing Command and Control (C2) technologies for the Air Force and the Department of Defense as 'Rome Air Development Center' and 'Rome Laboratory.' As part of the reorganization that created the Air Force Research Laboratory in 1997, AFRL/IF was tasked to provide Information Dominance technologies to the warfighter. These critical aerospace technologies are the cornerstone to moving C2 capabilities into the next millennium. AFRL/IF's vision encompasses a three pronged approach to applying C2 to achieve Full Spectrum Dominance, anytime and anywhere. Conceptually, the three prongs are Global Awareness, Dynamic Planning and Execution, and Global Information Exchange. To achieve the vision, AFRL/IF has formed six Integrated Technology Thrust Programs (ITTPs) that apply C2 principles allowing the future Battle Manager's control of the battlespace. The first five ITTPs come under AFRL's Information Dominance thrust area: Configurable Command Center, Dynamic Command and Control, Consistent Battlespace Picture, Defensive Information Warfare, and Global Grid. The sixth ITTP, Real-time Sensor-to-Shooter, falls under the Precision Strike thrust area. This paper provides a brief background regarding Information Dominance and provides the goals, capabilities, and technologies required for each of the six ITTPs.

DTIC

*Aerospace Engineering; Command and Control; Dominance; Spectra; Warfare*

**20070015848** Naval Research Lab., Washington, DC USA

**Modulating Retroreflector Implementation of MIL-STD 1553 Protocol with Free-Space Optics**

Goetz, Peter G; Rabinovich, W S; Meehan, Timothy J; Katzer, D S; Binari, Steven C; Funk, Eric E; Gilbreath, G C; Mahon, Rita; Swingen, Lee; Rende, John; Jan 2003; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464594; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A modulating retroreflector (MRR) is used for a free-space optics (FSO) implementation of the MILSTD-1553 protocol. A multiple quantum well (MQW) p-i-n structure is used for a single device that acts both as a modulator for transmitting data and as a photodiode for receiving data. A master node and two slave nodes with cat's eye retroreflectors were designed using COTS optics. Two-way communication using the 1553 protocol is demonstrated at a separation of 3 meters, using widely available 980 nm pump lasers. The link was closed using only 15 mW of laser light. We have also demonstrated a coherent receiver to increase sensitivity and quadrature amplitude modulation (QAM) to enhance the data rate of a bandwidth-limited MRR.

DTIC

*Data Transmission; Modulation; Optical Communication; Protocol (Computers); Retroreflectors; Standards*

**20070015856** Naval Research Lab., Washington, DC USA

**Effects of Proton Irradiation on InGaAs/AlGaAs Multiple Quantum Well Modulators (Preprint)**

Goetz, Peter G; Rabinovich, W S; Walters, Robert J; Messenger, Scott R; Gilbreath, G C; Mahon, Rita; Ferraro, M; Ikossi-Anastasiou, Kiki; Katzer, D S; Mar 2001; 8 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464607; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Recently large area multiple quantum well (MQW) optical modulators have been coupled to cornercube optical retro-reflectors to allow free-space optical communications using a lightweight, low-power device. A pointing/tracking system and laser are required only on one end of the link. Such a system is attractive for ground-to-space links or space-to-space communication between a satellite and a microsat. An important question for these potential space-borne systems is the radiation tolerance of the MQW modulator, which is the principle active component. To investigate this subject, we irradiated three 0.5 cm diameter InGaAs/AlGaAs modulators using a sequence of bombardments of 1 MeV protons. One of the devices was irradiated while under a normal operating reverse bias voltage of 15 V; the other devices were unbiased. After each exposure the electronic, optical and modulation characteristics of the modulators were evaluated. No degradation was observed until a cumulative fluence of  $1 \times 10^{14}$  protons/sq cm, equivalent to an ionizing radiation dose of approximately 200 Mrad(Si).

DTIC

*Aluminum Gallium Arsenides; Indium Gallium Arsenides; Modulators; Optical Communication; Proton Irradiation; Quantum Wells; Radiation Tolerance*

**20070015952** Naval Research Lab., Washington, DC USA

**Modulating Retro-Reflectors for Space, Tracking, Acquisition and Ranging using Multiple Quantum Well Technology (Preprint)**

Gilbreath, G C; Creamer, N G; Rabinovich, W S; Meehan, Timothy J; Vilcheck, Michael J; Vasquez, John A; Mahon, Rita; Oh, Eun; Goetz, Peter G; Mozersky, Sharon; Jan 2002; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464592; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper describes a novel concept for optical interrogation, communication, and navigation between spacecraft platforms. The technique uses a gimbaled laser source on a pursuer spacecraft and an array of solid-state, multiple quantum well modulating retroreflectors on a target spacecraft. The sensor system provides high-bandwidth optical communication, centimeter-level relative positioning, and better than arc-minute-level relative attitude of the target platform with minimal sacrifice in target size, weight, and power. To accomplish the relative navigation, each target retroreflector return is modulated with a unique code sequence, allowing for individual discrimination of the detected composite signal at the pursuer location. Experimental results using a dual-platform, multi-degree-of-freedom testbed provide verification and demonstration of the concept, highlighting its potential for applications such as inter-spacecraft rendezvous and capture, long-baseline space interferometry, and formation flying.

DTIC

*Modulation; Optical Communication; Quantum Wells; Ranging; Reflectors; Retroreflectors; Spacecraft Tracking*

**20070015974** Naval Academy, Annapolis, MD USA

**Measuring Latency in Iridium Satellite Constellation Data Services**

McMahon, Margaret M; Rathburn, Robert; Jun 2005; 39 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464192; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The use of Satellite Communications (SATCOM) has become essential to operations in both Afghanistan and Iraq. In particular, the Iridium satellite constellation has demonstrated its usefulness and flexibility. It has had significant impact on how operations are conducted. Iridium provides users both voice and data services. There are two approaches to sending data over the Iridium network: a circuit-switched data service and message-switched data service. Use of the circuit-switched data service requires the overhead of a setup in the same manner as a voice call. There are two message-switched data services: Short Burst Data (SBD) and Short Message Service (SMS). Our testing involves the SBD message-switched data service, which is optimized for high capacity and efficiency when sending small amounts of data through the Iridium network. While there are many users for these services, little information can be found about their actual performance in fielded systems. The best sources of information are specifications or modeling of the performance of these services. We perceived that understanding the underlying network performance was needed, and we established experiments to capture that performance. We present results from both circuit-switched data service and message-switched SBD data service. We also address insights into the use of these services.

DTIC

*Bursts; Communication Networks; Iridium; Messages; Satellite Constellations; Switching*

## 16

### SPACE TRANSPORTATION AND SAFETY

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety; 15 Launch Vehicles and Launch Operations; and 18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

**20070016681** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Expanding the Capabilities of the JPL Electronic Nose for an International Space Station Technology Demonstration**

Ryan, Margaret A.; Shevade, A. V.; Taylor, C. J.; Homer, M. L.; Jewell, A. D.; Kisor, A.; Manatt, K. S.; Yen, S. P. S.; Blanco, M.; Goddard, W. A., III; July 17, 2006; 4 pp.; In English; International Conference on Environmental Systems, Norfolk, Virginia, July 17, 2006, 17 Jul. 2006, Norfolk, VA, USA; Original contains color and black and white illustrations

Report No.(s): 2006-01-2179; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39935>

An array-based sensing system based on polymer/carbon composite conductometric sensors is under development at JPL for use as an environmental monitor in the International Space Station. Sulfur dioxide has been added to the analyte set for this phase of development. Using molecular modeling techniques, the interaction energy between SO<sub>2</sub> and polymer functional

groups has been calculated, and polymers selected as potential SO<sub>2</sub> sensors. Experiment has validated the model and two selected polymers have been shown to be promising materials for SO<sub>2</sub> detection.

Author

*Sulfur Dioxides; Polymers; Air Quality; Spacecraft Cabin Atmospheres; Electronic Filters*

## 17

### SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information see also *04 Aircraft Communications and Navigation*; and *32 Communications and Radar*.

**20070014901** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Single-Frequency GPS Relative Navigation in a High Ionosphere Orbital Environment**

Conrad, Patrick R.; Naasz, Bo J.; [2007]; 12 pp.; In English; 2007 AAS/AIA Space Flight Mechanics Meeting, 28 Jan. - 1 Feb. 2007, Sedona, AZ, USA

Report No.(s): AAS 07-235; Copyright; Avail.: CASI: [A03](#), Hardcopy

The Global Positioning System (GPS) provides a convenient source for space vehicle relative navigation measurements, especially for low Earth orbit formation flying and autonomous rendezvous mission concepts. For single-frequency GPS receivers, ionospheric path delay can be a significant error source if not properly mitigated. In particular, ionospheric effects are known to cause significant radial position error bias and add dramatically to relative state estimation error if the onboard navigation software does not force the use of measurements from common or shared GPS space vehicles. Results from GPS navigation simulations are presented for a pair of space vehicles flying in formation and using GPS pseudorange measurements to perform absolute and relative orbit determination. With careful measurement selection techniques relative state estimation accuracy to less than 20 cm with standard GPS pseudorange processing and less than 10 cm with single-differenced pseudorange processing is shown.

Author

*Global Positioning System; Formation Flying; Low Earth Orbits; Space Navigation; Onboard Equipment; Signal Detection*

**20070016646** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Accurate State Estimation and Tracking of a Non-Cooperative Target Vehicle**

Thienel, Julie K.; VanEpoel, John M.; Sanner, Robert M.; [2006]; 10 pp.; In English; AIAA Guidance, Navigation, and Control Conference, 21-24 Aug. 2006, Keystone, CO, USA; Original contains black and white illustrations; Copyright;

Avail.: CASI: [A02](#), Hardcopy

Autonomous space rendezvous scenarios require knowledge of the target vehicle state in order to safely dock with the chaser vehicle. Ideally, the target vehicle state information is derived from telemetered data, or with the use of known tracking points on the target vehicle. However, if the target vehicle is non-cooperative and does not have the ability to maintain attitude control, or transmit attitude knowledge, the docking becomes more challenging. This work presents a nonlinear approach for estimating the body rates of a non-cooperative target vehicle, and coupling this estimation to a tracking control scheme. The approach is tested with the robotic servicing mission concept for the Hubble Space Telescope (HST). Such a mission would not only require estimates of the HST attitude and rates, but also precision control to achieve the desired rate and maintain the orientation to successfully dock with HST.

Author

*State Estimation; Autonomy; Docking; Attitude Control; Space Rendezvous*

## 18

### SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance*; *39 Structural Mechanics*; and *16 Space Transportation and Safety*.

**20070014902** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Space Flight Qualification on a Multi-Fiber Ribbon Cable and Array Connector Assembly**

Xiaodan, Linda Jin; Ott, Melanie N.; LaRocca, Frank V.; Baker, Ronald M.; Keeler, Bianca E. N.; Friedberg, Patricia R.; Chuska, Richard F.; Malenab, Mary C.; Macmurphy, Shawn L.; [2006]; 10 pp.; In English; SPIE's Optics and Photonics

Symposium, 13-17 Aug. 2006, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

NASA's Goddard Space Flight Center (GSFC) cooperatively with Sandia National Laboratories completed a series of tests on three separate configurations of multi-fiber ribbon cable and MTP connector assemblies. These tests simulate the aging process of components during launch and long-term space environmental exposure. The multi-fiber ribbon cable assembly was constructed of non-outgassing materials, with radiation-hardened, graded index 100/140-micron optical fiber. The results of this characterization presented here include vibration testing, thermal vacuum monitoring, and extended radiation exposure testing data.

Author

*Connectors; Optical Fibers; Vibration; Thermal Radiation; Radiation Dosage; Launching; Qualifications*

**20070016005** Georgia Inst. of Tech., Atlanta, GA, USA

**Conceptual Inquiry of the Space Shuttle and International Space Station GNC Flight Controllers**

Kranzusch, Kara; March 14, 2007; 36 pp.; In English; Georgia Tech AE 8803 Distance Learning Class, 14 Mar. 2007, GA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016005>

The concept of Mission Control was envisioned by Christopher Columbus Kraft in the 1960's. Instructed to figure out how to operate human space flight safely, Kraft envisioned a room of sub-system experts troubleshooting problems and supporting nominal flight activities under the guidance of one Flight Director who is responsible for the success of the mission. To facilitate clear communication, MCC communicates with the crew through a Capsule Communicator (CAPCOM) who is an astronaut themselves. Gemini 4 was the first mission to be supported by such a MCC and successfully completed the first American EVA. The MCC seen on television is called the Flight Control Room (FCR, pronounced ficker) or otherwise known as the front room. While this room is the most visible aspect, it is a very small component of the entire control center. The Shuttle FCR is known as the White FCR (WFCR) and Station's as FCR-1. (FCR-1 was actually the first FCR built at JSC which was used through the Gemini, Apollo and Shuttle programs until the WFCR was completed in 1992. Afterwards FCR-1 was refurbished first for the Life Sciences Center and then for the ISS in 2006.) Along with supporting the Flight Director, each FCR operator is also the supervisor for usually two or three support personnel in a back room called the Multi-Purpose Support Room (MPSR, pronounced mipser). MPSR operators are more deeply focused on their specific subsystems and have the responsible to analyze patterns, and diagnose and assess consequences of faults. The White MPSR (WMPSR) operators are always present for Shuttle operations; however, ISS FCR controllers only have support from their Blue MPSR (BMPSR) while the Shuttle is docked and during critical operations. Since ISS operates 24-7, the FCR team reduces to a much smaller Gemini team of 4-5 operators for night and weekend shifts when the crew is off-duty. The FCR is also supported by the Mission Evaluation Room (MER) which is a collection of contractor engineers who provide analysis and long-term troubleshooting support. Each MER operator is an expert in a very small portion of a sub-system and each FCR console usually interfaces with several MER positions.

Derived from text

*International Space Station; Space Shuttles; Spacecraft Guidance; Navigation; Flight Control; Avionics*

**20070016023** NASA Langley Research Center, Hampton, VA, USA

**Terahertz NDE Application for Corrosion Detection and Evaluation under Shuttle Tiles**

Anastasi, Robert F.; Madaras, Eric I.; Seebo, Jeffrey P.; Smith, Stephen W.; Lomness, Janice K.; Hintze, Paul E.; Kammerer, Catherine C.; Winfree, William P.; Russell, Richard W.; [2007]; 6 pp.; In English; SPIE 14th Annual International Symposium on Smart Structures and Materials and Nondestructive Evaluation and Health Monitoring, 18-22 Mar. 2007, San Diego, CA, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 377813.06.03.03.05; Copyright; Avail.: CASI: [A02](#), Hardcopy

Pulsed Terahertz NDE is being examined as a method to inspect for possible corrosion under Space Shuttle Tiles. Other methods such as ultrasonics, infrared, eddy current and microwave technologies have demonstrable shortcomings for tile NDE. This work applies Terahertz NDE, in the frequency range between 50 GHz and 1 THz, for the inspection of manufactured corrosion samples. The samples consist of induced corrosion spots that range in diameter (2.54 to 15.2 mm) and depth (0.036 to 0.787 mm) in an aluminum substrate material covered with tiles. Results of these measurements are presented for known corrosion flaws both covered and uncovered and for blind tests with unknown corrosion flaws covered with attached tiles. The Terahertz NDE system is shown to detect all artificially manufactured corrosion regions under a Shuttle tile with a depth greater than 0.13 mm.

Author

*Space Shuttles; Inspection; Corrosion; Nondestructive Tests; Tiles; Defects*

**20070016609** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A Novel Attitude Determination Algorithm for Spinning Spacecraft**

Bar-Itzhack, Itzhack Y.; Harman, Richard R.; [2007]; 19 pp.; In English; Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper presents a single frame algorithm for the spin-axis orientation-determination of spinning spacecraft that encounters no ambiguity problems, as well as a simple Kalman filter for continuously estimating the full attitude of a spinning spacecraft. The later algorithm is comprised of two low order decoupled Kalman filters; one estimates the spin axis orientation, and the other estimates the spin rate and the spin (phase) angle. The filters are ambiguity free and do not rely on the spacecraft dynamics. They were successfully tested using data obtained from one of the ST5 satellites.

Author

*Algorithms; Attitude (Inclination); Spin; Satellite Orientation*

**20070016616** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Space Flight Requirements for Fiber Optic Components; Qualification Testing and Lessons Learned**

Ott, Melanie N.; Jin, Xiaodan Linda; Chuska, Richard; Friedberg, Patricia; Malenab, Mary; Matuszeski, Adam; [2007]; 15 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

'Qualification' of fiber optic components holds a very different meaning than it did ten years ago. In the past, qualification meant extensive prolonged testing and screening that led to a programmatic method of reliability assurance. For space flight programs today, the combination of using higher performance commercial technology, with shorter development schedules and tighter mission budgets makes long term testing and reliability characterization unfeasible. In many cases space flight missions will be using technology within years of its development and an example of this is fiber laser technology. Although the technology itself is not a new product the components that comprise a fiber laser system change frequently as processes and packaging changes occur. Once a process or the materials for manufacturing a component change, even the data that existed on its predecessor can no longer provide assurance on the newer version. In order to assure reliability during a space flight mission, the component engineer must understand the requirements of the space flight environment as well as the physics of failure of the components themselves. This can be incorporated into an efficient and effective testing plan that 'qualifies' a component to specific criteria defined by the program given the mission requirements and the component limitations. This requires interaction at the very initial stages of design between the system design engineer, mechanical engineer, subsystem engineer and the component hardware engineer. Although this is the desired interaction what typically occurs is that the subsystem engineer asks the components or development engineers to meet difficult requirements without knowledge of the current industry situation or the lack of qualification data. This is then passed on to the vendor who can provide little help with such a harsh set of requirements due to high cost of testing for space flight environments. This presentation is designed to guide the engineers of design, development and components, and vendors of commercial components with how to make an efficient and effective qualification test plan with some basic generic information about many space flight requirements. Issues related to the ~ physics of failure, acceptance criteria and lessons learned will also be discussed to assist with understanding how to approach a space flight mission in an ever changing commercial photonics industry.

Author

*Fiber Optics; Performance Tests; Fiber Lasers; Photonics; Aerospace Environments; Systems Engineering; Reliability; Qualifications*

**20070016625** NASA Langley Research Center, Hampton, VA, USA

**Mars Science Laboratory Entry Capsule Aerothermodynamics and Thermal Protection System**

Edquist, Karl T.; Hollis, Brian R.; Dyakonov, Artem A.; Laub, Bernard; Wright, Michael J.; Rivellini, Tomasso P.; Slimko, Eric M.; Willcockson, William H.; March 2007; 13 pp.; In English; 2007 IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 857464.02.07.07

Report No.(s): IEEAC Paper 1423; Copyright; Avail.: CASI: [A03](#), Hardcopy

The Mars Science Laboratory (MSL) spacecraft is being designed to carry a large rover (greater than 800 kg) to the surface of Mars using a blunt-body entry capsule as the primary decelerator. The spacecraft is being designed for launch in 2009 and arrival at Mars in 2010. The combination of large mass and diameter with non-zero angle-of-attack for MSL will result in unprecedented convective heating environments caused by turbulence prior to peak heating. Navier-Stokes computations predict a large turbulent heating augmentation for which there are no supporting flight data and little ground data for validation. Consequently, an extensive experimental program has been established specifically for MSL to understand the level of turbulent augmentation expected in flight. The experimental data support the prediction of turbulent transition and have also uncovered phenomena that cannot be replicated with available computational methods. The result is that the flight

aeroheating environments predictions must include larger uncertainties than are typically used for a Mars entry capsule. Finally, the thermal protection system (TPS) being used for MSL has not been flown at the heat flux, pressure, and shear stress combinations expected in flight, so a test program has been established to obtain conditions relevant to flight. This paper summarizes the aerothermodynamic definition analysis and TPS development, focusing on the challenges that are unique to MSL.

Author

*Aerothermodynamics; Mars Surface; Thermal Protection; Space Capsules; Spacecraft Design; Atmospheric Entry*

**20070016634** NASA Johnson Space Center, Houston, TX, USA

**Human Factors in the Design of the Crew Exploration Vehicle (CEV)**

Whitmore, Mihriban; Byrne, Vicky; Holden, Kritina; May 4, 2007; 1 pp.; In English; Human Factors and Ergonomics Society Meeting, 4 May 2007, Houston, TX, USA; Copyright; Avail.: Other Sources; Abstract Only

NASA's Space Exploration vision for humans to venture to the moon and beyond provides interesting human factors opportunities and challenges. The Human Engineering group at NASA has been involved in the initial phases of development of the Crew Exploration Vehicle (CEV), Orion. Getting involved at the ground level, Human Factors engineers are beginning to influence design; this involvement is expected to continue throughout the development lifecycle. The information presented here describes what has been done to date, what is currently going on, and what is expected in the future. During Phase 1, prior to the contract award to Lockheed Martin, the Human Engineering group was involved in generating requirements, conducting preliminary task analyses based on interviews with subject matter experts in all vehicle systems areas, and developing preliminary concepts of operations based on the task analysis results. In addition, some early evaluations to look at CEV net habitable volume were also conducted. The program is currently in Phase 2, which is broken down into design cycles, including System Readiness Review, Preliminary Design Review, and Critical Design Review. Currently, there are ongoing Human Engineering Technical Interchange Meetings being held with both NASA and Lockheed Martin in order to establish processes, desired products, and schedules. Multiple design trades and quick-look evaluations (e.g. display device layout and external window size) are also in progress. Future Human Engineering activities include requirement verification assessments and crew/stakeholder evaluations of increasing fidelity. During actual flights of the CEV, the Human Engineering group is expected to be involved in in-situ testing and lessons learned reporting, in order to benefit human space flight beyond the initial CEV program.

Author

*Design Analysis; Human Factors Engineering; Habitability; Space Exploration; Display Devices*

**20070016679** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Quantification of Spore-forming Bacteria Carried by Dust Particles**

Lin, Ying; Cholakian, Tanya; Gao, Wenming; Osman, Shariff; Barengoltz, Jack; July 16, 2006; 16 pp.; In English; COSPAR Scientific Assembly, 16-23 Jul. 2006, Beijing, China; Original contains color and black and white illustrations

Contract(s)/Grant(s): NRA-03-OSS-01; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39937>

In order to establish a biological contamination transport model for predicting the cross contamination risk during spacecraft assembly and upon landing on Mars, it is important to understand the relationship between spore-forming bacteria and their carrier particles. We conducted air and surface sampling in indoor, outdoor, and cleanroom environments to determine the ratio of spore forming bacteria to their dust particle carriers of different sizes. The number of spore forming bacteria was determined from various size groups of particles in a given environment. Our data also confirms the existence of multiple spores on a single particle and spore clumps. This study will help in developing a better bio-contamination transport model, which in turn will help in determining forward contamination risks for future missions.

Author

*Spacecraft Contamination; Spores; Mars Landing; Bacteria; Air Sampling*



**SPACECRAFT PROPULSION AND POWER**

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, *15 Launch Vehicles and Launch Operations*, and *44 Energy Production and Conversion*.

**20070014951** National Renewable Energy Lab., Golden, CO USA, Battelle Columbus Labs., Arlington, VA, USA  
**New York City Transit (NYCT) Hybrid (125 Order) and CNG Transit Buses. Final Evaluation Results**  
 Barnitt, R.; Chandler, K.; Nov. 2006; 62 pp.; In English

Report No.(s): DE2006-894985; NREL/TP-540-40125; No Copyright; Avail.: Department of Energy Information Bridge

This report describes the evaluation results for new Orion VII buses at NYCT with CNG propulsion and new hybrid propulsion.

NTIS

*Compressed Gas; Electric Motor Vehicles; Natural Gas; New York City (NY); Propulsion System Configurations; Propulsion System Performance; Hybrid Propulsion*

**20070016582** NASA White Sands Test Facility, NM, USA

**Guide for Oxygen Compatibility Assessments on Oxygen Components and Systems**

Rosales, Keisa R.; Shoffstall, Michael S.; Stoltzfus, Joel M.; March 2007; 23 pp.; In English; Original contains black and white illustrations

Report No.(s): NASA/TM-2007-213740; S-998; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016582>

Understanding and preventing fire hazards is necessary when designing, maintaining, and operating oxygen systems. Ignition risks can be minimized by controlling heat sources and using materials that will not ignite or will not support burning in the end-use environment. Because certain materials are more susceptible to ignition in oxygen-enriched environments, a compatibility assessment should be performed before the component is introduced into an oxygen system. This document provides an overview of oxygen fire hazards and procedures that are consistent with the latest versions of American Society for Testing and Materials (ASTM) Standards G63 (1999) and G94 (2005) to address fire hazards associated with oxygen systems. This document supersedes the previous edition, NASA Technical Memorandum 104823, Guide for Oxygen Hazards Analyses on Components and Systems (1996). The step-by-step oxygen compatibility assessment method described herein (see Section 4) enables oxygen-system designers, system engineers, and facility managers to determine areas of concern with respect to oxygen compatibility and, ultimately, prevent damage to a system or injury to personnel.

Author

*Compatibility; Fires; Hazards; Oxygen; Oxygen Supply Equipment; Systems Engineering*

**CHEMISTRY AND MATERIALS (GENERAL)**

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 25 through 29*. For astrochemistry see category *90 Astrophysics*.

**20070014802** Brookhaven National Lab., Upton, NY USA

**Role of Dielectric Continuum Models in Electron Transfer: Theoretical and Computational Aspects**

Newton, M. D.; Nov. 2006; 23 pp.; In English

Report No.(s): DE2006-896730; BNL-77280-2006-BC; No Copyright; Avail.: Department of Energy Information Bridge

Condensed phase physical and chemical processes generally involve interactions covering a wide range of distance scales, from short-range molecular interactions requiring orbital overlap to long-range coulombic interaction between local sites of excess charge (positive or negative monopoles). Intermediate-range distances pertain to higher-order multipolar as well as inductive and dispersion interactions. Efforts to model such condensed phase phenomena typically involve a multi-tiered strategy in which quantum mechanics is employed for full electronic structural characterization of a site of primary interest (e.g., a molecular solute or cluster), while more remote sites are treated at various classical limits (e.g., a molecular force field for discrete solvent molecules or a dielectric continuum (DC) model, if the solute is charged or has permanent multipole moments). In particular, DC models have been immensely valuable in modeling chemical reactivity and spectroscopy in media

of variable polarity. Simple DC models account qualitatively for many important trends in the solvent dependence of reaction free energies, activation free energies, and optical excitation energies, and many results of semiquantitative or fully quantitative significance in comparison with experiment have been obtained, especially when detailed quantum chemical treatment of the solute is combined self consistently with DC treatment of the solvent (e.g., as in the currently popular PCM (polarized continuum model) approaches).

NTIS

*Continuum Modeling; Dielectrics; Electron Transfer*

**20070014833** Battelle Columbus Labs., OH USA

**Arsenic Removal from Drinking Water by Iron Removal U.S. EPA Demonstration Project at Climax, MN. Final Performance Evaluation Report**

Condit, W. E.; Chen, A. S. C.; Dec. 2006; 91 pp.; In English

Report No.(s): PB2007-107822; EPA/600/R-06/152; No Copyright; Avail.: National Technical Information Service (NTIS)

This report documents the activities performed and the results obtained for the arsenic removal treatment technology demonstration project at the Climax, Minnesota, site. The objectives of the project were to evaluate: (1) the effectiveness of Kinetico Macrolite pressure filtration process in removing arsenic to meet the new arsenic maximum contaminant level (MCL) of 10 mg/L; (2) the reliability of the treatment system; (3) the required system operation and maintenance (O&M) and operators skills; and 4) the capital and O&M costs of the technology. The project also characterized water in the distribution system and process residuals produced by the treatment system. The Macrolite FM-236-AS arsenic removal system consisted of two 42-in-diameter by 72-in-tall contact tanks (345 gal), and two 36-in-diameter by 72-in-tall filtration vessels (264 gal), each containing 14 ft<sup>3</sup> of Macrolite media. The system also included two chemical addition assemblies, one each for prechlorination and supplemental iron addition. Prechlorination was used to oxidize As(III) to As(V) and form As(V)-laden iron solids prior to the Macrolite pressure filtration. The design flowrate was 140 gal/min (gpm), which yielded 5 min of contact time prior to pressure filtration and 10 gpm/ft<sup>2</sup> of hydraulic loading rate to the filters. From August 11, 2004, through August 12, 2005, the system operated for a total of 2,086 hr at approximately 5.6 hr/day. Based on the totalizer to treatment readings, the system treated approximately 13,829,000 gal of water with an average daily water demand of 38,560 gal during this time period. The system operated in the service mode within the flow and pressure specifications. Operational issues related to the automated backwash process led to a number of backwash failures, but were later resolved. Total arsenic concentrations in source water ranged from 31.2 to 51.4 mg/L with As(III) being the predominating species at an average concentration of 35.8 mg/L. Iron in raw water existed primarily in the soluble form with an average value of 485 mg/L. This amount of soluble iron corresponded to an iron:arsenic ratio of 13:1 given the average soluble iron and soluble arsenic levels in raw water. From August 11, 2004, to January 3, 2005, total arsenic levels in the treated water averaged 14.1 mg/L, indicating the need for supplemental iron addition to improve arsenic removal. Supplemental iron addition using ferric chloride was initiated on January 3, 2005, with an average iron dosage of approximately 0.85 mg/L (as Fe). Total arsenic levels in the treated water were reduced to 6.0 to 9.3 mg/L with no exceedances of arsenic above the 10-mg/L MCL. A slight increase in particulate iron was observed in the Macrolite filter effluent with concentrations increasing from 25 to 36.8 mg/L before iron addition to less than 25 to 104 mg/L after iron addition. However, filtration of arsenic-laden particles at a hydraulic loading rate of up to 10.7 gpm/ft<sup>2</sup> (compared to 2 gpm/ft<sup>2</sup> for conventional gravity filters) and a median filter run time of 11 hr did not appear to have caused significant penetration of particles through the Macrolite filters. The filters were set for backwash at 20 lb/in<sup>2</sup> increase in differential pressure across the filters, 24 hr of run time, or 48 hr of standby time.

NTIS

*Arsenic; Evaluation; Iron; Performance Tests; Potable Water; Water Pollution*

**20070014836** Lawrence Livermore National Lab., Livermore, CA USA

**Thermodynamic Analysis Of Pure And Impurity Doped Pentaerythritol Tetranitrate Crystals Grown At Room Temperature**

Pithimani, R.; Zheng, A.; Simon, S.; Weeks, L. H.; Burnham, A. K.; Jun. 02, 2006; 8 pp.; In English

Report No.(s): DE2006-896296; UCRL-CONF-221788; No Copyright; Avail.: National Technical Information Service (NTIS)

Pentaerythritol tetranitrate (PETN) powders are used to initiate other explosives. During long-term storage, changes in powder properties can cause changes in the initiation performance. Changes in the morphology and surface area of aging powders are observed due to sublimation and growth of PETN crystals through coarsening mechanisms, (e.g. Ostwald ripening, sintering, etc.). In order to alleviate the sublimation of PETN crystals under service conditions, stabilization methods such as thermal cycling and doping with certain impurities during or after the crystallization of PETN have been proposed.

In this report we present our work on the effect of impurities on the morphology and activation energy of the PETN crystals. The pure and impurity doped crystals of PETN were grown from supersaturated acetone solution by solvent evaporation technique at room temperature. The difference in the morphology of the impurity-doped PETN crystal compared to pure crystal was examined by optical microscopy. The changes in the activation energies and the evaporation rates are determined by thermogravimetric (TGA) analyses. Our activation energies of evaporation agree with earlier reported enthalpies of vaporization. The morphology and activation energy of PETN crystals doped with Ca, Na, and Fe cations are similar to that for pure PETN crystal, whereas the Zn-ion-doped PETN crystals have different morphology and decreased activation energy.

NTIS

*Crystal Growth; Crystals; Doped Crystals; Impurities; PETN; Room Temperature; Thermodynamics*

**20070014883** Sandia National Labs., Albuquerque, NM USA

**Universal Bioprocessor LDRD Final Report**

Simmons, B. A.; Cummings, E. B.; Davalos, R. V.; Reichmuth, D.; Krafcik, K. L.; Nov. 01, 2006; 23 pp.; In English

Contract(s)/Grant(s): DE-AC04-94-AL85000

Report No.(s): DE2006-895984; SAND2006-6704; No Copyright; Avail.: National Technical Information Service (NTIS)

Microsystems pose unparalleled opportunity in the realm of real-time sample analysis for multiple applications, including Homeland Security monitoring devices, environmental monitoring, and biomedical diagnostics. The need for a universal means of processing, separating, and delivering a sample within these devices is a critical need if these systems are to receive widespread implementation in the industry and government sectors. Efficient particle separation and enrichment techniques are critical for a range of analytical functions including pathogen detection, sample preparation, high-throughput particle sorting, and biomedical diagnostics. Previously, using insulator-based dielectrophoresis (iDEP) in microfluidic glass devices, we demonstrated simultaneous particle separation and concentration. As an alternative to glass, we evaluate the performance of similar iDEP structures produced in polymer-based microdevices and their enhancement through dynamic surface coatings. There are numerous processing and operational advantages that motivate our transition to polymers such as the availability of numerous innate chemical compositions for tailoring performance, mechanical robustness, economy of scale, and ease of thermoforming and mass manufacturing. The polymer chips we have evaluated are fabricated through an injection molding process of the commercially available cyclic olefin copolymer Zeonor(reg-sign). We demonstrate that the polymer devices achieve the same performance metrics as glass devices.

NTIS

*Bioprocessing; Chemical Composition; Environmental Monitoring; Microfluidic Devices; Trapping*

**20070014917** Kentucky Univ., Lexington, KY, USA, Oak Ridge National Lab., TN USA

**Development of Advanced Surface Enhancement Technology for Decreasing Wear Corrosion of Equipment Used for Mineral Processing. Annual Technical Progress Report for July 21, 2005 to July 21, 2006**

Tao, D.; Blue, C. A.; Oct. 2006; 33 pp.; In English

Contract(s)/Grant(s): DE-FC26-03NT41787

Report No.(s): DE2006-895861; No Copyright; Avail.: National Technical Information Service (NTIS)

Equipment wear is a major concern in the mineral processing industry, which dramatically increases the maintenance cost and adversely affects plant operation efficiency. In this research, novel surface treatment technologies, High Density Infrared (HDI) and Laser Surface Engineering (LSE) surface coating processes were developed for the surface enhancement of selected mineral processing equipment. Microstructural and mechanical properties of the coated specimens were characterized. Laboratory-simulated wear tests were conducted to evaluate the tribological performance of the coated components. Test results indicate that the wear resistance of ASTM A36 (raw coal screen section) and can be significantly increased by applying HDI and LSE coating processes. Field testing has been performed using a LSE-treated screen panel and it showed a 2 times improvement of the service life.

NTIS

*Augmentation; Corrosion Resistance; Industries; Minerals; Wear Resistance; Surface Finishing*

**20070014946** Brookhaven National Lab., Upton, NY USA

**Molecular Mechanism of Uranium Reduction by Clostridia and its Manipulation**

Francis, A. J.; Gao, W.; Chidambaram, D.; Dodge, D. J.; Jun. 01, 2006; 5 pp.; In English

Report No.(s): DE2006-896246; ERSD-1026860-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

This research addresses the need for detailed studies of the enzymatic mechanisms for reduction of radionuclides and/or metals by fermentative microorganisms. The overall objective of this research is to elucidate systematically the molecular mechanisms involved in the reduction of uranium by Clostridia. We propose to (1) determine the role of hydrogenases in uranium reduction, (2) purify the enzymes involved in uranium reduction, (3) determine the mechanisms of reduction, e.g., one or two electron transfer reactions, and (4) elucidate the genetic control of the enzymes and cellular factors involved in uranium reduction. This is a collaborative study between BNL and Stanford University involving expertise in biomolecular science, biochemistry, microbiology, and electrochemistry.

NTIS

*Uranium; Microorganisms; Enzyme Activity; Radioactive Isotopes; Fermentation; Bioprocessing*

**20070015045** Sandia National Labs., Albuquerque, NM USA

**FWP Executive Summaries: Basic Energy Sciences Materials Sciences and Engineering Program (SNL/NM)**

Simmons, J. A.; Samara, G. A.; Jul. 2006; 96 pp.; In English

Report No.(s): DE2006-889948; SAND2006-4637; No Copyright; Avail.: National Technical Information Service (NTIS)

This report presents an Executive Summary of the various elements of the Materials Sciences and Engineering Program which is funded by the Division of Materials Sciences and Engineering, Office of Basic Energy Sciences, U.S. Department of Energy at Sandia National Laboratories, New Mexico. A general programmatic overview is also presented.

NTIS

*Ceramics; Electrical Engineering*

**20070015048** Lawrence Livermore National Lab., Livermore, CA USA

**Operation of the Oxide Washer for Water-Washing Solubles Out of Impure Pu Oxide**

Dodson, K. E.; Close, O. L.; Kirkorian, O. H.; Summers, H. V.; Jan. 30, 2006; 19 pp.; In English

Report No.(s): DE2006-889992; UCRL-TR-220688; No Copyright; Avail.: Department of Energy Information Bridge

An evaluation has been made for using the Oxide Washer to wash water-soluble materials out of impure Pu oxide. It is found that multiple washes are needed to reduce the water-soluble materials to very low levels in the impure Pu oxides. The removal of the wash water from the Oxide Washer is accompanied by particulates of the impure Pu oxide, which subsequently need to be filtered out. In spite of the additional filtration needed, the overall level of manpower required for processing is still only about one third of that for an all-manual operation.

NTIS

*Filtration; Oxides; Washing; Water*

**20070015050** Lawrence Livermore National Lab., Livermore, CA USA

**Efficacy and Design of Low-Cost Personal Decontamination System (LPDS) Formulations for Sulfur Mustard and Assorted TICs**

Smith, W. J.; Love, A. H.; Koester, C. J.; Purdon, J. G.; ODell, P.; Dec. 07, 2005; 19 pp.; In English

Report No.(s): DE2006-889997; UCRL-CONF-217576; No Copyright; Avail.: National Technical Information Service (NTIS)

No abstract available

*Decontamination; Low Cost; Sulfur*

**20070015056** Maryland Univ., College Park, MD, USA

**It's Elemental: Enhancing Career Success for Women in the Chemical Industry**

January 2007; 68 pp.; In English

Report No.(s): PB2007-107414; No Copyright; Avail.: CASI: [A04](#), Hardcopy

This report, Its Elemental: Enhancing Career Success for Women in the Chemical Industry represents another important goal of Project ENHANCE to share the results of this research effort with women and leaders in industrial chemistry. The project goal of identifying factors that facilitate or hinder the career success of women scientists and engineers working in industry is helpful only to the extent that these data will be utilized effectively in enhancing womens success in industrial workplaces. To this end, the National Science Foundation generously funded the creation and dissemination of Its Elemental.

NTIS

*Chemical Engineering; Females; Industries; Occupation*

**20070015059** National Science Foundation, Washington, DC USA

**NSF (National Science Foundation) Division of Chemistry: Plan for Broadening Participation in Chemistry, Adopted November 29, 2006**

Clarke, M.; Rohlfing, C.; Sisk, W.; Pibel, C.; Oct. 16, 2006; 17 pp.; In English

Report No.(s): PB2007-107425; No Copyright; Avail.: National Technical Information Service (NTIS)

During FY07 the Division of Chemistry (CHE) will undertake the following strategies and activities to broaden participation in chemistry: Hold a follow-up meeting to Gender Equity Workshop in FY07, at the April 2007 Council of Chemical Research Meeting. Sponsor a workshop on Under-Represented Minorities (URM) in FY07 to be modeled after the Gender Equity Workshop. Deliver presentations beginning in FY07 to CHE panels on bias in evaluations. Require a departmental plan for broadening participation in chemistry in the CRIF:MU (Chemistry Research Instrumentation and Facilities Multiuser) competition beginning in FY08. Monitor CHE principal investigator (PI) demographics and engage in mentoring and other forms of outreach. Update progress and include diversity efforts in annual Division report.

NTIS

*Demography; Occupation; Chemistry*

**20070015064** Argonne National Lab., IL USA, Pennsylvania State Univ., University Park, PA, USA, Wisconsin Univ., Madison, WI, USA

**Reaction-Based Reactive Transport Modeling of Fe(III)**

Kemner, K. M.; Kelly, S. D.; Burgos, B.; Roden, E.; Jun. 01, 2006; 4 pp.; In English

Report No.(s): DE2006-896240; ERSD-1024848-2006; No Copyright; Avail.: Department of Energy Information Bridge

This research project (started Fall 2004) was funded by a grant to Argonne National Laboratory, The Pennsylvania State University, and The University of Alabama in the Integrative Studies Element of the NABIR Program (DE-FG04-ER63914/63915/63196). Dr. Eric Roden, formerly at The University of Alabama, is now at the University of Wisconsin, Madison. Our project focuses on the development of a mechanistic understanding and quantitative models of coupled Fe(III)/U(VI) reduction in FRC Area 2 sediments. This work builds on our previous studies of microbial Fe(III) and U(VI) reduction, and is directly aligned with the Scheibe et al. NABIR FRC Field Project at Area 2.

NTIS

*Reactivity; Project Management; Microorganisms*

**20070015066** Hi-Z Technology, Inc., La Jolla, CA, USA

**Quantum Well Thermoelectrics for Converting Waste Heat to Electricity. Quarterly Technical Progress Report. Reporting Period 7-1-2006 through 9-30-2006**

Ghamaty, S.; Sep. 30, 2006; 13 pp.; In English

Contract(s)/Grant(s): DE-FC26-03NT41974

Report No.(s): DE2006-896129; No Copyright; Avail.: National Technical Information Service (NTIS)

New thermoelectric materials using Quantum Well (QW) technology are expected to increase the energy conversion efficiency to more than 25% from the present 5%, which will allow for the low cost conversion of waste heat into electricity. Hi-Z Technology, Inc. has been developing QW technology over the past six years. It will use Caterpillar, Inc., a leader in the manufacture of large scale industrial equipment, for verification and life testing of the QW films and modules. Other members of the team are Pacific Northwest National Laboratory, who will sputter large area QW films. The Scope of Work is to develop QW materials from their present proof-of-principle technology status to a pre-production level over a proposed three year period. This work will entail fabricating the QW films through a sputtering process of 50 micron thick multi layered films and depositing them on 12 inch diameter, 5 micron thick Si substrates. The goal in this project is to produce the technology for fabricating a basic 10-20 watt module that can be used to build up any size generator such as: a 5-10 kW Auxiliary Power Unit (APU), a multi kW Waste Heat Recovery Generator (WHRG) for a class 8 truck or as small as a 10-20 watt unit that would fit on a daily used wood fired stove and allow some of the estimated 2-3 billion people on earth, who have no electricity, to recharge batteries (such as a cell phone) or directly power radios, TVs, computers and other low powered devices. In this quarter Hi-Z has continued fabrication of the QW films and also continued development of joining techniques for fabricating the N and P legs into a couple.

NTIS

*Electricity; Quantum Wells; Sputtering; Thermoelectric Materials; Waste Energy Utilization; Waste Heat*

**20070015090** Argonne National Lab., IL USA, Oak Ridge National Lab., TN USA, Pacific Northwest National Lab., Richland, WA, USA

**Aqueous Complexation Reactions Governing the Rate and Extent of Biogeochemical U(VI) Reduction**

Kemner, K. M.; Kelly, S. D.; Brooks, S. C.; Dong, W.; Carroll, S.; Jun. 01, 2006; 4 pp.; In English

Report No.(s): DE2006-896239; ERSD-1024827-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

The proposed research will elucidate the principal biogeochemical reactions that govern the concentration, chemical speciation, and reactivity of the redox-sensitive contaminant uranium. The results will provide an improved understanding and predictive capability of the mechanisms that govern the biogeochemical reduction of uranium in subsurface environments.

NTIS

*Biogeochemistry; Chemical Reactions; Oxidation-Reduction Reactions; Prediction Analysis Techniques*

**20070015096** Fracture Technology Associates, Bethlehem, PA, USA

**Fracture Mechanics Characterization of Aluminum Alloys for Marine Structural Applications**

Jan. 2007; 372 pp.; In English

Report No.(s): PB2007-107000; SSC-448; No Copyright; Avail.: National Technical Information Service (NTIS)

The properties of fatigue crack growth resistance and fracture toughness are required to analyze structural integrity and damage tolerances of aluminum structures. Historically, fatigue crack growth data has usually been altered by external forces and often the results did not accurately represent the true behavior of the material. A new methodology with successful results has been developed to account for these effects and it has been used in this report. Three aluminum alloys used in marine structural applications: 5083-H321, 5086-H116, and 5383-H116 were investigated. Tests were conducted in air as well as simulated salt water environment at three different frequencies. This report complements the work completed in SSC-410, 'Fatigue of Aluminum Structural Weldments.

NTIS

*Aluminum Alloys; Fracture Mechanics; Marine Technology; Structural Design*

**20070015123** Stanford Univ., Stanford, CA USA

**Laser Diagnostics for Reacting Flows**

Hanson, Ronald K; Jan 30, 2007; 72 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9550-04-1-0009; Proj-2308

Report No.(s): AD-A463601; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463601>

Advanced optical diagnostic techniques relevant to propulsion were investigated. The techniques studied were based on laser spectroscopy, with emphasis on spectrally-resolved absorption and laser-induced fluorescence (LIF). Laser sources included tunable cw near-infrared diode lasers and tunable (or fixed-wavelength) pulsed lasers operated at ultraviolet (UV) or infrared (IR) wavelengths. The cw lasers were spectrally narrow, allowing study of innovative diagnostics based on spectral lineshapes, while the pulsed lasers provided intense bursts of photons needed for techniques based on LIF. Accomplishments of note included: (1) development of a new imaging diagnostic based on infrared planar laser-induced fluorescence (IR PLIF), (2) investigations of quantitative ultraviolet (UV) PLIF of NO and CO<sub>2</sub> in high-pressure combustion environments, (3) the development of a new temperature diagnostic using UV absorption of CO<sub>2</sub> for high-temperature combustion environments, (4) development of advanced wavelength-multiplexed diode laser absorption sensing of non-uniform temperature distributions, gas temperature in scramjet flows, and tunable mid-IR-based fuel sensing, and (5) further development of quantitative tracers to image fuel distribution using ketones and the aromatic toluene. The full spectrum of results was published in thirty-eight papers in the AIAA and peer reviewed literature, seven PhD theses, and forty-three presentations and invited lectures.

DTIC

*Absorption; Diagnosis; Laser Induced Fluorescence; Lasers; Reacting Flow*

**20070015162** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Surface Discharges for High-Speed Boundary Layer Control (Postprint)**

Kimmel, Roger L; Hayes, James R; Crafton, Jim W; Fonov, Sergey D; Menart, James; Shang, Joseph; Jan 2006; 11 pp.; In English

Contract(s)/Grant(s): Proj-A03U

Report No.(s): AD-A463793; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463793>

Surface plasma discharges have been shown to be effective in altering laminar boundary layers, Judicious choice of electrode shape can create a discharge that emulates a wedge or a bump, The 'virtual wedge' discharge has been shown to create a local pressure rise with potential applications to vehicle control. The 'virtual bump' creates a lesser pressure rise, but strong distortion of the boundary layer. In the current work the effect of the bump discharge on laminar shock boundary layer interactions is explored. Laminar shock boundary layer interactions are created with an impinging shock on a flat plate at a freestream Mach number of 5. The primary instrumentation is a low-modulus elastomer doped with a pressure-sensitive dye, Intensity distributions from the dye are imaged to interrogate the surface pressure. Displacement of surface markers provides surface shear information. Results show the presence of Gortler vortices in the reattaching shear flow. The Gortler vortices are also evident in temperature-sensitive paint images.

DTIC

*Boundary Layer Control; Dyes; Elastomers; Fluid Mechanics; High Speed; Laminar Boundary Layer; Shear Stress*

**20070015181** Washington Univ., Seattle, WA USA

**Sonar Detection of Buried Targets at Subcritical Grazing Angles: APL-UW Component**

Williams, Kevin L; Thorsos, Eric I; Tang, Dajun; Feb 15, 2006; 9 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-01-G-0460-0028

Report No.(s): AD-A463840; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463840>

The objective of the joint project (APL-UW and Naval Surface Warfare Center Panama City) was experimental investigation of subcritical buried target detection through rippled sediment/water interfaces. The APL-UW portion of the project had two main components: (1) measurement of the ripple profile and small scale roughness for use in modeling subcritical detections; and (2) collaboration with NSWC-PC in carrying out Synthetic Aperture Sonar (SAS) experiments, in analysis of the acoustic data, and in comparisons of the results to model predictions. The focus for the first component was deployment of a new digital stereo camera system (first used in the Sediment Acoustics Experiment in 2004 -SAx04) in the Gulf in support of an AUV mine-hunting exercise conducted by NSWC-PC in May 2006. This system gives an estimate of the small-scale 1-D roughness spectrum. The second component focused on measurements of both small scale roughness and subcritical buried target detections in controlled laboratory-type experiments carried out in the NSWC-PC test pond. Data were obtained on both spherical and cylindrical targets. Data from these targets were used for comparison with model predictions. Several models were tested experimentally and consistency between models shown. Together the models represent a hierarchy of sophistication that can be applied to buried target detection depending on the needs of a particular program.

DTIC

*Detection; Grazing; Sonar; Synthetic Apertures; Target Acquisition*

**20070015413** Pacific Northwest National Lab., Richland, WA, USA

**Computational Design of Metal Ion Sequestering Agents. 2006 Annual Report**

Hay, B. P.; Rapko, B. M.; January 2006; 8 pp.; In English

Report No.(s): DE2006-895761; No Copyright; Avail.: Department of Energy Information Bridge

Organic ligands that exhibit a high degree of metal ion recognition are essential precursors for developing separation processes and sensors for metal ions. Since the beginning of the nuclear era, much research has focused on discovering ligands that target specific radionuclides. Members of the Group 1A and 2A cations (e.g., Cs, Sr, Ra) and the f-block metals (actinides and lanthanides) are of primary concern to DOE. Although there has been some success in identifying ligand architectures that exhibit a degree of metal ion recognition, the ability to control binding affinity and selectivity remains a significant challenge. The traditional approach for discovering such ligands has involved lengthy programs of organic synthesis and testing that, in the absence of reliable methods for screening compounds before synthesis, have resulted in much wasted research effort.

NTIS

*Actinide Series; Ligands; Metal Ions; Synthesis (Chemistry)*

**20070015433** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Measured Properties of Turbulent Premixed Flames for Model Assessment, Including Burning Velocities, Stretch Rates, and Surface Densities (Postprint)**

Filat'yev, Sergei A; Driscoll, James F; Carter, Campbell D; Donbar, Jeffrey M; Oct 2006; 23 pp.; In English

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A464297; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464297>

One goal of this work was to quantify several properties of turbulent premixed flames that have not been quantified before and are especially useful for the assessment of direct numerical simulations (DNS) and models. It was decided to select a flame that is in the corrugated flamelet regime and use simultaneous CH planar laser-induced fluorescence/ particle image velocimetry (CH PLIF/PIV) diagnostics, which previously had been applied only to nonpremixed combustion. These diagnostics allow one to identify the thin wrinkled reaction zone (where CH exists) and the nearby velocity field. Properties that were measured include local stretch rates, a wrinkling parameter, the degree of flamelet extinction, reaction layer thicknesses, flame surface density ( ), and global consumption speed, which is one type of turbulent burning velocity that is described below.

DTIC

*Burning Rate; Combustion; Flames; Laser Induced Fluorescence; Models; Particle Image Velocimetry; Premixed Flames; Turbulent Flames; Turbulent Flow*

**20070015436** Dames and Moore, Bethesda, MD USA

**Quarterly Groundwater Monitoring Third Quarter Sampling Results, Fort Dix, New Jersey**

Feb 1, 1991; 19 pp.; In English

Contract(s)/Grant(s): DAAA15-88-D-0008

Report No.(s): AD-A464300; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464300>

Ten wells were selected for continued monitoring based on the first quarter sampling results. The wells were purged and sampled between September 19 and September 21, 1990 in accordance with procedures specified in the Draft Sampling and Analysis Plan (SAP), Fort Dix Follow-on Remedial Investigation/Feasibility Study, prepared by Dames & Moore. The sample containers were labeled, packed on ice in coolers, and shipped overnight with completed chain-of-custody forms to ESE for chemical analysis.

DTIC

*Chemical Analysis; Contaminants; Ground Water; Sampling*

**20070015440** Cincinnati Univ., OH USA

**Photoluminescence and Lasing from Deoxyribonucleic Acid Thin Films Doped With Sulforhodamine**

Yu, Z; Li, W; Hagen, J A; Zhou, Y; Klotzkin, D; Grote, J G; Steckl, A J; Mar 20, 2007; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464309; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464309>

Biological materials represent a rich and mainly untapped resource for photonic and electronic devices. Biomaterials have many attractive features: unusual optical and electrical properties that are not readily reproduced in manmade materials, they are a widely available and replenishable resource, and they are biodegradable and environmentally friendly. The integration of biological materials with semiconductors is a particularly fertile area with many applications. Because of its primacy in biological reproduction, DNA has been a subject of investigation by molecular biologists and other life scientists for several decades. More recently, the unique nanostructure and replication properties of DNA molecules have started to be investigated by physical scientists and engineers interested in incorporating these properties in new or improved devices. Studies of the electro-optical properties of DNA-based materials have opened doors to novel device implementation. For example, organic-light emitting diodes (OLED) containing DNA electron blocking layers have been recently reported to exhibit significant enhancements in luminance and luminous efficiency compared to conventional OLED without the DNA layer. Organic solid-state lasers using a variety of host and lumophore combinations have made steady progress in the last decade in terms of wavelength tunability, reduced threshold, and increased. Polymeric matrices have been found to be an extremely important factor in influencing lasing properties such as intensity, threshold, and optical gain. DNA is reported to be an efficient host for certain luminescent organic and organometallic molecules in both solution and solid-state thin films. In this paper we report on the use of DNA as a host material for optically pumped organic solid-state lasers.

DTIC

*Deoxyribonucleic Acid; Doped Crystals; Lasing; Organometallic Compounds; Photoluminescence; Thin Films*

**20070015463** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA

**Quartz Crystal Microbalance Studies Of Dimethyl Methylphosphonate Sorption Into Trisilanolphenyl-Poss Films**

Kittle, Joshua D; Nov 6, 2006; 84 pp.; In English

Report No.(s): AD-A464357; No Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464357>



Developing methods to detect, adsorb, and decompose chemical warfare agents (CWAs) is of critical importance to protecting military and civilian populations alike. The sorption of dimethyl methylphosphonate (DMMP), a CWA simulant, into trisilanolphenyl-POSS (TPP) films has previously been characterized with reflection absorption infrared spectroscopy, x-ray photoelectron spectroscopy, and uptake coefficient determinations. In our study, the quartz crystal microbalance (QCM) is used to study the sorption phenomena of DMMP into highly ordered Langmuir-Blodgett (LB) films of TPP. In a saturated environment, DMMP sorbs into the TPP films, binding to TPP in a 1:1 molar ratio. Although previous work indicated these DMMP-saturated films were stable for several weeks, DMMP is found to slowly desorb from the TPP films at room temperature and pressure. Upon application of vacuum to the DMMP-saturated films, DMMP follows first-order desorption kinetics and readily desorbs from the film, returning the TPP film to its original state.

DTIC

*Infrared Spectroscopy; Methyl Compounds; Microbalances; Photoelectron Spectroscopy; Quartz Crystals; Radicals; Sorption; X Ray Spectroscopy*

**20070015716** Applied Research Associates, Inc., Tyndall AFB, FL USA

**Biosensor for Continuous Monitoring of Organophosphate Aerosols (Preprint)**

Luckarift, Heather R; Johnson, Glenn R; Greenwald, Roby; Bergin, Mike; Spain, Jim C; Dec 2006; 22 pp.; In English  
Contract(s)/Grant(s): F08637-03-C-6006; Proj-4915

Report No.(s): AD-A464371; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An enzyme-based monitoring system provides the basis for continuous sampling of organophosphate contamination in air. The enzymes butyrylcholinesterase (BuChE) and organophosphate hydrolase (OPH) are stabilized by encapsulation in biomimetic silica nanoparticles, entrained within a packed bed column. The resulting immobilized enzyme reactors (IMERS) were integrated with an impinger-based aerosol sampling system for collection of chemical contaminants in air. The sampling system was operated continuously and organophosphate detection was performed in real-time by single wavelength analysis of enzyme hydrolysis products. The resulting sensor system detects organophosphates based on either enzyme inhibition (of BuChE) or substrate hydrolysis (by OPH). The system proved suitable for detection of a range of organophosphates including paraoxon, demeton-S and malathion. The detection limits of the IMERS for specific organophosphates are presented and discussed.

DTIC

*Aerosols; Bioinstrumentation; Contamination; Detection; Insecticides; Organic Phosphorus Compounds*

**20070015731** UT Battelle, LLC, Oak Ridge, TN, USA

**Chemical Vapor Deposition of Long Vertically Aligned Dense Carbon Nanotube Arrays by External Control of Catalyst Composition**

Eres, G.; 4 Mar 05; 13 pp.; In English

Contract(s)/Grant(s): DE-AC05-00OR22725

Patent Info.: Filed 4 Mar 05; US-Patent-Appl-SN-11-072 721

Report No.(s): PB2007-101709; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Vertically aligned carbon nanotubes (VACNTs) of increased length are produced in a method that introduces ferrocene into an acetylene/hydrogen/inert gas stream during a chemical vapor deposition process. The ferrocene is supplied from a controllable thermal sublimation source. Independent and precise control of the ferrocene into the feedstock gas facilitates the growth of thick films comprising long carbon nanotubes on conductive substrates. An order of magnitude increase in the length of CNTs, from a few hundred microns to several mm is achieved.

NTIS

*Carbon Nanotubes; Catalysts; Patent Applications; Vapor Deposition*

**20070015850** Naval Research Lab., Washington, DC USA

**Charge Spreading and Position Sensitivity in a Segmented Planar Germanium Detector (Preprint)**

Kroeger, R A; Gehrels, N; Johnson, W N; Kurfess, J D; Philips, B P; Tueller, J; Jan 1998; 5 pp.; In English

Report No.(s): AD-A464596; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The size of the charge cloud collected in a segmented germanium detector is limited by the size of the initial cloud, uniformity of the electric field, and the diffusion of electrons and holes through the detector. These factors affect the minimize size of a practical electrode structure and consequently the position sensitivity. We have completed measurements on a germanium strip detector with a finely collimated gamma ray beam to measure these properties. Preliminary results indicate

that the electrons and holes spread by 65 microns over 9 mm drift distance. The experiment was conducted using a germanium strip detector with 25 boron implanted strips on one face and 25 orthogonal lithium drifted strips on the opposite face. The size of the charge cloud is measured by scanning the fan beam between neighboring strips. Results of these experiments suggest that full charge collection on a single strip would be achieved for a majority of events with strip pitch down to 300 microns in a 10 mm thick device. Concerns of degradation in the energy resolution due to charge sharing between strips is important for strip pitch much finer than this. There is no evidence of charge loss in hole collection by the boron implanted strips. Applications of a fine pitch germanium strip detector include an imaging focal plane behind a hard X-ray mirror (NASA Constellation mission), or a gamma-ray polarimeter for nuclear physics, amongst others.

DTIC

*Germanium; Radiation Measuring Instruments; Segments; Sensitivity; Spreading*

**20070015957** Versar, Inc., Langhorne, PA, USA

**Environmental Investigation and Risk Assessment. Phase 1 Report Tacony Warehouse, Philadelphia, Pennsylvania**

Spencer, David; DiMauro, Jackie; Morganeli, Dan; Basko, David; Aug 24, 1993; 251 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAA15-90-D-0014-0001

Report No.(s): AD-A463616; 1137E1.001; No Copyright; Avail.: CASI: [A12](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463616>

Versar, Inc., performed an Environmental Investigation at the Tacony Warehouse Facility in Philadelphia, Pennsylvania. This final document presents the findings of the investigation, including an analysis of the analytical data obtained during the investigation. The Risk Assessment included as Section 8 of the document evaluates prospective risks of compounds identified on the site. This document provides the basis for the Phase II Report; ARARs Evaluation and Alternatives Analysis for the Tacony Warehouse Site.

DTIC

*Assessments; Ground Water; Risk*

## 24

### COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

**20070014818** Lane (Philip Douglas), Potomac Falls, VA, USA

**Metal Matrix Composite Bar Assemblies**

Joseph, B. E.; Rowe, M. M.; 24 Nov 04; 15 pp.; In English

Contract(s)/Grant(s): DAAD 19-01-2-0006

Patent Info.: Filed 24 Nov 04; US-Patent-Appl-SN-10-995-531

Report No.(s): PB2007-105984; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention provides for metal matrix composite assemblies and methods for preparing such assemblies. Such assemblies may provide a structure, a subassembly of a structure or another assembly, or be used to support other assemblies, materials, or structures. These metal matrix composite assemblies comprise, at least in part, metal matrix composite bars. The metal matrix composite bars are combined to form the assemblies of the present invention by the use of joining connectors. Joining connectors comprise solid materials fabricated such that they are simultaneously attached to at least one metal matrix composite bar and to at least one other joining connector. Such assemblies may encompass cross-bracing, triangular components, and the like, to advantage. Other materials may be utilized in the assemblies of the present invention to further accentuate the beneficial properties of the metal matrix composites.

NTIS

*Metal Matrix Composites; Fabrication*

**20070014944** SRI International Corp., Menlo Park, CA, USA

**Diffusion Coatings for Corrosion-Resistant Components in Coal Gasification Systems. Quarterly Technical Progress Report 13 for the period of July 1, 2006 to September 30, 2006**

Krishnan, G. N.; Malhorta, R.; Alvarez, E.; Lau, K. H.; Mariano, J. P.; Oct. 01, 2006; 28 pp.; In English

Contract(s)/Grant(s): DE-FC26-03NT41616

Report No.(s): DE2006-895923; No Copyright; Avail.: National Technical Information Service (NTIS)

Heat-exchangers, particle filters, turbines, and other components in integrated coal gasification combined cycle system must withstand the highly sulfiding conditions of the high-temperature coal gas over an extended period of time. The performance of components degrades significantly with time unless expensive high alloy materials are used. Deposition of a suitable coating on a low-cost alloy may improve its resistance to such sulfidation attack, and decrease capital and operating costs. The alloys used in the gasifier service include austenitic and ferritic stainless steels, nickel-chromium-iron alloys, and expensive nickel-cobalt alloys. The primary activity this period was preparation and presentation of the findings on this project at the Twenty-Third annual Pittsburgh Coal Conference. Dr. Malhotra attended this conference and presented a paper. A copy of his presentation constitutes this quarterly report.

NTIS

*Coal Gasification; Corrosion Resistance; Diffusion; Protective Coatings*

**20070015834** Academy of Sciences of the Ukraine, Kiev, Ukraine  
**Ti-Based Metal Matrix Composites Reinforced with TiB Particles**

Ivasyshyn, Orest M; May 16, 2006; 77 pp.; In English

Contract(s)/Grant(s): STCU-RN-P-132

Report No.(s): AD-A464564; No Copyright; Avail.: CASI: A05, Hardcopy

This report results from a contract tasking Institute for Metal Physics as follows: Reinforcement of a titanium matrix by TiB particles leads to increased tensile strength, creep resistance, Young's modulus, hardness and wear resistance of the composite material. This study will develop a scientific background of processing Ti/TiB in-situ composite material through ingot melting followed by hot working and heat treatment. The aim of the present study is to establish the potential of a melting approach to produce discontinuously reinforced Ti/TiB composites with a homogeneous distribution of fine TiB particles for improved mechanical properties at reduced cost.

DTIC

*Composite Materials; Heat Treatment; Hot Working; Metal Matrix Composites; Metallography; Titanium*

## 25

### INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use of inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see category 34 *Fluid Dynamics and Thermodynamics*. For astrochemistry see category 90*fAstrophysics*.

**20070014817** Florida State Univ., Tallahassee, FL, USA

**Chemical Speciation of Sr, Am and Cm in High Level Waste: Predictive Modeling of Phase Partitioning during Tank Processing**

Choppin, G. R.; Dec. 20, 2006; 17 pp.; In English

Contract(s)/Grant(s): FG07-02ER63222

Report No.(s): DE2006-896498; EMSP-73749; No Copyright; Avail.: Department of Energy Information Bridge

The objective of this project was to measure the effect of organic chelate complexation on the speciation and solubility of strontium and trivalent actinides under strongly basic, high carbonate conditions, similar to those present in the high level waste (HLW) tanks at the US department of energy storage sites. The research has focused on the measurement of complexation of Am (111), Cm (111) and Eu (111) with EDTA, Citrate, IDA, Oxalate (Ox), NTA and DTPA alone and with the mixtures of EDTA+ Citrate, NTA, Ox, and IDA at high ionic strength (5.0 M NaCQ), pH 3.60 and at temperatures ranging between 0 to 60 degrees C. In addition, we have addressed the formation of mixed ligand complexes of Eu(III) with EDTA+citrate, NTA, Ox, CDTA+IDA, NTA and Ox and DTPA+IDA and Ox in solutions by TRLFS, NMR and EXAFS spectral studies. The fundamental data on chemical speciation and solubility has been used to develop accurate thermodynamic models, which are valid at HLW tank conditions.

NTIS

*Prediction Analysis Techniques; Radioactive Wastes*

**20070014828** Environmental Protection Agency, Washington, DC, USA

**EPAORD's Computational Toxicology Research Implementation Plan (FY 2006-2008)**

Apr. 2006; 100 pp.; In English

Report No.(s): PB2007-107807; No Copyright; Avail.: National Technical Information Service (NTIS)

This document presents the implementation plan for the Framework for the Computational Toxicology Research Program (CTRP), a strategy document developed by the Office of Research and Development (ORD) in 2003. Computational toxicology is defined as the integration of modern computing and information technology, with molecular biology and chemistry to improve risk assessment and prioritization of data requirements of chemicals by the Agency. The program is intended to provide innovative solutions to a number of persistent and pervasive issues facing The Environmental Protection Agency (EPA) regulatory programs. The three objectives of the Framework have been translated into long term goals (LTGs) for the CTRP and the subsequent research has been aligned into five supporting tracks. The LTGs for the program are: (I) EPA risk assessors use improved methods and tools to better understand and describe linkages across the source to outcome paradigm; (II) EPA Program Offices use advanced hazard characterization tools to prioritize and screen chemicals for toxicological evaluation; and (III) EPA risk assessors and regulators use new models based on the latest science to reduce uncertainties in dose-response assessment, cross-species extrapolation, and quantitative risk assessment. The supporting research tracks are: (A) Development of Data for Advanced Biological Models; (B) Information Technologies Development and Application; (C) Prioritization Method Development and Application; (D) Providing Tools and System Models for Extrapolation across Dose, Life Stage, and Species; and (E) Advanced Computational Toxicology Approaches to Improve Cumulative Risk Predictions. A standing subcommittee of ORDs Board of Scientific Counselors has been established to provide guidance to the CTRP as it develops its research agenda.

NTIS

*Computational Chemistry; Toxicology; Molecular Biology; Research and Development*

**20070014837** Marsh, Fischmann and Beryfogle, LLP, Aurora, CO, USA

**Modified Carbon Products, Their Use in Electrocatalysts and Electrode Layers and Similar Devices and Methods Relating to the Same**

Hampton-Smith, M. J.; Atanassova, P.; Rice, G. L.; Caruso, J.; Brewster, J.; 15 Mar 05; 48 pp.; In English

Contract(s)/Grant(s): NIST-70NAN2B3021

Patent Info.: Filed Filed 15 Mar 05; US-Patent-Appl-SN-11-081-752

Report No.(s): PB2007-105982; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Electrodes and electrocatalyst layers incorporating modified carbon products. The modified carbon products may advantageously enhance the properties of an electrode or electrode layer, leading to more efficiency within the a fuel cell or similar device.

NTIS

*Carbon; Electrocatalysts; Electrodes; Patent Applications*

**20070014849** Pennsylvania State Univ., University Park, PA, USA

**Oxidation of Zircaloy Fuel Cladding in Water-Cooled Nuclear Reactors. (Final Report, September 15, 2002-September 14, 2006)**

Macdonald, D. D.; Urquidi-Macdonald, M.; Chen, Y.; Ai, J.; Park, P.; Dec. 2006; 133 pp.; In English

Report No.(s): DE2007-896213; No Copyright; Avail.: National Technical Information Service (NTIS)

Our work involved the continued development of the theory of passivity and passivity breakdown, in the form of the Point Defect Model, with emphasis on zirconium and zirconium alloys in reactor coolant environments, the measurement of critically-important parameters, and the development of a code that can be used by reactor operators to actively manage the accumulation of corrosion damage to the fuel cladding and other components in the heat transport circuits in both BWRs and PWRs. In addition, the modified boiling crevice model has been further developed to describe the accumulation of solutes in porous deposits (CRUD) on fuel under boiling (BWRs) and nucleate boiling (PWRs) conditions, in order to accurately describe the environment that is contact with the Zircaloy cladding. In the current report, we have derived expressions for the total steady-state current density and the partial anodic and cathodic current densities to establish a deterministic basis for describing Zircaloy oxidation. The models are deterministic because the relevant natural laws are satisfied explicitly, most importantly the conservation of mass and charge and the equivalence of mass and charge (Faradays law). Cathodic reactions (oxygen reduction and hydrogen evolution) are also included in the models, because there is evidence that they control the rate of the overall passive film formation process. Under open circuit conditions, the cathodic reactions, which must occur at the same rate as the zirconium oxidation reaction, are instrumental in determining the corrosion potential and hence the thickness of the barrier and outer layers of the passive film.

NTIS

*Nuclear Reactors; Oxidation; Water Cooled Reactors; Zircalloys (Trademark); Passivity; Corrosion*

**20070014877** Pacific Northwest National Lab., Richland, WA, USA, Argonne National Lab., IL USA  
**Biogeochemical Coupling of Fe and Tc Speciation in Subsurface Sediments: Implications to Long-Term Tc Immobilization. 2006 Annual Report**

Zachara, J. M.; Fredrickson, J. K.; Steefel, C. I.; Kukkadapu, R. K.; Heald, S. M.; Jun. 01, 2006; 5 pp.; In English  
Report No.(s): DE2006-895940; ERSD-1022402-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

The project has been focused on biochemical processes in subsurface sediments involving Fe that control the valence state, solubility, and effective mobility of <sup>99</sup>Tc. Our goal has been to understand the Tc biogeochemistry as it may occur in suboxic and biostimulated subsurface environments. Two objectives have been pursued: (1) To determine the relative reaction rates of <sup>99</sup>Tc(VII)O<sub>2</sub>(aq) with metal reducing bacteria and biogenic Fe(II); and to characterize the identity, structure, and molecular speciation of Tc(IV) products formed through reaction with both biotic and abiotic reductants. (2) To quantify the biogeochemical factors controlling the reaction rate of O<sub>2</sub> with Tc(IV)O<sub>2</sub>nH<sub>2</sub>O in sediment resulting from the direct enzymatic reduction of Tc(VII) by DIRB and/or the reaction of Tc(VII) with the various types of biogenic Fe(II) produced by DIRB.

NTIS

*Biogeochemistry; Sediments; Technetium; Iron; Atomic Mobilities*

**20070014878** Pacific Northwest National Lab., Richland, WA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Argonne National Lab., IL USA

**Aqueous Complexation Reactions Governing the Rate and Extent of Biogeochemical U (VI) Reduction. 2006 Annual Report**

Brooks, S. C.; Dong, W.; Carroll, S.; Fredrickson, J.; Kemner, K.; Jun. 01, 2006; 5 pp.; In English  
Report No.(s): DE2006-895942; ERSD-1024842-2006; No Copyright; Avail.: Department of Energy Information Bridge

The proposed research will elucidate the principal biogeochemical reactions that govern the concentration, chemical speciation, and reactivity of the redox-sensitive contaminant uranium. The results will provide an improved understanding and predictive capability of the mechanisms that govern the biogeochemical reduction of uranium in subsurface environments. In addition, the work plan is designed to: (1) Generate fundamental scientific understanding on the relationship between U(VI) chemical speciation and its susceptibility to biogeochemical reduction reactions. Elucidate the controls on the rate and extent of contaminant reactivity. (2) Provide new insights into the aqueous and solid speciation of U(VI)/U(IV) under representative groundwater conditions.

NTIS

*Biogeochemistry; Uranium; Radioactive Contaminants*

**20070014881** Sandia National Labs., Albuquerque, NM, USA

**Studies of the Laser-Induced Fluorescence of Explosives and Explosive Compositions**

Phifer, C. C.; Schmitt, R.; Hargis, P.; Thorne, L. R.; Parmeter, J. E.; Oct. 01, 2006; 70 pp.; In English  
Report No.(s): DE2006-895982; SAND2006-6697; No Copyright; Avail.: National Technical Information Service (NTIS)

Continuing use of explosives by terrorists throughout the world has led to great interest in explosives detection technology, especially in technologies that have potential for standoff detection. This LDRD was undertaken in order to investigate the possible detection of explosive particulates at safe standoff distances in an attempt to identify vehicles that might contain large vehicle bombs (LVBs). The explosives investigated have included the common homogeneous or molecular explosives, 2,4,6-trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), cyclonite or hexogen (RDX), octogen (HMX), and the heterogeneous explosive, ammonium nitrate/fuel oil (ANFO), and its components. We have investigated standard excited/dispersed fluorescence, laser-excited prompt and delayed dispersed fluorescence using excitation wavelengths of 266 and 355 nm, the effects of polarization of the laser excitation light, and fluorescence imaging microscopy using 365- and 470-nm excitation. The four nitro-based, homogeneous explosives (TNT, PETN, RDX, and HMX) exhibit virtually no native fluorescence, but do exhibit quenching effects of varying magnitude when adsorbed on fluorescing surfaces. Ammonium nitrate and fuel oil mixtures fluoresce primarily due to the fuel oil, and, in some cases, due to the presence of hydrophobic coatings on ammonium nitrate prill or impurities in the ammonium nitrate itself. Pure ammonium nitrate shows no detectable fluorescence. These results are of scientific interest, but they provide little hope for the use of UV-excited fluorescence as a technique to perform safe standoff detection of adsorbed explosive particulates under real-world conditions with a useful degree of reliability.

NTIS

*Chemical Explosions; Explosives; Laser Induced Fluorescence; Explosives Detection; Terrorism; Explosive Devices; Laser Outputs*

**20070014923** Pacific Northwest National Lab., Richland, WA, USA

**Composition Reactivity, and Regulations of Extracellular Metal-Reducing Structures (Bacterial Nanowires) Produced by Dissimilatory Metal Reducing Bacteria. 2006 Annual Report**

Scholten, J.; January 2006; 3 pp.; In English

Report No.(s): DE2006-895881; No Copyright; Avail.: National Technical Information Service (NTIS)

This research proposal seeks to describe the composition and function of electrically conductive appendages known as bacterial nanowires. This project targets bacterial nanowires produced by dissimilatory metal reducing bacteria *Shewanella* and *Geobacter*. Specifically, this project will investigate the role of these structures in the reductive transformation of iron oxides as solid phase electron acceptors, as well as uranium as a dissolved electron acceptor that forms nanocrystalline particles of uraninite upon reduction.

NTIS

*Bacteria; Binding Energy; Electrons; Iron Oxides; Nanowires; Reactivity; Regulations*

**20070014924** Pacific Northwest National Lab., Richland, WA, USA, Oregon State Univ., Corvallis, OR, USA, Oklahoma Univ., Norman, OK, USA

**Stability of U(VI) and Te(VII) Reducing Microbial Communities to Environmental Perturbation: A Thermodynamic Network Model and Intermediate-Scale Experiments. 2006 Annual Report**

McKinley, J. P.; Liu, C.; Istok, J.; Krumholz, L.; January 2006; 3 pp.; In English

Report No.(s): DE2006-895882; No Copyright; Avail.: National Technical Information Service (NTIS)

The project is a collaborative task with a larger project headed by Jack Istok at Oregon State University, which is conducted under the same title. The project was conceptualized as follows. A 'geochemical' model of microbial communities was hypothesized, in which microbes were characterized as mineral species according to the chemical transformations they used for metabolic function. The iron-reducing bacteria, for example, would be represented by the iron reducing chemical reaction, including a specific electron donor, the fraction of the consumed donor used for biomass maintenance or growth, and a free energy for the reaction. The pseudomineral species would then be included in a standard geochemical model, and community succession could be calculated according to the thermodynamically favored microbially mediated reactions under progressive consumption of electron donors and receptors, and evolving geochemical conditions. The project includes relatively minor participation by the University of Oklahoma and Pacific Northwest National Laboratory, with the major component at OSU. The PNNL project was funded to provide assistance to Dr. Istok in formulating the appropriate modeling approach and geochemical constraints on the modeling effort.

NTIS

*Biomass; Free Energy; Microorganisms; Stability; Thermodynamics*

**20070014929** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Vacuum Pyrolysis and Related ISRU Techniques**

Cardiff, Eric H.; Pomeroy, Brian R.; Banks, Ian S.; Benz, Alexis; [2007]; 8 pp.; In English; Space Technology and Applications International Forum, 15-17 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

A number of ISRU-related techniques have been developed at NASA Goddard Space Flight Center. The focus of the team has been on development of the vacuum pyrolysis technique for the production of oxygen from the lunar regolith. However, a number of related techniques have also been developed, including solar concentration, solar heating of regolith, resistive heating of regolith, sintering, regolith boiling, process modeling, parts manufacturing, and instrumentation development. An initial prototype system was developed to vaporize regolith simulants using a approx. 1 square meter Fresnel lens. This system was successfully used to vaporize quantities of approx. 1g, and both mass spectroscopy of the gasses produced and Scanning Electron Microscopy (SEM) of the slag were done to show that oxygen was produced. Subsequent tests have demonstrated the use of a larger system With a 3.8m diameter reflective mirror to vaporize the regolith. These results and modeling of the vacuum pyrolysis reaction have indicated that the vaporization of the oxides in the regolith will occur at lower temperature for stronger vacuums. The chemical modeling was validated by testing of a resistive heating system that vaporized quantities of approx. 10g of MLS-1A. This system was also used to demonstrate the sintering of regolith simulants at reduced temperatures in high vacuum. This reduction in the required temperature prompted the development of a small-scale resistive heating system for application as a scientific instrument as well as a proof-of principle experiment for oxygen production.

Author

*Pyrolysis; Vacuum; In Situ Resource Utilization; Technology Utilization; Lunar Geology*

**20070014945** Pacific Northwest National Lab., Richland, WA, USA

**Selective Media for Actinide Collection and Pre-Concentration: Results of FY 2006 Studies**

Lumetta, G. J.; Addleman, R. S.; Hay, B. P.; Hubler, T. L.; Levitskaia, T. G.; Nov. 01, 2006; 64 pp.; In English

Contract(s)/Grant(s): DE-AC05-76RL01830

Report No.(s): DE2006-896079; PNNL-16213; No Copyright; Avail.: National Technical Information Service (NTIS)

In this work, we have investigated new materials for potential use in automated radiochemical separations. The work can be divided into three primary tasks: (1) synthesis of new ligands with high affinity for actinide ions, (2) evaluation of new materials for actinide ion affinity, and (3) computational design of advanced ligand architectures for highly selective binding of actinide ions. Ligand Synthesis Work was conducted on synthesizing Klaui ligand derivatives containing functionalized pendant groups on the cyclopentadienyl ring. The functionalized pendant groups would allow these ligands to be attached to organic and inorganic solid supports. This work focused on synthesizing the compound  $\text{Na}(\text{Cp Co}(\text{PO}(\text{OC}_2\text{H}_5)_2)_3)$ , where  $\text{Cp} = \text{C}_5\text{H}_4\text{C}(\text{O})\text{OCH}_3$ . Synthesizing this compound is feasible, but the method used in FY 2006 produced an impure material. A modified synthetic scheme has been developed and will be pursued in FY 2007. Work was also initiated on synthesizing bicyclic diamides functionalized for binding to polymeric resins or other surfaces. Researchers at the University of Oregon are collaborators in this work. To date, this effort has focused on synthesizing and characterizing a symmetrically substituted bicyclic diamide ligand with the COOH functionality.

NTIS

*Actinide Series; Ligands; Radiochemistry*

**20070015082** Oak Ridge National Lab., TN, USA

**Fission-Product Separation Based on Room-Temperature Ionic Liquids**

Luo, H.; Dei, S.; Bonnesen, P. V.; Buchanan, A. C.; Hussey, C. L.; Nov. 15, 2006; 6 pp.; In English

Report No.(s): DE2006-895831; No Copyright; Avail.: Department of Energy Information Bridge

The objectives of this project are (a) to synthesize new ionic liquids tailored for the extractive separation of Cs + and Sr 2+; (b) to select optimum macrocyclic extractants through studies of complexation of fission products with macrocyclic extractants and transport in new extraction systems based on ionic liquids; (c) to develop efficient processes to recycle ionic liquids and crown ethers; and (d) to investigate chemical stabilities of ionic liquids under strong acid, strong base, and high-level-radiation conditions.

NTIS

*Fission Products; Liquids; Synthesis (Chemistry); Ionic Mobility*

**20070015085** CH2M/Hill Hanford Group, Inc., Richland, WA, USA, Pacific Northwest National Lab., Richland, WA, USA

**Electrochemical Studies of Carbon Steel Corrosion in Hanford Double-Shell Tank Waste**

Duncan, J. B.; Windisch, C. F.; January 2007; 17 pp.; In English

Contract(s)/Grant(s): DE-AC27-99RL14047

Report No.(s): DE2006-895750; No Copyright; Avail.: Department of Energy Information Bridge

This paper reports on the electrochemical scans for the supernatant of Hanford double-shell tank (DST) 241-SY-102 and the electrochemical scans for the bottom saltcake layer for Hanford DST 241-AZ-102. It further reports on the development of electrochemical test cells adapted to both sample volume and hot cell constraints.

NTIS

*Carbon Steels; Corrosion; Electrochemistry; Hazardous Wastes*

**20070015092** Pacific Northwest National Lab., Richland, WA, USA, Savannah River National Lab., Aiken, SC, USA, Princeton Univ., NJ, USA

**Aluminum-Containing Phases in Tank Waste: Precipitation and Deposition of Aluminum-Containing Phases**

Mattigod, S.; Hobbs, D. T.; Wellman, D. M.; Dubbs, D. M.; Aksay, I.; January 2006; 6 pp.; In English

Report No.(s): DE2006-895836; No Copyright; Avail.: National Technical Information Service (NTIS)

Aluminosilicate deposit buildup experienced during the tank waste volume-reduction process at the Savannah River Site (SRS) required an evaporator to be shut down in October 1999. Recent investigations illustrated the accumulation 7 wt% uranium, 3% was 235U and absent of neutron poisons, within these deposits and presented a criticality concern. The Waste Processing Technology Section of Westinghouse Savannah River Company at SRS is now collaborating with a team from Pacific Northwest National Laboratory in efforts to identify the phases controlling uranium solubility and understand the conditions under which they precipitate. The objective of this project is to: (1) identify the insoluble uranium phase(s) and

characterize the chemistry and microstructure of these phases, (2) study the kinetics of the phase formation and transformation of uranium phases under hydrothermal conditions, and (3) verify the stability boundaries in the activity diagram of interest to the 2H Evaporator, namely the critical concentrations for formation of uranyl-hydroxide versus uranyl-silicate phases. This research is critical to understand the mechanism for incorporating uranium phases into the sodium-aluminosilicate (NAS) scales and inhibit the growth of NAS scales. Prevention of enriched uranium phases within the evaporator scales, will minimize criticality concerns, and will increase waste stream processing flexibility.

NTIS

*Aluminum; Deposition; Radioactive Wastes; Waste Management; Uranium; Waste Treatment*

**20070015197** Coleman Sudon Sapone, PC, Bridge Port, CT, USA, Yale Univ., New Haven, CT, USA

**Enantioselective Amination and Etherification**

Hartwig, J. F.; Shu, C.; Ohmura, T.; Kiener, C.; Lopez, F. G.; 12 Sep 03; 46 pp.; In English

Contract(s)/Grant(s): GM-58108

Patent Info.: Filed 12 Sep 03; US-Patent-Appl-SN-10-527 899

Report No.(s): PB2007-101730; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention is directed to a catalyst composition, comprising: (1) a catalyst precursor having the general structure  $MSX(\text{sub})n$  wherein M is a transition metal selected from the group consisting of iridium, molybdenum, and tungsten; S is a coordinating ligand; X is a counterion; and n is an integer from 0 to 5; and (2) a phosphoramidite ligand having the structure wherein  $O-C(\text{sub } n)-O$  is an aliphatic or aromatic diolate and wherein  $R(\text{sub } 1)$ ,  $R(\text{sub } 2)$ ,  $R(\text{sub } 3)$  and  $R(\text{sub } 4)$  are selected from the group consisting of substituted or unsubstituted aryl groups, substituted or unsubstituted heteroaryl groups, substituted or unsubstituted aliphatic groups, and combinations thereof, with the proviso that at least one of  $R(\text{sub } 1)$ ,  $R(\text{sub } 2)$ ,  $R(\text{sub } 3)$ , or  $R(\text{sub } 4)$  must be a substituted or unsubstituted aryl or heteroaryl group. The present invention is also directed to activated catalysts made from the above catalyst composition, as well as methods of allylic amination and etherification using the above catalysts.

NTIS

*Ethers; Chemical Reactions; Enantiomers; Catalysts*

**20070015298** Naval Surface Warfare Center, Bethesda, MD USA

**Characterization of Surface Film Growth During Electrochemical Process: Nickel/Nickel Alloys in Seawater**

Rao, A S; Nov 2006; 89 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464051; NSWCDD-61-TR-2006/18; No Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464051>

In order to better understand the formation of films during corrosion processes, an analytical technique using x-ray diffraction was developed to examine the structure of compounds in closest proximity to the metal liquid interface. The in situ structure at the metal liquid interface was examined for pure nickel, 90-10 and 70-30 Cu-Ni alloy in seawater solution at room temperature. The nickel-seawater system was investigated at potentiostatically controlled potentials of -800 mV and +450 mV (versus Ni/NiO). Both the 90-10 Cu-Ni and the 70-30 Cu-Ni alloys seawater systems were investigated at -500 mV, -100 mV, +500 mV and +100 mV versus Ni/NiO. The chemical changes at the metal interface were studied over a period of 48 hours. The inner and outer oxide structure of pure nickel in seawater at -800 mV is NiOOH and Ni(OH)<sub>2</sub>. Similarly the structure of inner and outer layers at +450 mV (versus Ni/NiO) contains both NiO/Ni<sub>2</sub>O<sub>3</sub> and Ni<sub>2</sub>O<sub>3</sub>. The results for 90-10 Cu-Ni and 70-30 Cu-Ni alloys in seawater indicated that the structure of outer passive layers at -500 mV and -100 mV (versus Ni/NiO), comprises Ni(OH)<sub>2</sub>, Cu(OH)<sub>2</sub>, NiOOH and Cu<sub>2</sub>O-NiO and the structure of inner passive layer is NiOOH and Cu<sub>2</sub>O-NiO. Similarly, the structure of outer interface at +500 mV and +100 mV (versus Ni/NiO) contains NiO, Ni<sub>2</sub>O<sub>3</sub>, Cu<sub>2</sub>O-NiO and Ni<sub>2</sub>CuO<sub>3</sub>; and the inner passive layer contains Cu<sub>2</sub>O-NiO and Ni<sub>2</sub>CuO<sub>3</sub>.

DTIC

*Corrosion; Metal-Water Reactions; Nickel; Nickel Alloys; Sea Water*

**20070015299** Link Simulation and Training, Mesz, AZ USA

**Perceptual Tests of the Temporal Properties of a Shuttered LCD Projector**

Winterbottom, Marc D; Geri, George A; Morgan, Bill; Eidman, Craig; Gaska, Jim; Pierce, Byron; Aug 2006; 7 pp.; In English

Contract(s)/Grant(s): F41624-97-D-5000; FA8650-05-D-6502; Proj-1123

Report No.(s): AD-A464052; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464052>



Perceptual motion blur was studied in imagery presented on an LCD projector equipped with a mechanical shutter to reduce pixel hold-time. Perceptual measures of image blur were obtained with both a simple test stimulus, as well as real-world imagery. Both were found to correlate well with the measured pixel hold-time.

DTIC

*Display Devices; Liquid Crystals; Mechanical Properties; Projectors*

**20070015320** North Carolina Univ., Charlotte, NC USA

**Factors Influencing Material Removal And Surface Finish Of The Polishing Of Silica Glasses**

Landis, Alan C; Jan 2006; 107 pp.; In English

Report No.(s): AD-A464080; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464080>

The polishing process is ancient form of material processing that has changed little in form over thousands of years. Even with all of the experience that the human race has gained on the subject, the underlying mechanism that promotes polishing still lies in the realm of theory. Of the existing theories available, each falls into one of two broad categories, chemical or mechanical removal mechanisms, or a combination of both. Effects of polishing pressure and velocity on material removal rate were analyzed. A novel method of controlling the polishing load will also be provided. Additionally, this work quantifies some of the factors that influence polishing, and then correlate the results to polishing theory. Specifically, abrasive polishing particle size and concentration, and abrasive polishing slurry pH were variables in a broad range of experiments, with other influencing factors kept as consistent as possible. The effects of pH were analyzed for interaction with the entire polishing system, as well as for effects on the polishing workpiece only. Silica materials were used as a baseline, and are polished on a synthetic optical polishing pitch with ceria (cerium oxide) abrasive particles. Finally, the experimental results will provide justification for a combined chemical-mechanical material removal model and form the basis of future work on more advanced materials like glass-ceramics and ultra low expansion glasses.

DTIC

*Polishing; Quartz; Silica Glass; Silicon Dioxide; Surface Finishing*

**20070015323** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Performance Measurements of Direct Air Injection in a Cavity-Based Flameholder for a Supersonic Combustor (Postprint)**

Edens, S G; King, P I; Gruber, M R; Hsu, K -Y; Oct 2006; 17 pp.; In English

Contract(s)/Grant(s): Proj-3012

Report No.(s): AD-A464084; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464084>

For several years the Air Force Research Lab Propulsion Directorate has been studying the difficulties in fueling supersonic combustion ramjet engines with hydrocarbon based fuels. Direct air injection has been shown to be a valuable tool for improving combustion in a directly fueled cavity-based flameholder. The objective of this research was to quantitatively determine the advantages and disadvantages of the direct air injection scheme. This was accomplished via intrusive probing into a supersonic free stream flow downstream of the cavity flameholder. Pitot and static pressure, total temperature, and gas sampling measurements were taken and the corresponding values were processed to yield relevant engineering quantities. Data were taken over a range of fuel and air injection rates. Direct air injection resulted in increased combustion throughout the area of interest behind the cavity. Air injection increased the static temperature and pressure throughout the area of interest. Enthalpy spread into the free stream and total pressure losses also increased through the use of air injection. Direct air injection shows more promise for higher fuel loadings.

DTIC

*Cavities; Combustion Chambers; Flame Holders; Fuel Injection; Gas Injection; Supersonic Combustion*

**20070015325** Schwegman Lundberg Woessner and Kluth, PA, Minneapolis, MN, USA

**Use of Functionalized Mesoporous Silicates to Esterify Fatty Acids and Trasesterify Oils**

Yin Lin, V. S.; Radu, D. R.; 20 Sep 04; 18 pp.; In English

Patent Info.: Filed Filed 20 Sep 04; US-Patent-Appl-SN-10-945 559

Report No.(s): PB2007-101584; No Copyright; Avail.: CASI: A03, Hardcopy

The present invention provides a method to prepare a fatty acid lower alkyl esters from a feedstock, such as a vegetable or an animal oil, comprising one or more fatty acid glycerol esters such as mono-, di- or tri-glycerides, and free fatty acids,

comprising combining the feedstock, a lower alcohol and an acidic mesoporous silicate under conditions wherein the mesoporous silicate catalyzes the formation of the corresponding fatty acid lower alkyl ester of the free fatty acids an optionally glycerol.

NTIS

*Carboxylic Acids; Fatty Acids; Oils; Patent Applications; Silicates*

**20070015349** Naval Research Lab., Stennis Space Center, MS USA

**Rapid Precipitation of Amorphous Silica in Experimental Systems with Nontronite (NAu-1) and Shewanella oneidensis MR-1**

Furukawa, Yoko; O'Reilly, S E; Jan 15, 2007; 16 pp.; In English

Report No.(s): AD-A464132; NRL/JA/7430-04-13; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464132>

Nanometer-size (h50 nm) precipitates of amorphous silica globules were observed in laboratory systems containing nontronite NAu-1, Shewanella oneidensis strain MR-1, and lean aqueous media. Their formation was attributed to the release of polysilicic acids at the expense of dissolving NAu-1, and subsequent polymerization and stabilization mediated by biomolecules. Rapid (h24 h) silica globule formation was confirmed in the immediate vicinity of bacterial cells and extracellular polymeric substances in all experimental systems that contained bacteria, whether the bacteria were respiring dissolved O<sub>2</sub> or Fe(III) originating from NAu-1, and whether the bacteria were viable or heat-killed. Silica globules were not observed in bacteria- and biomolecule-free systems. Thermodynamic calculations using disilicic acid, rather than monomeric silica, as the primary aqueous silica species suggest that the systems may have been super-saturated with respect to amorphous silica even though they appeared to be undersaturated if all aqueous silica was assumed to be monomeric H<sub>4</sub>SiO<sub>4</sub>. The predominant aqueous silica species in the experimental systems was likely polysilicic acids because aqueous silica was continuously supplied from the concurrent dissolution of aluminosilicate. Further polymerization and globule formation may have been driven by the presence of polyamines, a group of biologically produced compounds that are known to drive amorphous silica precipitation in diatom frustules. Globules were likely to be positively charged in our systems due to chemisorption of organic polycations onto silica surfaces that would have been otherwise negatively charged. We propose the following steps for the formation of nanometer-size silica globules in our experimental systems: (i) continuous supply of polysilicic acids due to NAu-1 dissolution; (ii) polysilicic acid polymerization to form h50 nm silica globules and subsequent stabilization mediated by microbially produced polyamines...

DTIC

*Amorphous Materials; Anaerobes; Bacteria; Clays; Globules; Minerals; Silicon Dioxide*

**20070015350** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Cobalt Doping of Semiconducting Boron Carbide Using Cobaltocene**

Carlson, Lonnie; Mar 2007; 100 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464141; AFIT/GNE/ENP/07-01; No Copyright; Avail.: CASI: A05, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464141>

The decomposition of cobaltocene and metacarborane (closo-1,7-dicarba-decaborane) under low energy electron irradiation at about 200 K results in a material with the Fermi level closer to the valence band than the material resulting from the decomposition of metacarborane alone. This indicates that cobaltocene provides a relatively p-type dopant as seen in ultraviolet photoemission spectroscopy/inverse photoemission spectroscopy. Upon warming to room temperature, however, the Fermi level shifts towards the conduction band, suggesting an n-type dopant. This temperature dependent surface photovoltage effect is not compelling evidence for the majority carrier type but does suggest an increase in the carrier concentration in semiconducting boron carbides with cobaltocene fragment doping. Using cobaltocene to introduce dopants into a orthocarborane (closo-1,2-dicarbadeccaborane) derived film, deposited by plasma enhanced chemical vapor deposition, a semiconducting boron carbide homojunction diode has been fabricated. This diode has potential applications in neutron detection, direct neutron power conversion, and as a dilute magnetic semiconductor.

DTIC

*Additives; Boron Carbides; Cobalt; Electron Irradiation; Energy Conversion; Photoelectric Emission; Spectroscopy; Ultraviolet Spectroscopy; Valence; Vapor Deposition*

**20070015354** Hampton Univ., VA USA

**Large Resonant Third-order Optical Nonlinearity of CdSe Nanocrystal Quantum Dots**

Seo, JaeTae; Ma, SeongMin; Yang, Qiguang; Creekmore, Linwood; Battle, Russell; Brown, Herbert; Jackson, Ashley; Skyles, Tifney; Tabibi, Bagher; Yu, William; Jung, SungSoo; Namkung, Min; Jan 2006; 5 pp.; In English

Contract(s)/Grant(s): DAAD17-02-C-0107; DAAD19-03-1-0011

Report No.(s): AD-A464160; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464160>

Resonant third-order nonlinear optical susceptibility and hyperpolarizability of CdSe nanocrystal quantum dots were revealed to be  $\sim 2.6 \cdot 10^{20}$   $2.7 \cdot 10^{19}$   $\text{sq m/V}^2$  and  $\sim 2.2 \cdot 10^{40}$   $\text{m}^5/\text{V}^2$  by using nanosecond degenerate four-wave mixing at 532 nm. The large nonlinearity of the CdSe nanocrystals is attributed to the resonant excitation and multiple nonlinear optical processes.

DTIC

*Cadmium Selenides; Crystals; Nanocrystals; Nonlinearity; Quantum Dots*

**20070015368** Fluor Daniel Hanford, Inc., Richland, WA, USA, Pacific Northwest National Lab., Richland, WA, USA

**Operational Limitations for Demolition of a Highly Alpha-Contaminated Building Modeled Versus Measured Air and Surface Activity Concentrations**

Droppo, J. G.; Napier, B. A.; Lloyd, E. R.; Mantooth, D.; Minette, M. J.; Oct. 2006; 14 pp.; In English

Contract(s)/Grant(s): DE-AC06-96RL13200

Report No.(s): DE2006-895753; No Copyright; Avail.: Department of Energy Information Bridge

The demolition of a facility historically used for processing and handling transuranic materials is considered. Residual alpha emitting radionuclide contamination poses an exposure hazard if released to the local environment during the demolition. The process of planning for the demolition of this highly alpha contaminated building, 232-Z, included a predemolition modeling analysis of potential exposures. Estimated emission rates were used as input to an air dispersion model to estimate frequencies of occurrence of peak air and surface exposures. Postdemolition modeling was also conducted, based on the actual demolition schedule and conditions. The modeling results indicated that downwind deposition is the main operational limitation for demolition of a highly alpha-contaminated building. During the demolition of 232-Z, airborne radiation and surface contamination were monitored. The resultant non-detect monitoring results indicate a significant level of conservatism in the modeled results. This comparison supports the use of more realistic assumption in the estimating emission rates. The resultant reduction in modeled levels of potential exposures has significant implications in terms of the projected costs of demolition of such structures.

NTIS

*Contamination; Destruction; Models; Radioactive Wastes; Air; Concentration (Composition); Buildings*

**20070015389** University of Southern California, Los Angeles, CA USA

**Development of a Comprehensive and Predictive Reaction Mechanism of Liquid Hydrocarbon Combustion**

Wang, Hai; Jan 2007; 9 pp.; In English

Contract(s)/Grant(s): FA9550-05-1-0010; Proj-2328

Report No.(s): AD-A464234; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464234>

Studies were conducted in several relevant areas, including (1) validation of the chemistry and transport models against the extinction of ultra-lean premixed hydrogen-air mixtures, (2) a comprehensive theoretical analysis of the reaction kinetics of carbon monoxide and the hydroxyl radical, (3) a theoretical kinetic study of the decomposition of ethylene oxide; (4) a gas-kinetic analysis for the transport properties of long chain molecules in dilute gases, (5) quantum-chemistry, master equation modeling of the unimolecular decomposition of ortho-benzyne, (6) extension of the previously developed hydrocarbon model to combustion pressures as high as 600 atm, (7) an updated kinetic mechanism of small-hydrocarbon fuel combustion for use as a kinetic foundation of higher hydrocarbon combustion, and (8) a methodology for kinetic uncertainty propagation. These projects represent the two key ingredients for meeting the overall project objectives: (a) an accurate physico-chemical property database for combustion kinetics, and (b) a unified and optimized kinetic model for liquid aliphatic and aromatic fuel combustion with quantifiable uncertainties.

DTIC

*Carbon Monoxide; Combustion; Fuels; Hydrocarbon Combustion; Hydrocarbons; Predictions; Reaction Kinetics*

**20070015390** Applied Research Associates, Inc., Tyndall AFB, FL USA

**Ammonia-Based Hydrogen Source for Fuel Cell Applications**

Li, Lixiong; Hurley, James A; Jan 2006; 7 pp.; In English

Contract(s)/Grant(s): F08637-03-C-6006; Proj-2103

Report No.(s): AD-A464236; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464236>

Generation of hydrogen from the reaction of ammonia (NH<sub>3</sub>) with magnesium hydride (MgH<sub>2</sub>) was studied. Experiments were conducted at near ambient temperatures (75-150 deg C), which are lower than that required by ammonia cracking and/or metal hydride thermal decomposition reactions. Effects of selected catalysts/promoters for the production of hydrogen by the NH<sub>3</sub>-MgH<sub>2</sub> reaction were evaluated. Addition of ammonium chloride (NH<sub>4</sub>Cl) accelerated the NH<sub>3</sub>-MgH<sub>2</sub> reaction. MgH<sub>2</sub> doped with either PdCl<sub>2</sub> or PtCl<sub>4</sub> also showed increased reactivity towards NH<sub>3</sub> for H<sub>2</sub> production in the presence of NH<sub>4</sub>Cl. Results from this study demonstrated the feasibility of hydrogen production from ammonia-based reactions in support of portable hydrogen fuel cells. These preliminary results warrant further systematic studies to elucidate the activation mechanism of PdCl<sub>2</sub> or PtCl<sub>4</sub> as catalysts, as well as the role of NH<sub>4</sub>Cl as an additive, a reactant and/or a catalyst in the reaction system of interest.

DTIC

*Ammonia; Endothermic Reactions; Fuel Cells; Hydrides; Hydrogen; Hydrogen Fuels*

**20070015409** Wisconsin Univ., Madison, WI USA

**Interface Effects on Magnetism in Model Thin Films**

Lagally, Max G; Jan 25, 2007; 9 pp.; In English

Contract(s)/Grant(s): N00014-02-1-1026

Report No.(s): AD-A464264; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464264>

The goals of the research were to explore the fundamental physical mechanisms that allow interfaces between magnetic and nonmagnetic/magnetic and magnetic/vacuum) thin films to influence and control thin-film magnetic properties. We explored the relationship of magnetic properties to nano-scale chemical and physical interface morphologies. Our approach focused on obtaining a quantitative and microscopic description of these interface morphologies, and relating them quantitatively to magnetism. We grew our own films in-situ and used a unique combination of probes, to relate physical/chemical boundary morphology to behavior of magnetic moments at interfaces.

DTIC

*Flight Training; Magnetic Properties; Space Transportation System Flights; Thin Films; Training Devices; X Ray Scattering*

**20070015415** Purdue Univ., West Lafayette, IN USA

**Atomistic Simulations of Long-Range Strain and Spatial Asymmetry Molecular States of Seven Quantum Dots**

Korkusinski, Marek; Klimeck, Gerhard; Jan 2006; 5 pp.; In English

Contract(s)/Grant(s): EEC-0228390

Report No.(s): AD-A464273; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464273>

Coherent coupling and formation of molecular orbitals in vertically coupled quantum-dot molecules is studied for a seven-dot InAs/GaAs system. The electron states are computed using a nanoelectronic modelling tool NEMO-3D. The tool optimizes atomic positions in the sample with up to 64 million atoms in the frame of the atomistic VFF model. The resulting optimal interatomic distances are then used to formulate the 20-band sp<sup>3</sup>d<sup>5</sup>s\* tight-binding Hamiltonian defined on a subdomain large enough to guarantee a correct treatment of confined orbitals. It is found that in the absence of strain (VFF optimization turned off), a clear and highly symmetric miniband structure of the seven-dot orbitals is formed. It maintains a high degree of symmetry even if the dots are taken to be realistically non-identical, where the dot size increases in the growth direction. However, the inclusion of strain breaks this symmetry completely. The simulations demonstrate the important interplay of strain engineering and size engineering in the design of quantum dot stacks.

DTIC

*Asymmetry; Electron States; Gallium Arsenides; Indium Arsenides; Molecular Orbitals; Quantum Dots; Semiconductors (Materials); Simulation*

**20070015429** Nonlinear Control Strategies, Inc., Tucson, AZ USA

**A Control Strategy for High-Performance Macromolecular Materials**

Forest, M G; Jan 4, 2007; 9 pp.; In English

Contract(s)/Grant(s): FA9550-06-C-0017; Proj-7002

Report No.(s): AD-A464293; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464293>

This contract has led to a design and control capability for high performance, nano-composite materials. Results obtained explicitly link material performance properties to detailed modeling of flow processing. The target materials are nematic polymer nano-composites in which nano-elements are high-aspect-ratio rods or platelets with extreme property contrasts relative to the matrix. Benchmark prototype materials yield striking enhancements in multi-functional properties. A suite of modeling tools for design engineering, which did not exist previously, have been developed. We have developed key theoretical, modeling, and numerical tools for modeling nano-composite permeability to gases or liquids, high electrical conductivity, high and low thermal conductivity, and elastic moduli, and have developed an integrated model and simulation package, capable of direct predictions as well as inverse characterization tools. In this 9 month period, we have arrived at the key ingredients for a property control strategy.

DTIC

*Composite Materials; Electrical Resistivity; Liquid Crystals; Mechanical Properties; Platelets; Probability Distribution Functions; Rods; Tensors*

**20070015438** Utah State Univ., Logan, UT USA

**Design and Development of Nanoscale Biomotor Power Units**

Holz, Richard C; Feb 21, 2007; 8 pp.; In English

Contract(s)/Grant(s): F49620-02-1-0375; Proj-2312

Report No.(s): AD-A464307; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464307>

1. We have continued to refine our theoretical model for the design of a bacterial cell powered motor. 2. We have determined what types of surfaces bind motile bacterial cells. 3. We have monitored surface adhered bacterial cell motility using fluorescent dyes and found that cells remain alive and motile for more than 4 hours. 4. We have discovered that E. coli bacterial cells will not bind to surface dot features with a diameter of 1.2 micrometers or smaller. 5. We have designed and fabricated 'holed' surfaces that bind motile bacterial cells in a 'nose-on' fashion. 6. We have used DPN to attach bacterial cells to surfaces. 7. We have obtained and attached CheY deficient (*Pseudomonas aeruginosa*) 'smooth swimming' bacterial cells to prefabricated micro-array surfaces. 8. We have generated an initial design and fabricated a prototype micro-scale biomotor. 9. We have 'proof-of-concept' that motile bacterial cells can spin a device. Progress in the last four years has been excellent, and included the publication of three manuscripts (Small, Talanta and, Langmuir). We currently have at least two additional manuscripts in preparation.

DTIC

*Adhesion; Bacteria*

**20070015439** Idaho Univ., Moscow, ID USA

**Ionic Liquids as Energetic Materials**

Shreeve, Jeanne M; Mar 2007; 75 pp.; In English

Contract(s)/Grant(s): F49620-03-1-0209

Report No.(s): AD-A464308; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464308>

Remarkable progress was made in developing new compounds with many of the properties required for AFOSR specs. Several of the compounds have high positive heats of formation, densities approaching 2 g/cm<sup>3</sup>, and apparently low sensitivities. Heterocyclic rings (containing amino, nitro or azido substituents) paired with nitrate, perchlorate, dinitramide, or picrate anions form highly energetic salts which may be more environmentally acceptable (perchlorate excepted). Additionally, high energy salts in which both the cation and anion are high-nitrogen species, e.g., azolium, substituted azolium, guanidinium, bridged imidazolium and triazolium, urotropinium cations, etc. coupled with azolates, substituted azolates, azotetrazolate, bis(5,5'-tetrazolates), iminobis(5-tetrazolate), etc. were synthesized. All have been thoroughly characterized via NMR and mass spectral analyses, melting point, thermal stability, density, and elemental analyses. Gaussian03 and

CHEETAH 4.0 gave heats of formation, and detonation pressure/velocity and specific impulse. An accurate empirical method for estimation of densities of energetic compounds was developed.

DTIC

*Explosives; Liquids*

**20070015441** Pennsylvania State Univ., University Park, PA USA

**Simulation of Reaction for the Design of Energetic Materials, Resistant Coatings, and Laser Protection Devices**

Hammes-Schiffer, Sharon; Dec 2006; 16 pp.; In English

Contract(s)/Grant(s): FA9550-04-1-0062

Report No.(s): AD-A464311; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464311>

The objective of this research was the development of theoretical and computational methods to guide the design and characterization of materials relevant to the Air Force. The research centered on the development of new methodology for the simulation of hydrogen transfer reactions. The method development focused mainly on the nuclear-electronic orbital method for the incorporation of nuclear quantum effects in electronic structure calculations. Other projects included simulations of proton transfer reactions in condensed phases, calculations of vibronic couplings for self-exchange hydrogen transfer reactions, and computational studies of hydrogen bonding properties in ionic liquids. The applications of these novel computational approaches to materials relevant to the Air Force are providing information that should aid in the design and characterization of these materials. Ionic liquids are of interest to the Air Force due to the wide range of technological applications, including the development of highly energetic and environmentally benign propellants.

DTIC

*Explosives; Hydrogen Bonds; Laser Damage; Lasers; Protection; Simulation*

**20070015461** Utah Univ., Salt Lake City, UT USA

**Chalcogenide Materials Fabrication and Initial Characterization for Reconfigurable Interconnect Technology**

Taylor, P C; Oct 1, 2006; 51 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F29601-03-1-0229; Proj-4846

Report No.(s): AD-A464352; UU-04; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464352>

The optical properties of sputtered, amorphous films of GeTe, Sb<sub>2</sub>Te<sub>3</sub>, and Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub> grown up to several micrometers thick are influenced by the presence of oxygen impurities. The absorption edges in these glasses are sometimes broader than in standard chalcogenide glasses, such as GeSe<sub>2</sub> and As<sub>2</sub>Se<sub>3</sub>. This result implies either that the valance band consists of high strained bonds or that large densities of defects exist. Below the optical gap the refractive index for Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub> is approximately 3.5. In samples of Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub> made with large oxygen concentrations using a hot-pressed target, there exists a large ESR signal corresponding to a defect density of 10 to the power of 19 cm to the power of -3. In samples with the lowest oxygen contamination levels (approximately 10 to the power of 19 cm to the power of -3) no ESR signal is observed, which implies that the defect density is below 10 to the power of 18 com to the power of -3. ESR signals associated with the glassy SiO<sub>2</sub> interface with the chalcogenide films are also observed. In amorphous Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub>, the average coordination numbers for Ge, Sb, and Te are approximately 4, 3, and 2.5 respectively.

DTIC

*Chalcogenides; Fabrication; Impurities; Optical Properties; Oxygen; Refractivity*

**20070015462** TDA Research, Inc., Wheat Ridge, CO USA

**Pd Alloy Membranes for Hydrogen Separation from Coal-Derived Syngas**

Alptekin, Gokhan O; DeVoss, Sarah; Amalfitano, Bob; Way, Douglas; Thoen, Paul; Lusk, Mark; Sep 26, 2006; 23 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W56HSV-06-C-0077

Report No.(s): AD-A464356; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464356>

TDA Research Inc., in collaboration with Colorado School of Mines (CSM) is developing a sulfur and CO-tolerant membrane to produce the clean hydrogen from syngas using Pd membrane films prepared on a variety of supports (e.g. symmetric ceramic supports and porous stainless steel supports). This paper summarizes the results of the membrane development and test efforts. Membranes that showed superior properties in screening tests using hydrogen/nitrogen mixtures

were further evaluated under representative conditions. In general, membranes showed very good stability in water gas shift environmental and were tested for several days with stable permeance and selectivity. We examined the effect of operating parameters including temperature, pressure and H<sub>2</sub> recovery on membrane performance. We also investigated the impact of CO, CO<sub>2</sub> and H<sub>2</sub>S concentration in the reformat gas on the H<sub>2</sub> permeation and selectivity of the membrane.

DTIC

*Coal; Hydrogen; Membranes; Palladium Alloys; Synthesis Gas*

**20070015471** Choate Hall and Stewart, LLP, Boston, MA, USA

**Polarizing Agents for Dynamic Nuclear Polarization**

Griffin, R. G.; Hu, K. N.; 18 Aug 04; 11 pp.; In English

Contract(s)/Grant(s): EB002804-15

Patent Info.: Filed Filed 18 Aug 04; US-Patent-Appl-SN-10-920 900

Report No.(s): PB2007-101585; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We describe polarizing agents for use in enhancing NMR and MRI signals via dynamic nuclear polarization (DNP). The polarizing agents include two or more paramagnetic centers, preferably two paramagnetic centers. In a preferred embodiment, the polarizing agent comprises two nitroxide radicals tethered by a polyethylene glycol chain of variable length. Signal enhancements of up to 175 have been achieved in comparison with factors of (approx.) 45 at similar concentrations of monomeric radical such as TEMPO.

NTIS

*Polarization (Spin Alignment); Imaging Techniques; Nuclear Spin*

**20070015699** Gohypersonic, Inc., Dayton, OH USA

**Cavity-Based Injector Mixing Experiments for Supersonic Combustors With Implications on Igniter Placement (Postprint)**

Jacobsen, Lance S; Carter, Campbell D; Dwenger, Andrew C; Oct 2006; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A464135; AIAA-2006-5268; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Mixing experiments using simultaneous acetone and NO PLIF were performed in the AFRL/PRA Test-cell 19 supersonic wind tunnel. These experiments investigated the influence of simulated plasma-torch placement in an injector-cavity configuration exposed to a supersonic crossflow. Both the simulated plasma torch and fuel injector holes injected room temperature air, respectively seeded with acetone and nitric oxide (NO). Experiments at the streamwise centerline of the rectangular wind tunnel investigated the differences between an aero-ramp and a single 15-degree downstream-angled injector in coupling to the recirculating flow in a downstream cavity. The influence of wall effects were investigated with a similar single-hole injector placed 3.5 injector diameters from the sidewall of the rectangular duct. Simulated plasma torch holes were tested up and downstream of the injectors, all upstream of the cavity. Tests took place in a uniform Mach-2 crossflow; the respective tunnel total pressure and temperature were 1.7 atmospheres and 530 K.

DTIC

*Cavities; Combustion Chambers; Fuel Injection; Igniters; Injectors; Supersonic Combustion*

**20070015721** Hampton Univ., VA USA

**Third-Order Optical Nonlinearities of Singlewall Carbon Nanotubes for Nonlinear Transmission Limiting Application**

Seo, JaeTae; Ma, SeongMin; Yang, Qiguang; Creekmore, Linwood; Battle, Russell; Tabibi, Makaye; Brown, Herbert; Jackson, Ashley; Skyles, Tifney; Tabibi, Bagher; Jan 2006; 5 pp.; In English

Contract(s)/Grant(s): DAAD19-03-1-0011; W911NF-04-1-0393

Report No.(s): AD-A464380; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Third-order nonlinear susceptibility of single wall carbon nanotubes thin film was measured to be  $\sim 1.4 \times 10^{16}$  (exp -16) sq m/V<sup>2</sup>. The nonlinear transmission limiting threshold of carbon SWNT was  $\sim 20$  MW/sq cm with visible and nanosecond laser excitation.

DTIC

*Carbon Nanotubes; Nonlinear Optics; Nonlinearity; Transmittance; Walls*

**20070015733** North Carolina State Univ., Raleigh, NC USA

**Local Bonding Arrangements in Amorphous Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub>: The Importance of GE and TE Bonding**

Baker, D A; Dec 5, 2006; 12 pp.; In English

Contract(s)/Grant(s): F29601-03-01-0229; Proj-4846

Report No.(s): AD-A464396; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Studies of amorphous (a-) semiconductors have been driven by technological advances as well as fundamental theories. Observation of electrical switching, for example, fueled early interest in a-chalcogenides. More recently a-chalcogenides switching has been applied successfully to programmable memory devices, as well as DVD technology where the quest for the discovery of better-suited materials continues. Thus, switching grants researchers today with an active arena of technological as well as fundamental study. Bond constraint theory and rigidity theory provided a powerful framework for understanding the structure and properties of a-materials. Application of these theories to switching in a-chalcogenides holds the promise of finding the best composition suited for switching applications. Extended X-ray Absorption Fine Structure (EXAFS) spectroscopy is an ideally suited technique to investigate the switching properties of these materials. Results of previous EXAFS experiments are presented and viewed through the lens of bond constraint theory and rigidity theory.

DTIC

*Amorphous Materials; Bonding*

**20070015735** Dayton Univ., OH USA

**Investigation of Kinetics of Iso-Octane Ignition Under Scramjet Conditions (Postprint)**

Kahandawala, Moshan S; Corera, Shehan A; Sidhu, Sukh S; Williams, Skip; Carter, Campbell D; Oct 2006; 10 pp.; In English

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A464398; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A single pulse reflected shock tube was used to investigate iso-octane ignition over the temperature range of 900-1400 K at a pressure of ~1 atm. To account for the anticipated long ignition delay times at the lower temperatures, long shock tube dwell times (~12 ms) at lower temperature and near atmospheric pressure were achieved by using argon-helium mix as a driver gas. Chemical thermometer experiments were conducted to remove any uncertainties in determining post-reflected shock temperatures. The ignition delay data obtained in this study are in good agreement (in the overlap region) with the iso-octane ignition data from a previous shock tube study. However, the activation energy of iso-octane ignition obtained in this study in the lower temperature region (>1300 K) is significantly smaller (~15 kcal vs. ~40 kcal) than that obtained in a previous higher temperature study. The deflagration may be responsible for lowering of activation energy under the conditions of this study. The AFRL mechanism showed a good agreement with measured ignition delays while a second mechanism (Curran et al.) showed poorer agreement.

DTIC

*Ignition; Kinetics; Reaction Kinetics; Supersonic Combustion Ramjet Engines*

**20070015796** Naval Research Lab., Washington, DC USA

**Spatial and Spectral Resolution of a Germanium Strip Detector**

Kroeger, R A; Johnson, W N; Kinzer, R L; Kurfess, J D; Inderhees, S; Philips, B; Gehrels, N; Jan 1994; 5 pp.; In English

Report No.(s): AD-A464495; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Germanium strip detectors combine both the excellent energy resolution typical of germanium detectors and fine spatial resolution possible in a strip detector. They are applicable to sensitive, high spectral resolution nu-ray detectors using coded-aperture or Compton telescope techniques. Our first detector is in a planar geometry with orthogonal strips on the upper and lower detector surfaces, providing 9 mm spatial resolution. The detector has 5 strips on each surface and an active volume of 45x45x12 mm. Good spatial and energy resolution are demonstrated.

DTIC

*Detectors; Germanium; Resolution; Spatial Resolution; Spectral Resolution; Spectroscopy*

**20070015802** Naval Research Lab., Washington, DC USA

**InGaAs/AlGaAs Intersubband Transition Structures Grown on InAlAs Buffer Layers on GaAs Substrates by Molecular Beam Epitaxy**

Katzer, D S; Rabinovich, W S; Beadie, G; Jun 2000; 6 pp.; In English

Report No.(s): AD-A464508; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We report on the use of InAlAs linearly graded buffer layers for improving the performance of In(sub y)Ga(sub



1-y)As(y\g0.42)/0.42)/AlGaAs intersubband transition (ISBT) superlattice structures grown on GaAs substrates by molecular beam epitaxy. Linearly graded InAlAs buffer layers give better optical confinement in the active superlattice region, similar intersubband transition linewidths, and comparable surface morphology compared to linearly graded InGaAs buffer layers. The best surface morphology for our ISBT superlattices was obtained by growing the linearly graded InGaAs buffer layer at 360 degrees C.

DTIC

*Aluminum Gallium Arsenides; Gallium Arsenides; Indium Aluminum Arsenides; Indium Gallium Arsenides; Molecular Beam Epitaxy; Substrates*

**20070015808** National Inst. of Advanced Industrial Science and Technology, Ibaraki, Japan

**First-Principles Calculation of Spin Transport in Magnetic Nanowire Using Green's Function Method with Localized Basis Set**

Kobayashi, Nobuhiko; Ozaki, Taisuke; Hirose, Kenji; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464516; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report ab-initio calculations of the spin-dependent transport and magnetoresistance of Ni atom wires. The electronic states are calculated using a numerical pseudo atomic orbital basis set in the frame work of the density functional theory, and the conductance is calculated using the Green's function method. We show a magnetoresistance of 250%, which is explained by the scattering of d orbital channels.

DTIC

*Atoms; Electron States; Green's Functions; Magnetoresistivity; Nanowires*

**20070015824** National Inst. for Materials Science, Tsukuba, Japan

**Voltage-Induced Insulator-Metal Transition at Room Temperature in an Anodic Porous Alumina Thin Film**

Kato, S; Nigo, S; Uno, Y; Onisi, T; Kido, G; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464541; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Bistable switching effect, induced by an electric field, in an anodic porous alumina thin film is reported. An electrode was bonded on the surface of a thin film with Ag paste, and I-V characteristic between the electrode and the aluminium substrate was measured. The I-V characteristic reveals a reversible resistance change, initiating at +4 V and terminating at 1.5 V at room temperature. Huge electrical resistance change ratio (RR), defined as the ratio of the resistance change to the low resistance state, is observed. The RR is approximately ten million. The resistance in the low resistance state was measured down to 18 K. The temperature dependence of the resistance shows a metal-like behaviour. The huge RR and the temperature dependence of the resistance suggest that an insulator-metal transition is occurred. Excellences of this device are huge RR ratio, easiness of mass production, and containing only common materials. It is a promising material for non-volatile memory with low power consumption and other electrical applications.

DTIC

*Aluminates; Aluminum Oxides; Anodes; Bistable Circuits; Electric Fields; Electric Potential; Insulators; Porosity; Room Temperature; Thin Films; Transition Temperature*

**20070015847** New Jersey Inst. of Tech., Newark, NJ USA

**Inductive Cross Shaped Metal Meshes in Silicon Substrate**

Sternberg, O; Moller, K D; Grebel, H; Stewart, K P; Henry, R M; Apr 12, 2002; 10 pp.; In English

Contract(s)/Grant(s): ECS-9820200

Report No.(s): AD-A464593; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Thin inductive metal meshes on silicon substrate have been studied in the infrared spectral region. The wavelength dependent transmissions of meshes with cross shaped, square shaped, rectangular shaped openings, and meshes with grating pattern were measured. The resonance wavelength and width of resonance were determined for various geometries of the openings. The Micro-Stripes program was used for the calculation of resonance wavelength and width of resonance of cross shaped metal meshes and best-fit formulas were developed for the presentation of the data. The dependence on the shape of the opening was studied for free standing thin meshes and meshes on a silicon substrate. The Wood anomaly was studied experimentally for cross, square, rectangular shaped meshes and for gratings on silicon substrate. A simple model for the dependence of the Wood anomaly on the refractive index is presented.

DTIC

*Anomalies; Mesh; Silicon; Substrates; Wood*

**20070015859** California Univ., Santa Barbara, CA USA

**System for Bulk Growth of Gallium Nitride. Vapor Phase Epitaxy of Gallium Nitride by Gallium Arc Evaporation**

Heikman, Sten J; Mishra, Umesh K; Mar 9, 2005; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-03-1-0235

Report No.(s): AD-A464611; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A vapor phase growth system intended for the growth of bulk gallium nitride crystals was investigated. Potential advantages of the growth technique are cheap source materials of high purity, no corrosive gasses, and low operating and equipment costs. Ga contained in a crucible was evaporated by an arc discharge between a W-electrode and the Ga surface, and was transported to the growth zone by a carrier gas flowing over the Ga source. After mixing with ammonia, the mixture was passed between a top and a bottom susceptor, on which samples were mounted. High growth rates as high as 30 micrometers/hr were obtained on the top sample. The surface of deposited material was rough near the front of the susceptor, but was specular elsewhere and showed step-flow growth morphology in atomic force microscopy. The bottom sample experienced lower growth rates and a high density of macroscopic defects, presumably caused by Ga droplets in the gas phase. Computer flow dynamic simulations predicted growth rates 4 times higher than experiments. The discrepancy was attributed to ammonia pre-reactions, based on the experimental growth rate dependence on ammonia partial pressure. An additional factor 4 reduction in efficiency was due to Ga wall condensation between the evaporation and growth zones. The overall growth efficiency was 2 %.

DTIC

*Epitaxy; Evaporation; Gallium; Gallium Nitrides; Vapor Phase Epitaxy; Vapor Phases*

**20070015970** Aerospace Corp., El Segundo, CA USA

**Digital Imaging and Analysis of Particulate Contamination**

Luey, K T; Taylor, D P; Coleman, D J; Folgner, K A; Dec 15, 2006; 23 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8802-04-C-0001

Report No.(s): AD-A464149; TR-2006(8565)-10; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The use of digital cameras and digital imaging software for the measurement of particle obscuration is discussed. Novel calibration standards are used to evaluate the sensitivity and accuracy of commercially available digital cameras for detecting microscopic dust particles and other contaminant features on surfaces. Lighting and illumination effects are also illustrated and discussed. The digital image histogram of particles on a surface is shown to give good results for the percent area coverage.

DTIC

*Contamination; Imaging Techniques; Particulates*

**20070015979** Aerospace Corp., El Segundo, CA USA

**Formation of Contaminant Droplets on Surfaces**

Luey, K T; Coleman, D J; Dec 15, 2006; 24 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8802-04-C-0001

Report No.(s): AD-A464143; TR-2006(8565)-11; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464143>

The effects of molecular film contamination on optical systems depend strongly on the film uniformity and thickness. Molecular films of uniform thickness are responsible for light transmission losses through absorption. For example, a partially darkened film of dioctyl phthalate 100 Å thick may cause losses of about 2% in the visible spectrum. However, Ternet, et al, Villahermosa, et al, and others have shown that scattering from droplets or 'puddles' can cause transmission losses of 30%. In this report, we examine properties of the contaminant and surface that drive the formation of smooth films and droplets. It is shown that surfaces play a strong and sometimes dominant role in controlling film or droplet formation. DC 704, a high-purity, siloxane liquid, is shown to assume both droplet and smooth film character depending on the surface.

DTIC

*Contaminants; Drops (Liquids); Monomolecular Films*

**20070015984** Bozicevic Field and Francis, LLP, Palto Alto, CA, USA

**Universal Linker Compositions for the Release or Transfer of Chemical Agents from a Polynucleotide**

Kool, E. T.; Abe, H.; 1 Sep 05; 33 pp.; In English

Contract(s)/Grant(s): GM068122; DAAD19-03-1-0066

Patent Info.: Filed 1 Sep 05; US-Patent-Appl-SN-11-218 961  
Report No.(s): PB2007-101719; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A universal linker structure is provided, in which a functional group and activating leaving group are placed on a tether, allowing the placement of an electrophile at the end of any nucleic acid sequence. The electrophile on the tether can react with a second nucleic acid carrying a nucleophile when the two nucleic acids are hybridized near one another, resulting in release of the leaving group, and creation of a functional change. The linker can be designed to destabilize the ligation product without slowing the rate of reaction. This lowers product inhibition, and the target DNA or RNA can become a catalyst for isothermally generating multiple signals for detection. This enhanced signal is demonstrated in solution experiments and in solid supported assays. The universal linkers of the present invention are simple and inexpensive to prepare, and can be appended to any polynucleotide in automated steps on a standard DNA synthesizer.

NTIS

*Patent Applications; Polynucleotides*

**20070015986** Jones Tullar and Cooper, PC, Arlington, VA, USA

**Single Step, High Temperature Nucleation Process for a Lattice Mismatched Substrate**

Shealy, J. R.; Smart, J. A.; 2 Mar 05; 5 pp.; In English

Contract(s)/Grant(s): N00014-96-1-1223; DABT63-C95-0121

Patent Info.: Filed 2 Mar 05; US-Patent-Appl-SN-11-069 040

Report No.(s): PB2007-101727; No Copyright; Avail.: CASI: [A01](#), Hardcopy

A single step process for nucleation and subsequent epitaxial growth on a lattice mismatched substrate is achieved by pre-treating the substrate surface with at least one group III reactant or at least one group II reactant prior to the introduction of a group V reactant or a group VI reactant. The group III reactant or the group II reactant is introduced into a growth chamber at an elevated growth temperature to wet a substrate surface prior to any actual crystal growth. Once the pre-treatment of the surface is complete, a group V reactant or a group VI reactant is introduced to the growth chamber to commence the deposition of a nucleation layer. A buffer layer is then grown on the nucleation layer providing a surface upon which the epitaxial layer is grown preferably without changing the temperature within the chamber.

NTIS

*High Temperature; Nucleation; Patent Applications; Substrates*

**20070015988** Peters Verny Jones and Schmitt, Palo Alto, CA, USA

**Surface Manipulation and Selective Deposition Processes Using Adsorbed Halogen Atoms**

Muscat, A. J.; 21 Feb 06; 23 pp.; In English

Contract(s)/Grant(s): EEC-9528813

Patent Info.: Filed 21 Feb 06; US-Patent-Appl-SN-11-358 953

Report No.(s): PB2007-101728; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention provides a surface preparation process using adsorbed halogen. The halogen is applied in a gas phase with UV light. The adsorbed halogen is subsequently modified in another gas phase reaction. The halogen may be reacted with water to form a hydroxyl-bearing Si-O monolayer that forms a layer for subsequent metal deposition. In one aspect the halogen layer is reacted with an alkyl or alkoxy of the formula R-OH to form a passivation layer. By replacing hydrogen atom termination with alkoxy (e.g. methoxy termination, -OCH<sub>3</sub>). The selective deposition process can be used for passivating and depositing thin metal films on material surfaces composed of any combination of the group consisting of semiconductors, conductors, insulators, and the like.

NTIS

*Adsorption; Deposition; Halogens; Patent Applications*

## 26

### METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

**20070014842** Department of Energy, Las Vegas, NV, USA

**Electrochemical Testing of Gas Tungsten ARC Welded and Reduced Pressure Electron Beam Welded Alloy 22**

Day, S. D.; Wong, F. M. G.; Gordon, S. R.; Wong, L. L.; Rebak, R. B.; May 08, 2006; 11 pp.; In English

Report No.(s): DE2007-893361; No Copyright; Avail.: National Technical Information Service (NTIS)

Alloy 22 (N06022) is the material selected for the fabrication of the outer shell of the nuclear waste containers for the Yucca Mountain high-level nuclear waste repository site. A key technical issue in the waste package program has been the integrity of the container weld joints. The currently selected welding process for fabricating and sealing the containers is the traditional gas tungsten arc welding (GTAW) or TIC method. An appealing faster alternative technique is reduced pressure electron beam (RPEB) welding. It was of interest to compare the corrosion properties of specimens prepared using both types of welding techniques. Standard electrochemical tests were carried on GTAW and RPEB welds as well as on base metal (non-welded) to determine their relative corrosion behavior in simulated concentrated water (SCW) at 90 C (alkaline), 1 M HCl at 60 C (acidic) and 1 M NaCl at 90 C (neutral) solutions. Results show that for all practical purposes, the three tested materials had the same electrochemical behavior in the three tested electrolytes.

NTIS

*Corrosion; Electron Beams; Gas Pressure; Mountains; Radioactive Wastes; Tungsten; Waste Management*

**20070014953** Iowa State Univ. of Science and Technology, Ames, IA USA

**Rare-Earth Transition-Metal Intermetallics. Structure Bonding Property Relationships**

Han, M. K.; May 06, 2006; 233 pp.; In English

Report No.(s): DE2006-882892; IS-T 2306; No Copyright; Avail.: Department of Energy Information Bridge

The explorations of rare-earth, transition metal intermetallics have resulted in the synthesis and characterization, and electronic structure investigation, as well as understanding the structure-bonding property relationships. The work has presented the following results: (1) Understanding the relationship between compositions and properties in LaFe(sub 13-x)Si(sub x) system: A detailed structural and theoretical investigation provided the understanding of the role of a third element on stabilizing the structure and controlling the transformation of cubic NaZn(sub 13)-type structures to the tetragonal derivative, as well as the relationship between the structures and properties. (2) Synthesis of new ternary rare-earth iron silicides Re(sub 2-x)Fe(sub 4)Si(sub 14-y) and proposed superstructure: This compound offers complex structural challenges such as fractional occupancies and their ordering in superstructure. (3) Electronic structure calculation of FeSi(sub 2): This shows that the metal-semiconductor phase transition depends on the structure. The mechanism of band gap opening is described in terms of bonding and structural distortion. This result shows that the electronic structure calculations are an essential tool for understanding the relationship between structure and chemical bonding in these compounds. (4) Synthesis of new ternary rare-earth Zinc aluminides Tb(sub 3)Zn(sub 3.6)Al(sub 7.4): Partially ordered structure of Tb(sub 3)Zn(sub 3.6)Al(sub 7.4) compound provides new insights into the formation, composition and structure of rare-earth transition-metal intermetallics. Electronic structure calculations attribute the observed composition to optimizing metal-metal bonding in the electronegative (Zn, Al) framework, while the specific ordering is strongly influenced by specific orbital interactions. (5) Synthesis of new structure type of Zn(sub 39)(Cr(sub x)Al(sub 1-x))(sub 81): These layered structures are similar to icosahedral Mn-Al quasicrystalline compounds. Therefore, this compound may provide new insights into the formation, composition and structure of quasicrystalline materials.

NTIS

*Bonding; Electronic Structure; Intermetallics; Rare Earth Elements*

**20070015046** Sandia National Labs., Albuquerque, NM USA

**Characterization of Aluminum Honeycomb and Experimentation for Model Development and Validation. Volume II, Honeycomb Experimentation for Model Development and Validation**

Hinnerichs, T. D.; Carne, T. G.; Lu, W. Y.; Stasiunas, E. C.; Neilsen, M. K.; Aug. 01, 2006; 156 pp.; In English

Report No.(s): DE2006-889957; SAND2006-4455; No Copyright; Avail.: National Technical Information Service (NTIS)

The crush of aluminum honeycomb is a very attractive shock mitigation concept for dissipating large amounts of kinetic energy in laydown weapon systems such as the B61-7 and for shipping container applications. This report is the second of a three-volume set describing aluminum honeycomb crush behavior and model validation. Volume I documents an experimental study of the crush behavior of high-density aluminum honeycombs. Volume III is yet to be published. It will cover the execution of the validation plan described in Volume II. This report, Volume II, describes the need for an improved constitutive model for the large deformation of aluminum honeycomb and is intended to document the procedure that was followed to provide data to calibrate and validate a new constitutive model for large deformation of aluminum honeycomb. The emphasis is on the experimental procedures, but sufficient model description is given to motivate the experiments that were documented herein. The model is first discussed along with the metric, or measuring stick, that will be used to quantify the models fit with test data. Next, a description of the necessary constitutive tests and the associated test data are shown that are being used to calibrate the model parameters for the new Honeycomb Crush Model. Parameters for the linear elastic portion of the model are described first, followed by the nonlinear crush parameters. Next, a description of the dynamic

experiments used to quantify strain rate sensitivity of the honeycomb are given. The final three chapters cover the basic model (single physics or Tier 1) validation and the combined physics or Tier II model validation steps. Finally, all the calibration and validation data are presented.

NTIS

*Aluminum; Honeycomb Structures*

**20070015193** Aerospace Testing Alliance, Arnold AFB, TN USA

**Hypersonic Wind Tunnel Nozzle Survivability for T&**

Felderman, E J; Akers, D T; Liu, C T; Schneibel, J; Mar 2007; 55 pp.; In English

Contract(s)/Grant(s): Proj-10054; Proj-0909

Report No.(s): AD-A463872; AEDC-TR-06-17; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463872>

The nozzle in a hypersonic wind tunnel is generally subjected to a severe thermal environment. Several methods can be used to manage the energy absorbed by the nozzle, including backside cooling, film/transpiration cooling, and storing the energy in a heatsink fashion. The development of new alloys that retain strength at higher temperatures has increased the feasibility of the self-limiting heat-sink mode of operation. This paper discusses the development of a series of such alloys as well as the applications for which they have been designed. The most promising of these is an Ir-Zr alloy. A nozzle has been fabricated from this alloy. Nozzle survivability tests with this alloy are planned.

DTIC

*High Temperature; Hypersonic Wind Tunnels; Iridium Alloys; Nozzles; Wind Tunnel Nozzles; Zirconium Alloys*

**20070015288** Naval Research Lab., Stennis Space Center, MS USA

**The Effects of Microstructure on Shear Properties of Shallow Marine Sediments**

Kim, Gil Y; Yoon, Hong J; Kim, Jin W; Kim, Dae C; Khim, Boo K; Kim, Seok Y; Jan 2007; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464041; NRL/JA/7430-07-4; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464041>

This study was undertaken to investigate the implication of geoacoustic behaviors in the shallow marine sediments associated with the changes in geotechnical index properties. Two piston cores (270cm and 400cm in core length) used in this study were recovered from stations 1 and 2, the western continental margin, the East Sea. Scanning electron microscopy (SEM) was employed to illustrate the effects of microstructure on shear properties. The direct SEM observation of sediment fabrics is inevitable to understand the correlation of the changes in geoacoustic properties to the sediment structure. The consolidation of sediments by overburden stress resulting in the clay fabric alteration appears to play an important role in changing shear properties. Water contents and porosity of sediments gradually decreases with increasing depth, whereas wet bulk density shows a reverse trend. It is interesting to note that shear wave velocities increase rapidly from 8 to 20 m/s while compressional wave velocities significantly fluctuate, ranging from 1450 to 1550 m/s with depth. The fabric changes in sediment with increasing depth for example, uniform grain size and well oriented clay fabrics may cause the shear strength increase from 1 to 12 kPa. Shear wave velocity is, therefore, shown to be very sensitive to the changes in undrained strength for unconsolidated marine sediments. This correlation allows an in-situ estimation of shear stress in the subsurface from shear wave velocity data.

DTIC

*Compression Waves; Geotechnical Engineering; Microstructure; Sediments; Shear Properties*

**20070015371** Naval Air Warfare Center, Patuxent River, MD USA

**Fatigue of Ti-3Al-2.5V Alloy Tube and Rod**

Lee, E U; Taylor, R E; Sanders, H C; Lei, C; Yu, M; Feb 28, 2007; 38 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464195; NAWCADPAX/TR-2007/11; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464195>

The hydraulic impulse fatigue of Ti-3Al-2.5V alloy tube was studied under cyclic hydraulic pressurization and the low cycle fatigue (LCF) of the alloy tube and rod under cyclic axial straining. Employing a newly fabricated test frame, the cyclic-pressurization-induced fatigue crack growth through the tube wall thickness was characterized quantitatively. On the basis of the results, a relationship between electric potential drop and crack depth was established and a method of determining fatigue crack initiation, growth, and fracture lives was also defined. The LCF behavior of the alloy tube and rod was

investigated, examining the shape change of load-displacement hysteresis loop and the drop of load and elastic modulus with increasing strain cycle. The LCF crack initiation and growth lives were defined. They were found to follow the Coffin-Manson relation with relatively longer LCF crack initiation life. The LCF lives were longer for the tube than the rod. This is attributable to the greater cold work done in the tube forming process, evidenced by the smaller in size and higher tensile strength.

DTIC

*Crack Propagation; Rods; Titanium Alloys*

**20070015707** Naval Postgraduate School, Monterey, CA USA

**Characterization of Microstructure and Microtexture in Longitudinal Sections from Friction Stir Processed Nickel-Aluminum Bronze**

Faires, Kenneth B; Jun 2003; 77 pp.; In English

Report No.(s): AD-A464287; No Copyright; Avail.: CASI: A05, Hardcopy

Cast nickel-aluminum bronze (NAB) is the material of choice for propellers in both surface ships and submarines. New designs require a material with improved strength and hardness while retaining NAB's corrosion resistance. Friction stir processing (FSP) represents a new technology for surface hardening of as-cast NAB by means of severe plastic deformation induced by a rotating tool that is traversed across the surface of a material. FSP can convert a microstructure from a cast to a wrought condition without altering the overall shape of the object being worked. The purpose of this study is to apply recently developed orientation imaging microscopy (OIM) methods to evaluate the influence of FSP on microstructure and microtexture of an as-cast NAB material. Processed material was examined in planes having both longitudinal and transverse orientations with respect to tool motion. Shear textures in the thermomechanically-affected zone (TMAZ) were of particular concern. Results of the analysis of this work will be described and the implications to FSP of NAB propeller materials will be delineated.

DTIC

*Aluminum; Aluminum Alloys; Bronzes; Corrosion Resistance; Friction; Friction Stir Welding; Microstructure; Nickel; Nickel Alloys; Nickel Aluminides; Shear Properties; Submarines*

## 27

### NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials*.

**20070014848** Northwestern Univ., Evanston, IL USA

**Atomic and Electronic Structure and Chemistry of Ceramic/Metal Interfaces (Final Report, September 1, 1996-February 29, 2004)**

Seidman, D. N.; Jul. 07, 2006; 17 pp.; In English

Contract(s)/Grant(s): DE-FG02-96ER45597

Report No.(s): DE2007-896097; No Copyright; Avail.: Department of Energy Information Bridge

Materials containing ceramic and metal phases play a significant role in modern materials technology.

NTIS

*Atomic Structure; Ceramics; Electronic Structure; Metals; Molecular Structure*

**20070014952** Alaska Univ., Fairbanks, AK, USA, Missouri Univ., Rolla, MO, USA, Houston Univ., TX, USA, Toronto Univ., Ontario, Canada

**Oxygen Transport Ceramic Membranes. Quarterly Report for April 2006 to June 2006**

Bandopadhyay, S.; Nithyanantham, T.; Jul. 2006; 32 pp.; In English

Contract(s)/Grant(s): DE-FC26-99FT40054

Report No.(s): DE2006-895737; No Copyright; Avail.: National Technical Information Service (NTIS)

A non-agglomerated and nanocrystalline-sized powder was successfully produced using ethylene glycol nitrate methods. The LSFT powder prepared using this method exhibits well dispersed and nano sized particles about 100-200 nm. The density of LSFT sintered at 1300 C was about 90% of the theoretical density at which is 100 C less than that of the previous LSFT which was sintered at 1400 C. The sample sintered at 1400 C exhibited the evidence of a liquid phase at the grain boundaries and 2nd phase formation which probably caused low mechanical stability. The electrical conductivity and Seebeck coefficient were measured as a function of temperature. The LSFT-CGO specimens were cut from the as sintered bars and used for the

evaluation of Mechanical Properties after polishing. The effect of strain rate on the flexural strength of the LSFT-CGO test specimens was studied. Three strain rates 6, 60 and 600 in/ min were chosen for this study. It is observed from the results that with increasing cross head speed the membrane takes higher loads to fail. A reduction in the strength of the membrane was observed at 1000DGC in N<sub>2</sub>. Two different routes were investigated to synthesis GDC using either formate or carbonate precursors. The precursor and CGO particle morphologies were examined by scanning electron microscopy. The thermal decomposition behaviors of Ce(Gd)(HCOO)<sub>3</sub> and Ce(Gd)(CO<sub>3</sub>)(OH) were determined by thermogravimetric analysis (TGA) at a rate of 3DGC/min in air. The X-ray powder diffraction patterns of the precursor and CGO were collected and nitrogen adsorption isotherms were measured. Conductivity measurements were made by AC impedance spectroscopy on sintered disks in air using platinum electrodes.

NTIS

*Ceramics; Mechanical Properties; Membranes; Oxygen*

**20070014954** Alaska Univ., Fairbanks, AK, USA, Missouri Univ., Rolla, MO, USA, Houston Univ., TX, USA, Toronto Univ., Ontario, Canada

**Oxygen Transport Ceramic Membranes. Quarterly Report for July 2006 to September 2006**

Bandopadhyay, S.; Nihyanantham, T.; Oct. 2006; 37 pp.; In English

Contract(s)/Grant(s): DE-FC26-99FT40054

Report No.(s): DE2006-895740; No Copyright; Avail.: National Technical Information Service (NTIS)

The total electrical conductivity and Seebeck coefficient were measured in air on both porous and dense LSFT samples, which were prepared using nano-crystalline powders. The conductivity in air at 900 C was about 0.19 and 1.5 S/cm for porous and dense LSFT, respectively. The activation energy of conduction for the porous and dense LSFT was about 0.2 eV and 0.20-0.33 eV, respectively. The average value of the acceptor dopant concentration based on Seebeck and electrical conductivity measurements on the porous LSFT was calculated to be 0.35, which suggests that the dopants were fully ionized at the lowest temperature, 400 C. Thermal analysis of the fractured dual phase membranes at 1000DGC in air and N<sub>2</sub> atmosphere has been carried out and the results were compared with that of the as received dual phase membranes carried out in air and N<sub>2</sub>. The dual phase samples were calcined at 1000 and 1250DGC in air and annealed at 1000DGC in air and N<sub>2</sub> for TGA. The results confirmed the non-stoichiometry of the membranes at the elevated temperatures. Fractured dual phase membranes at 1000DGC in N<sub>2</sub> and CO/CO<sub>2</sub> environment have annealed at 1000DGC in air and N<sub>2</sub> and their weight gain was estimated. Thermal expansion of the LSFT and dual phase membranes were characterized using dilatometer in air and N<sub>2</sub>. We have pursued understanding of oxygen surface activation on perovskite oxides by compositional variations and detailed SIMS analysis. We have pursued ink-jet printing from solutions as a means of producing films of various perovskite oxide compositions on suitable substrates. Preliminary oxygen isotope infusion results on these materials show the expected variation in oxygen uptake on a matrix of printed La<sub>1-x</sub>Sr<sub>x</sub>FeO<sub>3-y</sub> bars. Time of flight SIMS has showed substantial variation in the surface composition of various substrates. We are attempting to detect minor variations which will correlate with variable surface activation rates coefficients.

NTIS

*Ceramics; Mechanical Properties; Membranes; Oxygen*

**20070014959** Wayne State Univ., Detroit, MI, USA

**Chemical Reaction Dynamics in Nanoscale Environments**

Goldfield, E. M.; Schlegel, H. B.; Hase, W. L.; January 2006; 5 pp.; In English

Contract(s)/Grant(s): DE-FG02-01ER15212

Report No.(s): DE2006-891931; No Copyright; Avail.: Department of Energy Information Bridge

The major focus of the research in this program is the study of the behavior of molecular systems confined in nanoscale environments. The goal is to develop a theoretical framework for predicting how chemical reactions occur in nanoscale environments. To achieve this goal we have employed ab initio quantum chemistry, classical dynamics and quantum dynamics methods. Much of the research has focused on the behavior of molecules confined within single-walled carbon nanotubes (SWCNTs). We have also studied interactions of small molecules with the exterior surface of SWCNTs. Nonequilibrium molecular dynamics of interfaces of sliding surface interfaces have also been performed.

NTIS

*Carbon Nanotubes; Chemical Reactions*

**20070015101** Massachusetts Inst. of Tech., Cambridge, MA, USA, Pacific Northwest National Lab., Richland, WA, USA  
**Millimeter-Wave Measurements of High Level and Low Level Activity Glass Melts. 2006 Annual Report**

Woskov, P. P.; Sundaram, S. K.; Daniel, W. E.; January 2006; 6 pp.; In English

Report No.(s): DE2006-895763; No Copyright; Avail.: National Technical Information Service (NTIS)

The primary objectives of the current research is to develop on-line sensors for characterizing molten glass in high-level and low-activity waste glass melter using millimeter-wave (MMW) technology and to use this technology to do novel research of melt dynamics. Existing and planned waste glass melter lack sophisticated diagnostics due to the hot, corrosive, and radioactive melter environments. Without process control diagnostics, the Defense Waste Processing Facility (DWPF) and the Waste Treatment Plant (WTP) under construction at Hanford operate by a feed forward process control scheme that relies on predictive models with large uncertainties. This scheme severely limits production throughput and waste loading. Also operations at DWPF have shown susceptibility to anomalies such as pouring, foaming, and combustion gas build up, which can seriously disrupt operations. Future waste chemistries will be even more challenging. The scientific goals of this project are to develop new reliable on-line monitoring capability for important glass process parameters such as temperature profiles, emissivity, density, viscosity, and other characteristics using the unique advantages of millimeter wave electromagnetic radiation that can be eventually implemented in the operating melter. Once successfully developed and implemented, significant cost savings would be realized in melter operations by increasing production through put, reduced storage volumes (through higher waste loading), and reduced risks (prevention or mitigation of anomalies).

NTIS

*Ceramics; Glass; Melts (Crystal Growth); Millimeter Waves; Radioactive Wastes*

**20070015332** Texas A&M Univ., College Station, TX USA

**Thermodynamic and Mechanical Properties of Epon 862 With Curing Agent Detda by Molecular Simulation**

Tack, Jeremy L; Dec 2006; 40 pp.; In English

Report No.(s): AD-A464097; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464097>

Fully atomistic molecular dynamics (MD) simulations were used to predict the properties of EPON 862 cross-linked with curing agent DETDA, a potentially useful epoxy resin for future applications of nanocomposites. The properties of interest were density (at near-ambient pressure and temperature), glass transition temperature, bulk modulus, and shear modulus. The EPON molecular topology, degree of curing, and MD force-field were investigated as variables. The range of molecular weights explored was limited to the oligomer region, due to practical restrictions on model size. For high degrees of curing (greater than 90%), the density was found to be insensitive to the EPON molecular topology and precise value of degree of curing. Of the two force-fields that were investigated, cff91 and COMPASS, COMPASS clearly gave more accurate values for the density and moduli as compared to experiment. In fact, the density predicted by COMPASS was in excellent agreement with reported experimental values. However, the bulk and shear moduli predicted by simulation were about two times higher than the corresponding experimental values.

DTIC

*Bisphenols; Curing; Epoxy Resins; Ethers; Mechanical Properties; Molecular Dynamics; Simulation; Thermodynamic Properties*

**20070015697** Los Alamos National Lab., NM, USA

**Preparation of Graphitic Articles**

Phillips, J.; Nemer, M.; Weigle, J. C.; 28 Feb 06; 22 pp.; In English

Contract(s)/Grant(s): W-7405-ENG-36

Patent Info.: Filed Filed 28 Feb 06; US-Patent-Appl-SN-11-364 980

Report No.(s): PB2007-101706; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Graphitic structures have been prepared by exposing templates (metal, metal-coated ceramic, graphite, for example) to a gaseous mixture that includes hydrocarbons and oxygen. When the template is metal, subsequent acid treatment removes the metal to yield monoliths, hollow graphitic structures, and other products. The shapes of the coated and hollow graphitic structures mimic the shapes of the templates.

NTIS

*Graphite; Patent Applications*



**20070015720** Naval Air Warfare Center, Patuxent River, MD USA

**Mode I and Mode II Interlaminar Crack Growth Resistances of Ceramic Matrix Composites at Ambient Temperature**

Choi, Sung R; Kowalik, Robert W; Alexander, Donald J; Mar 2, 2007; 39 pp.; In English

Report No.(s): AD-A464376; NAWCADPAX/TR-2007/4; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Interlaminar crack growth resistances were determined for five different SiC fiber-reinforced ceramic matrix composites (CMCs) including three gas-turbine grade melt-infiltrated SiC/SiC composites. Modes I and II crack growth resistances, GI and GII, were evaluated at ambient temperature using double cantilever beam and end notched flexure methods, respectively. The CMCs exhibited  $GI = 200-500 \text{ J/m}^2$  and  $GII = 200-900 \text{ J/m}^2$ . Most of the CMCs, except the SiC/CAS composite, showed rising R-curve behavior either in Mode I or in Mode II, presumably attributed to fiber bridging (in Modes I and II) and frictional constraint (in Mode II) in the wake region of a propagating crack. A glass fiber-reinforced epoxy polymer matrix composite, used as comparison, showed R-curve behavior and typically 2-3 and 8 times greater in GI and GII, respectively, than the CMCs. Experimental error analysis concerning the effect of the off-the-center of a crack plane on GI and GII was also made.

DTIC

*Ambient Temperature; Ceramic Matrix Composites; Crack Propagation; Fiber Composites*

**20070015729** Colorado Univ., Boulder, CO USA

**Lyotropic Liquid Crystal - Butyl Rubber Blended Nanomaterials**

Jin, Jizhu; Nguyen, Vinh; Lu, Xiaoyun; Elliott, Brian J; Gin, Douglas L; Jan 2003; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAD19-02-C-0018

Report No.(s): AD-A464392; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Butyl Rubber (BR) is a highly effective barrier material fabric liner with excellent chemical stability and low permeability toward organic solvents and reactive chemicals. However, it has poor air and water vapor permeability. Used as a liner in protective clothing against chemical warfare agents, this disadvantage can lead to fatigue and heat stress in wearer. But blend BR with lyotropic liquid crystals (LLCs) form inverted hexagonal (HII) phase, creating a nanoporous breathable LLC-BR composite.

DTIC

*Butenes; Liquid Crystals; Rubber*

**20070015781** Leas (James Marc), Burlington, VT, USA

**Feedback Enhanced Plasma Spray Tool**

Gevelber, M. A.; Wroblewski, D. E.; 8 Aug 05; 43 pp.; In English

Contract(s)/Grant(s): DMI-9713957

Patent Info.: Filed 8 Aug 05; US-Patent-Appl-SN-11-199 294

Report No.(s): PB2007-101713; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An improved automatic feedback control scheme enhances plasma spraying of powdered material through reduction of process variability and providing better ability to engineer coating structure. The present inventors discovered that controlling centroid position of the spatial distribution along with other output parameters, such as particle temperature, particle velocity, and molten mass flux rate, vastly increases control over the sprayed coating structure, including vertical and horizontal cracks, voids, and porosity. It also allows improved control over graded layers or compositionally varying layers of material, reduces variations, including variation in coating thickness, and allows increasing deposition rate. Various measurement and system control schemes are provided.

NTIS

*Feedback; Patent Applications; Plasma Spraying; Plasmas (Physics); Sprayers*

**20070015965** Army Missile Command, Redstone Arsenal, AL USA

**CHNO Energetic Polymer Specific Heat Prediction From The Proposed Nominal/Generic (N/G) CP Concept**

Billingsley, James P; Feb 2007; 38 pp.; In English

Report No.(s): AD-A464294; RDECOM/AL-TR-AMR-SS-07-04; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464294>

The importance of the specific heat ( $C_p$ ) of CHNO energetic polymers relative to their impact shock sensitivity has been documented in MICOM TR-RD-SS-95-2, AMCOM TR-KD-SS-99-8, and RDECOM TR-AMR-SS-06-09. A follow-on-

report, RDECOM TR-AMR-SS-06-35, documents a proposed nominal/generic (N/G) Cp for CHNO energetic materials. The motivation for this proposed N/G Cp was its utilization to predict Cp for energetic polymers whose Cp was unknown. This report documents the successful application of the N/G Cp concept to predict the Cp for a relatively new CHNO explosive, FOX-7.

DTIC

*Polymers; Specific Heat*

## 28

### PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

**20070015081** Oak Ridge National Lab., TN USA, Pacific Northwest National Lab., Richland, WA, USA

#### **Stability of High-Level Waste Forms 2006 ERSD Annual Report**

Besmann, T. M.; Vienna, J. D.; Nov. 10, 2006; 4 pp.; In English

Report No.(s): DE2006-895824; No Copyright; Avail.: Department of Energy Information Bridge

The objective of the proposed effort is to use a new approach to develop solution models of complex waste glass systems and spent fuel that are predictive with regard to composition, phase separation, and volatility. The effort will also yield thermodynamic values for waste components that are fundamentally required for corrosion models used to predict the leaching/corrosion behavior for waste glass and spent fuel material. This basic information and understanding of chemical behavior can subsequently be used directly in computational models of leaching and transport in geologic media, in designing and engineering waste forms and barrier systems, and in prediction of chemical interactions.

NTIS

*Radioactive Wastes; Spent Fuels; Stability*

**20070015156** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

#### **Predicting Argentine Jet Fuel Prices**

Salaverry, Juan A; Mar 2007; 84 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463764; AFIT/GLM/ENC/07M-01; No Copyright; Avail.: CASI: **A05**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463764>

Oil distillates are considered important elements to accomplish the missions of the Argentine Air Force (AAF). Of all oil products consumed by the AAF, jet fuel is the resource with highest demand and at the end of the day the most expensive support item procured by the Argentine Air Force. Accurate predictions of Argentine jet fuel prices are necessary to improve AAF financial and logistics planning. This thesis presents a systematic, statistical regression approach to forecast Argentine jet fuel prices. The application of this methodology has allowed us to obtain a very useful model that utilizes information available on the internet to produce forecasting of jet fuel prices with average percentage absolute errors lower than 3%

DTIC

*Argentina; Government Procurement; Jet Engine Fuels; Predictions*

## 31

### ENGINEERING (GENERAL)

Includes general research topics related to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

**20070015206** Space and Naval Warfare Systems Command, San Diego, CA USA

#### **Information Age Assessment Applied to Anti-Terrorism/Force Protection**

Augustine, Thomas H; Jun 2005; 31 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463893; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463893>

The Information Age Framework for Assessment, inspired by John Zachman, posits a new way to account for the value of information-intensive investments by focusing not just on the current process or product but on the increased ability of the

organization to perform its mission and adapt to a changing environment. The 'Warfighter's Associate' is a future concept of a robotic assistant to the warfighter that would leverage the advantages of robotics to improve the effectiveness of the warfighter much as a police dog improves the performance of the policeman acting alone. This capability will be shown to powerfully and positively affect the performance of a war fighting organization. This paper addresses how a Warfighter's Associate would provide an Anti-Terrorism/Force Protection (AT/FP) capability and how the Associate should be appropriately assessed to understand its true benefit in a networked environment (like FORCEnet for the US Navy, or the Global Information Grid (GIG) for the US DoD).

DTIC

*Metrology; Protection; Terrorism*

**20070015268** Naval Observatory, Washington, DC USA

**Time Transfer Methodologies for International Atomic Time (TAI)**

Matsakis, Demetrios; Jan 2007; 5 pp.; In English

Report No.(s): AD-A464011; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464011>

While there are many forms of time-transfer, the most precise long-distance forms currently used for the generation of International Atomic Time (TAI) and Coordinated Universal Time (UTC) involve either GPS or Two Way Satellite Time and Frequency Transfer (TWSTFT). This paper gives a brief description of their current and future capabilities, with emphasis on how their uncertainties affect UTC. Some of these uncertainties are due to inherent modeling or receiver instabilities, while others can be reduced through temperature and humidity stabilization, electronic impedance matching, and multipath minimization. The residual time-transfer uncertainties directly affect the uncertainties in each individual laboratory's realization of UTC.

DTIC

*Atoms; Time Measurement*

**20070015269** Naval Observatory, Washington, DC USA

**On Optimizing the Configuration of Time-Transfer Links Used to Generate TAI**

Matsakis, D; Arias, F; Bauch, A; Davis, J; Gotoh, T; Hosokawa, M; Piester, D; Jan 2007; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464012; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464012>

This is the report of Study Group II of the Working Group on TAI, which was formed to study two of the three proposals in the BIPM Technical Memo 132, circulated in December, 2004. It is recommended that TAI be generated through combinations of Two Way Satellite Time and Frequency Transfer (TWSTFT) links and GPS links. It is assumed that Study Group I will not oppose acceptance of the first proposal, which is that GPS links will be converted from Common View (CV) to All in View (AV). In that case, we find benefits to the use of AV in order to optimize the link configurations, and also recommend in principle the acceptance of the second of the proposals, which was to adapt a single pivot. We specify the optimal requirements for the site selection and site maintenance, but we note that the lack of low-noise connectivity between the Asian and American-European TWSTFT links may require two pivot sites instead of one. We recommend against the third proposal, which is the introduction of a virtual pivot. We do not recommend averaging time-transfer techniques over TAI-generating links until the possibilities are further studied, and recommend that the BIPM staff give priority to developing carrier phase GNSS links over developing the averaging of redundant links.

DTIC

*Atoms; Optimization; Time Measurement*

**20070015270** Naval Observatory, Washington, DC USA

**The Evaluation of Uncertainties in [UTC-UTC(k)]**

Lewandowski, W; Matsakis, D; Panfilo, G; Tavella, P; Jan 2006; 10 pp.; In English

Report No.(s): AD-A464013; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464013>

This work presents a study of the determination of uncertainties in [UTC-UTC(k)] needed for publication in the Bureau International des Poids et Mesures's (BIPM's) Circular T and the Key Comparison Database, as required by the Mutual Recognition Arrangement. In the first part of the paper, an analytical solution based on the law of the propagation of

uncertainty is derived. In the second part, the solution is verified numerically using the software used by the BIPM for the generation of UTC.

DTIC

*Atoms; Evaluation; System Effectiveness; Time Measurement; Universal Time*

**20070015330** Vanderbilt Univ., Nashville, TN USA

**Hydroxyl Tagging Velocimetry in a Mach 2 Flow With a Wall Cavity (Postprint)**

Pitz, R W; Lahr, M D; Douglas, Z W; Wehrmeyer, J A; Hu, S; Carter, C D; Hsu, K Y; Lum, C; Koochesfahani, M M; Jan 2005; 15 pp.; In English

Contract(s)/Grant(s): F40600-03-D-0001; Proj-2308

Report No.(s): AD-A464095; AIAA-2005-36; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464095>

Hydroxyl tagging velocimetry (HTV) measurements of velocity were made in a Mach 2 flow with a wall cavity. In the HTV method, ArF excimer laser (193 nm) beams pass through a humid gas and dissociate H<sub>2</sub>O into H + OH to form a tagging grid of OH molecules. In this study, a 7x7 grid of hydroxyl (OH) molecules is tracked by planar laser-induced fluorescence. The grid motion over a fixed time delay yields about 50 velocity vectors of the two-dimensional flow. Instantaneous, single-shot measurements of two-dimensional flow patterns were made in the non-reacting Mach 2 flow with a wall cavity under low and high pressure conditions. The single-shot profiles were analyzed to yield mean and rms velocity profiles in the Mach 2 non-reacting flow.

DTIC

*Cavities; Marking; Supersonic Speed; Velocity Measurement; Walls*

**20070015339** Naval Research Lab., Bay Saint Louis, MS USA

**Naval Research Laboratory Ecological -- Photochemical -- Bio-optical--Numerical Experiment (Neptune) Version 1: A Portable, Flexible Modeling Environment Designed to Resolve Time-dependent Feedbacks Between Upper Ocean Ecology, Photochemistry, and Optics**

Jolliff, Jason K; Kindle, John C; Feb 21, 2007; 52 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464111; NRL/MR/7330--07-9026; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464111>

A modeling system has been constructed that combines ecological element cycling, photochemical processes, and bio-optical processes into a single simulation that may be coupled to hydrodynamic models that provide temperature fields as well as the advection/diffusion of state variables. The model is derived from a history of ocean biogeochemical models that describe the transformation of elemental reservoirs (carbon, nitrogen, phosphorus) based upon lower-trophic order ecosystem function. The model description of the relationship between reservoirs of organic carbon and optical properties permits the use of satellite ocean color data to validate and constrain the model. The model has been coupled to the Modular Ocean Data Assimilation System, which permits examination of the one-dimensional case in any region of interest around the globe.

DTIC

*Ecology; Ecosystems; Extraterrestrial Oceans; Feedback; Marine Environments; Neptune (Planet); Ocean Models; Oceanographic Parameters; Oceans; Photochemical Reactions; Time Dependence; Water Color*

**20070015407** Air Force Research Lab., Wright-Patterson AFB, OH USA

**The Utilization of Synthetic Task Environments in C2 Domains**

Galster, Scott M; Nelson, W T; Bolia, Robert S; Jun 2005; 43 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464260; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464260>

Synthetic task environments (STEs) are often thought of as places where abstractions of real world tasks can be researched and are often employed in research programs that address command and control (C2) issues. A description of several Synthetic Task Environments that are used in command and control research programs is offered. The STEs as well as new augmenting capabilities are currently being used at the Air Force Research Lab to examine technologies, procedures, and concepts that will enhance air battle manager capabilities and situation awareness while decreasing the workload associated with these environments. A simple taxonomy is given for the selection of synthetic task environments in this domain.

DTIC

*Command and Control; Domains*

**20070015797** California Univ., Los Angeles, CA USA

**Laboratory Experiments on Whistler Wave Interactions with Energetic Electrons**

Stenzel, Reiner L; Urrutia, J M; Jul 25, 2006; 12 pp.; In English

Contract(s)/Grant(s): FA8718-05-C-0072; Proj-DARP

Report No.(s): AD-A464498; UCLA-444025-ST-25304; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Whistler wave excitation in plasmas has been modeled in a laboratory experiment. The most efficient coupling is achieved with magnetic loop antennas which can deposit 50% of the applied energy into waves in a dense plasma with low ambient magnetic field. Since space plasmas are dilute, it is suggested to eject an expanding plasma plume into space for efficient wave excitation with a small magnetic antenna. The ejected waves have magnetic fields exceeding the ambient field. The properties of such nonlinear whistler modes have been investigated. Their propagation speed depends on amplitude and field topology, they can steepen into whistler shocks and strongly accelerate electrons. In the presence of neutrals, the energetic electrons produce visible light emission. Anisotropic electron distributions are formed which create whistler instabilities and emissions at different frequencies than applied. Scattering of electrons in phase space is evident.

DTIC

*Electron Scattering; Electrons; Magnetic Fields; Wave Interaction; Whistlers*

**20070015944** Army Research Inst., Orlando, FL USA

**Immersive Simulation Training for the Dismounted Soldier**

Knerr, Bruce W; Feb 2007; 67 pp.; In English

Report No.(s): AD-A464022; ARI-SR-2007-01; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464022>

A study was conducted to document the need for immersive dismounted virtual Soldier and leader training and the available research evidence regarding the effectiveness of virtual training for training Soldiers and leaders in complex skills. A literature search of research reports, journal articles, and conference proceedings to identify evaluations and experiments related to the study topic of the training effectiveness of immersive virtual simulations was conducted. Particular attention was paid to an expended series of evaluations conducted by the Army R&D organizations during the period 1997 - 2005. The major findings are organized around the topics of training effectiveness, Soldier task performance, and advantages and disadvantages of immersive virtual simulations. Soldiers and small unit leaders report that their skills improve as a result of training in virtual simulations, and these self-reports by have generally, if informally, been confirmed by observers. While the simulators impose constraints on the performance of some Soldier activities, this should limit training effectiveness only if those activities that cannot be performed in the simulator are not trained by other means. Advantages and disadvantages of immersive simulations are also described.

DTIC

*Education; Simulation; Virtual Reality*

**20070015968** Stanford Univ., CA USA

**A Computational Framework for Experimentation with Edge Organizations**

Ramsey, Marc S; Levitt, Raymond E; Jun 2005; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464187; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464187>

Edge organizations emphasize moving knowledge and decision-making power to individuals and teams who directly interface with the environment. Traditional project modeling tools cannot adequately represent the critical impact of information and knowledge flows, nor the importance of developing trust between workers in Edge organizations. The Virtual Design Team (VDT) computational modeling platform evolved from ongoing research at Stanford University starting in the late 1980s. VDT has been used successfully to model activities, communications, and exception handling within traditional project organizations performing relatively routine, albeit highly concurrent, tasks. This paper discusses POWER, a new computational modeling platform based on the same information processing view of organizations as VDT. POW-ER is an extensible organization simulation platform, within which we have prototyped direct support for modeling several critical dynamic behaviors of workers in modern knowledge-based organizations: knowledge flows, trust effects, and cultural/institutional differences between team members from different backgrounds. POW-ER can also support demand-driven, dynamic allocation of resources to tasks as needed, to model work processes that cannot be represented by predefined tasks. Using POW-ER, researchers can now conduct emulation experiments on Edge organizations to validate and calibrate the

computational model, ultimately aiding in the systematic design and optimization of these organizational forms.  
DTIC

*Decision Making; Knowledge Based Systems; Organizations; Simulation*

## 32

### COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 *Space Communications, Spacecraft Communications, Command and Tracking*; for search and rescue, see 03 *Air Transportation and Safety*; and 16 *Space Transportation and Safety*.

**20070014827** Swedish Defence Research Establishment, Linköping, Sweden

#### **Systemanalys Flexibla MikrovågssystemSystem)**

Nelander, A.; Erickson, R.; Dec. 2005; 32 pp.; In Swedish

Report No.(s): PB2007-105501; FOI-R-1865-SE; No Copyright; Avail.: National Technical Information Service (NTIS)

This report is a final report of the activity Analysis of Flexible Microwave Systems within the project MIRA-Array Antennas and Programmable Microwave Systems. The system analysis is intended to review the prerequisites to integrate multiple RF-functions into a single flexible multifunction microwave system. The system analysis has been performed with typical requirements for international operations. In the project we focus on surveillance and communication functions. The system analysis forms a basis for the studies of concepts and technological solutions for systems, RF-electronics and conformal antennas for flexible microwave systems. A number of system concepts for surveillance functions have been proposed.

NTIS

*Microwave Equipment; Radar Antennas; Systems Analysis*

**20070014880** Sandia National Labs., Albuquerque, NM USA

#### **Design and Initial Deployment of the Wireless Local Area Networking Infrastructure at Sandia National Laboratories**

Miller, M. M.; Wiener, D. J.; Witzke, E. L.; Long, J. P.; Hamill, M. J.; Nov. 01, 2006; 83 pp.; In English

Report No.(s): DE2006-895980; SAND2006-6616; No Copyright; Avail.: National Technical Information Service (NTIS)

A major portion of the Wireless Networking Project at Sandia National Laboratories over the last few years has been to examine IEEE 802.11 wireless networking for possible use at Sandia and if practical, introduce this technology. This project team deployed 802.11a, b, and g Wireless Local Area Networking at Sandia. This report examines the basics of wireless networking and captures key results from project tests and experiments. It also records project members thoughts and designs on wireless LAN architecture and security issues. It documents some of the actions and milestones of this project, including pilot and production deployment of wireless networking equipment, and captures the team's rationale behind some of the decisions made. Finally, the report examines lessons learned, future directions, and conclusions.

NTIS

*Telecommunication; Wireless Communication; Local Area Networks*

**20070015063** Bureau of the Census, Washington, DC, USA

#### **Information and Communication Technology: 2005**

Apr. 2007; 56 pp.; In English

Report No.(s): PB2007-107479; ICT/05; No Copyright; Avail.: CASI: [A04](#), Hardcopy

The Information and Communication Technology Survey (ICTS), a supplement to the Annual Capital Expenditures Survey (ACES), was created in response to economic data user and policymaker concerns about the lack of available data on e-business infrastructure investment by nonfarm businesses. Rapid changes and advances in information and communication technology (ICT) equipment have resulted in these assets having short useful lives and a tendency to be replaced much quicker than other types of equipment. Companies are expensing the full cost of such assets during the current annual period rather than capitalizing the value of the assets and expensing the cost over two or more years. In some cases this is due to the short useful life of the asset, and in other cases it is because companies have varying dollar levels for capitalization. The ICTS data are an improved source of information for official estimates of the investment component of Gross Domestic Product, and of U.S. capital stock and capital flows. In addition, economists use the data to assess prospects for productivity and economic growth, and businesses use the data to identify market opportunities, develop new products, and establish strategic plans. The

2005 estimates in this report are based on data collected from a sample of 46,009 companies with employees. The sample frame for companies with employees was slightly more than 5.9 million.

NTIS

*Information Systems; Technology Utilization; Interprocessor Communication*

**20070015109** Swedish National Defence Coll., Stockholm, Sweden

**The Planning Under Time Pressure Model - Presentation**

Thunholm, Peter; Jun 2006; 17 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463346; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463346>

Current Status of the PUT-Model: (1) The PUT model is a new military, tactical level, decision making (or mission planning) model. (2) The PUT model was developed by Thunholm, at the Swedish National Defence College, within the framework of the Swedish Supreme Commander's Program for Doctoral Studies. (3) The model has been tested both in scientifically controlled studies and in training and field evaluations since 2000. (4) Will be the base of a new unified armed forces tactical planning model and is currently adapted for use in integrated/parallel planning within the framework of the Swedish NBD C2 Development project. (5) Is the only tactical model trained and used at the NDC for navy and army officers. (6) 'Locally' adapted to mechanized units, SF, and anti-aircraft forces.

DTIC

*Military Operations; Models; Planning*

**20070015133** Naval War Coll., Newport, RI USA

**Contractor Support on the Battlefield -- Increased Reliance Requires Commander's Attention**

Maloney, Kathy J; May 16, 2006; 25 pp.; In English

Report No.(s): AD-A463651; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463651>

The number and criticality of contractors on the battlefield have grown across the spectrum of conflict. Department of Defense initiatives to adopt a leaner business strategy, increase efficiency, and reduce expenditures have exposed the battlefield commander to additional operational risk centered on the command and control associated with outsourcing efforts. The challenge to the commander is to specifically design a planning and execution methodology that integrates contractor and military personnel efforts that support success on the battlefield. A growing reliance on contractor support provides significant challenges for commanders to overcome. The challenges presented by the loss of core competencies, limited flexibility brought on by contractor security concerns, the legal limitations on the role that contractors can play on the battlefield, and the failure to integrate contractors fully into the command and control system are all critical to battlefield success. Striving to integrate contractors on their battlefield, commanders must integrate them as part of the total force. To do this, commanders must assimilate contractors into their command and control systems, define the contractors' mission via the unit's desired end-state, evaluate risk by determining the contractors' ability to perform under combat conditions, replicate the habitual relationships organic support units share with operational units, and limit the risk associated with contractor failure.

DTIC

*Command and Control; Contractors; Risk*

**20070015134** Naval War Coll., Newport, RI USA

**Criticisms Associated with Operation Anaconda: Can Long-Distance Leadership Be Effective?**

Marzano, Todd; Oct 23, 2006; 22 pp.; In English

Report No.(s): AD-A463654; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463654>

Although Anaconda was successful in achieving its objective of clearing al Qaeda fighters out of the Shah-i-Kot Valley in Afghanistan, the planning and execution errors associated with this operation have provided a wealth of valuable lessons for the USA military. This paper reviews the events of Anaconda and through a detailed analysis, examines the various criticisms it has received. Critical shortfalls associated with CENTCOM's upper-level command and control structure are revealed as the primary source of the confusion and problems surrounding the operation. Particular attention is paid to General Tommy Frank's controversial decision to lead such a large military effort from his Tampa headquarters, 9 1/2 time-zones away from the fight. The author concludes that, despite errors resulting from this decision, it was a viable strategy that offered many inherent benefits. By implementing the lessons learned from General Franks' long-distance leadership, in conjunction with the

latest academic recommendations on the subject, valuable guidelines are provided for combatant commanders choosing to lead this country's future conflicts from a headquarters geographically removed from the theater of operation.

DTIC

*Command and Control; Leadership; Military Operations; System Effectiveness*

**20070015135** Naval War Coll., Newport, RI USA

**Joint Task Force - Global Network Operations; The Supported Command**

Helfrich, Kenneth S; Oct 23, 2006; 20 pp.; In English

Report No.(s): AD-A463655; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463655>

The recent information and technology revolutions along with a few of their by-products such as the Global Information Grid and the Net-Centric Warfare Concept have brought about great changes for our nations government and military. Along with these changes are additional challenges in processes and development of command and control structures. In this paper, the present Supported and Supporting relationship between the Joint Task Force-Global Network Operations and the other Combatant Commanders is analyzed from four different perspectives. Finally, the paper draws conclusions based on the analysis and makes recommendations to adjust the command and control architecture to better protect the Global Information Grid from the ever present electronic enemy.

DTIC

*Command and Control; Military Operations; Strategy*

**20070015139** Naval War Coll., Newport, RI USA

**Joint Interagency at the Combatant Commands: Making it Real; Making it Work**

Herr, Christopher H; Feb 13, 2006; 26 pp.; In English

Report No.(s): AD-A463662; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463662>

Current doctrine regarding Joint Military and Interagency cooperation is inadequate for effective and consistent results by the Regional Combatant Commanders. Vague or non-existent Joint and U.S. Government (USG) agency doctrine regarding planning and command and control structures has left seams and gaps in our ability to effectively carry out national policy. Steps that can be taken today for improvement at the operational level are the expansion, improvement and standardization of procedures and structure beyond the current JIACG construct. This useful organization needs to be fully leveraged with the proper staffing, resources and authority to significantly impact US National Interests. The US Military is the only governmental organization with the resources and command and control architecture to significantly effect National Policy. As the executers of the military portion of this arm of nation power, the Regional Combatant Commands must accept the role they are in. They require all the tools and skills of USG specialties and cannot afford to wait for significant USG interagency reforms.

DTIC

*Command and Control; Military Operations*

**20070015140** Naval War Coll., Newport, RI USA

**Command, Cooperation, and Control for Joint Distributed Operations**

Henderson, Anthony M; Feb 13, 2006; 37 pp.; In English

Report No.(s): AD-A463663; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463663>

Our current and potential adversaries understand that they cannot fight the American military in a symmetric manner. We face at each level of war an adaptive, autonomous, highly motivated, dispersed enemy who executes in a decentralized fashion. We should expect that our conventional foes may adopt in part or as a whole this asymmetric form of warfare mixed with viable conventional capability. Distributed Operations provides the joint force and the joint force commander with the additional operational capabilities necessary to counter a decentralized foe and rapidly and decisively defeat these threats. The tempo and depth of Distributed Operations will require a change to the current joint forces command and control structure and system to match the speed and chaos that effective distributed units can bring to bear against the enemy. Command and control as we currently fight would be the Achilles heel of the Distributed Operations capability. Thus, the joint force requires an evolution of the command and control to a more cooperative balanced system. A cooperative balanced system will enable independent, but synchronized actions that achieve a faster and disproportionate effect compared to the force committed.



Failure to create the necessary C2 structure that takes full advantage of Distributed Operations will severely limit, if not preclude the commander's utilization of this operational capability.

DTIC

*Asymmetry; Command and Control; Warfare*

**20070015150** CACI International, Inc., Arlington, VA USA

**C2 Policy Evolution at the U.S. Department of Defense. WWMCCS to a Unified Military Command Capability**

Dick, David; Comerford, John D; Jun 2005; 27 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463743; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463743>

The primary command and control policy document for the U.S. Department of Defense (DoD) has been unchanged since 1971, the last time that DoD Directive 5100.30 titled The World Wide Military Command and Control System was published. Since this publication has, in effect, been obsolete for at least 10-15 years, one could argue that we have been operating without a Department-level C2 policy for at least that long. By all accounts, as witnessed during recent conflict, our tactical forces are doing a better job of C2 than ever before. The same might not be said for national and strategic C2. Nor may we believe coalition C2 is improved. This situation then begs the following questions: is tactical C2 better because we have no effective department-level policy or in spite of that fact? Is a broad Departmental policy for command and control required only at the strategic and national level, and, if so, what should it address? Is DoD C2 policy necessary to address strategic or tactical C2; national or global issues: regional or theater concerns: or should it be directed primarily toward the joint and coalition environment, or all of the above. A more basic issue is what areas of C2 should be addressed. Some potential categories that come to mind are national, strategic, nuclear, global, regional, theater, joint, tactical, coalition, etc. Finally, but not of least importance, regardless of the categories selected, is a C2 policy needed to determine who should be in charge of ensuring command and control capabilities, at any level, meet the needs of the warfighter and how do these roles and responsibilities fit with legislative and regulatory mandates? Importantly, as we move into a net-centric environment, does C2 change? Is an entirely new policy required that transcends previous policy? Logically, it seems a DoD directive that codifies overall C2 policy for the Department should be at the forefront of DoD directives.

DTIC

*Command and Control; Defense Program; Policies*

**20070015198** QinetiQ Ltd., Malvern, UK

**Implementing Edge Organizations: Exploiting Complexity. (Part 1: A Framework for the Characterization of Edge Organizations and their Environments)**

Alston, Anthony; Beaument, Patrick; Dodd, Lorraine; Jun 2005; 42 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463885; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463885>

During 2003, CCRP published 'Power to the Edge' which described a new kind of organization, an 'Edge Organization' (EO), which would display exceptional agility. Key to implementing and employing Edge Organisations is achieving an understanding of the types of arrangements which would enable Edge Organisations to work in this manner. This paper provides initial output on four themes from a DoD-sponsored programme of work being carried out in the UK to look into these issues. This paper contends that Edge Organisations follow a highly-extended, totally unconstrained organisational concept that enables power to be dynamically distributed away from the centre to those involved in execution. Therefore, Edge Organisations will have to have (effectively unlimited) degrees of freedom available to them that non-edge organisations do not have. The challenges to be addressed in the work include: finding out how to characterise Edge Organisations and provide a 'language' for reasoning about them; investigating the degrees of freedom, mechanisms and features that Edge Organisations need to have; understanding the circumstances under which they will and won't work; and indicating how the concept of Military Capability Packages is changed by Edge Organisations. The work will also indicate the kind of programme of experimentation that would be appropriate to Edge Organisations.

DTIC

*Command and Control; Organizations*

**20070015212** Mitre Corp., McLean, VA USA

**Custodial Multicast in Delay Tolerant Networks: Challenges and Approaches**

Symington, Susan; Durst, Robert C; Scott, Keith; Jan 2006; 6 pp.; In English

Contract(s)/Grant(s): DAAB07-03-C-N206

Report No.(s): AD-A463904; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463904>

Although custodial transmission of multicast bundles would be a desirable capability to have in Delay-Tolerant Networks (DTNs), support for custodial multicast transmission was omitted from the Bundle Protocol Specification because of its complexity. This paper explains the difficulties that arise with respect to supporting custody transfer and retransmission of multicast bundles, and it describes some potential solutions for addressing these issues that the authors are currently exploring as work-in-progress.

DTIC

*Communication Networks; Maintenance*

**20070015225** QinetiQ Ltd., Malvern, UK

**Functional Impacts of Network-Centric Operations on Future C2**

Dodd, Lorraine; Lloyd, Merfyn; Markham, Geoff; Jun 2005; 32 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463926; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463926>

What are the unavoidable functional impacts of effects-based, network-centric operations (EBNCO) on command and control (C2)? In other words what C2 mechanisms, network structures and new ways of working are necessary to enable military forces to function in future conflict operations? The central question is: what form(s) must the C2 organizations adopt to conform to the whole range of potential operational requirements? These requirements must cover, for example, the political need for accuracy and the likelihood of achieving precision due to the nature of the environment, number of interactions, rate of representative events and predictability. The effects-based nature of operations forces us to think of operational requirements in themselves rather than using pre-defined means as surrogate operational requirements. The desired effects drive the outcome objectives; and hence drive the plans, actions and inter-organizations of activities from which the C2 plan must naturally emerge. How can we evaluate and assess capabilities in the context of a command space that has a lay-down of cost-benefit contours that define 'OK regions' (or comfort zones or basins of attraction) for C2 organizations given a range of operational contexts? Perrow's Quadrants help to define the command space within which the OK regions for the Way of Command can be defined.

DTIC

*Command and Control; Communication Networks; Military Operations*

**20070015279** Defence Research and Development Canada, Valcartier, Quebec Canada

**Supporting Critical Thinking with Critiquing Systems in Military C2 Environments**

Irandoost, Hengameh; Boury-Brisset, Anne-Claire; Jun 2005; 39 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464027; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464027>

There is a growing interest for the integration of critical thinking, defined as the capacity of thinking about one's own reasoning, into military practices. In this paper, we discuss the potential of critiquing systems (critics) - software programs that provide a critique of the user-generated solution - for training critical thinking skills. More specifically, we discuss the use of two types of critics, generic and experiential, which respectively use doctrine-related and case-related knowledge. The generic critic applies general knowledge about standard practices, while the experiential critic makes the practitioner consider distributional data, as provided by case bases and lessons learned. This paper discusses the type of issues that can thus be addressed. The aim of the present paper is to show the usefulness of critiquing systems (critics) for supporting critical reasoning in the military context. We argue here that these advisory systems can, on the one hand, provide generic critiques that would remind the user of general doctrine-related knowledge, and on the other hand, bring him, by means of experiential critics, to consider relevant knowledge retrieved from similar cases and lessons learned. The paper is organized as follows: first, we outline the principles of critical thinking as discussed in relevant literature (Section 2), and then we compare the dynamics of collaborative criticism dialogues in the human-critic setting with the internalized dialogue of critical reasoning (Section 3). In Section 4, we discuss the type of judgment biases that the use of critics can correct. Next, we show how generic critics can guide the user in his problem solving process by reminding him of relevant issues and factors (Section 5) and how

the experiential critic, using case-based reasoning and lessons learned, can make the user consider or learn from previously experienced cases (Section 6).

DTIC

*Command and Control; Problem Solving*

**20070015289** Link Simulation and Training, Mesz, AZ USA

**Binocular Rivalry and Attention in Helmet-Mounted Display Applications**

Winterbottom, Marc D; Patterson, Robert; Pierce, Byron J; Covas, Christin; Rogers, Jason; Feb 2007; 8 pp.; In English

Contract(s)/Grant(s): FA8650-05-D-6502; Proj-1123

Report No.(s): AD-A464042; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464042>

As monocular head-mounted displays (HMDs) are introduced into existing flight simulators for training and mission rehearsal it will be important to determine whether binocular rivalry affects the visibility of HMD presented symbology or the out-the-window (OTW) flight simulator display imagery. In the present study, we examined whether rivalry suppression could be objectively measured under conditions that simulated a monocular HMD and OTW display, and whether voluntary attention and moving imagery influenced the strength of rivalry suppression. The results indicated that strength of suppression under these conditions was less than that found under classic dichoptic viewing conditions, and that attention had little influence on performance.

DTIC

*Binocular Vision; Binoculars; Helmet Mounted Displays*

**20070015291** Link Simulation and Training, Mesz, AZ USA

**The Influence of Depth of Focus on Visibility of Monocular Head-Mounted Display Symbology in Simulation and Training Applications**

Winterbottom, Marc D; Patterson, Robert; Pierce, Byron J; Covas, Christine; Winner, Jennifer; Feb 2007; 13 pp.; In English

Contract(s)/Grant(s): F41624-97-D-5000; Proj-1123

Report No.(s): AD-A464044; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464044>

The Joint Helmet Mounted Cueing System (JHMCS) is being considered for integration into the F-15, F-16, and F-18 aircraft. If this integration occurs, similar monocular head-mounted displays (HMDs) will need to be integrated with existing out-the-window simulator systems for training purposes. One such system is the Mobile Modular Display for Advanced Research and Training (M2DART), which is constructed with flat-panel rear-projection screens around a nominal eye-point. Because the panels are flat, the distance from the eye point to the display screen varies depending upon the location on the screen to which the observer is directing fixation. Variation in focal distance may create visibility problems for either the HMD symbology or the out-the-window imagery presented on the simulator rear-projection display screen because observers may not be able to focus both sets of images simultaneously. The extent to which blurring occurs will depend upon the difference between the focal planes of the simulator display and HMD as well as the depth of focus of the observer. In our psychophysical study, we investigated whether significant blurring occurs as a result of such differences in focal distances and established an optimal focal distance for an HMD which would minimize blurring for a range of focal distances representative of the M2DART. Our data suggest that blurring of symbology due to differing focal planes is not a significant issue within the range of distances tested and that the optimal focal distance for an HMD is the optical midpoint between the near and far rear-projection screen distances

DTIC

*Depth; Education; Helmet Mounted Displays; Simulation; Visibility*

**20070015308** Air Force Research Lab., Mesa, AZ USA

**Visual Suppression of Monocularly Presented Symbology Against a Fused Background in a Simulation and Training Environment**

Winterbottom, Marc D; Patterson, Robert; Pierce, Byron J; Taylor, Amanda; Aug 2006; 13 pp.; In English

Contract(s)/Grant(s): FA8650-05-D-6502; Proj-1123

Report No.(s): AD-A464062; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464062>

When wearing a monocular head-mounted display (HMD), one eye views the HMD symbology while both eyes view an

out-the-window scene. This may create interocular differences in image characteristics that could disrupt binocular vision by provoking visual suppression, thus reducing visibility of the background scene, monocular symbology, or both. However, binocular fusion of the background scene may mitigate against the occurrence of visual suppression, a hypothesis that was investigated in the present study. Observers simultaneously viewed a static background scene and HMD symbology while performing a target recognition task under several viewing conditions. In a simulated HMD condition observers binocularly viewed a background scene with monocular symbology superimposed. In another condition, viewing was dichoptic (i.e. completely different images were presented to the left and right eyes). Additionally, one control condition was implemented for comparison. The results indicate that for continuously presented targets binocular rivalry did not have significant effects on target visibility. However, for briefly presented targets, binocular rivalry was shown to increase thresholds for target recognition time in HMD and dichoptic viewing conditions relative to the control. Impairment was less in the HMD condition. Thus, binocular fusion of a background scene can partially mitigate against the occurrence of visual suppression. However, some suppression still exists which occurs between monocular pathways. Implications for the integration of monocular HMDs into Air Force training environments will be discussed.

DTIC

*Binocular Vision; Education; Helmet Mounted Displays; Simulation; Visual Perception*

**20070015370** Battle Command, Fort Gordon, GA USA

**Broadband Time Division Multiple Access (TDMA) Solution (Tech Insertion - C4 Enhancement for the U.S. Army in Transformation)**

Pressley, Corey S; Langley, James; White, Dale; Kruse, Barry; White, Shawn; Eidson, Edward; Mims, Thomas; Dunn, III, Charles; Pangle, Charlie; Jun 2005; 52 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464189; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464189>

The Battle Command Battle Lab located at Fort Gordon, Georgia (BCBL-G) leads the U.S. Army's efforts to bridge C4 (Command, Control, Communications, and Computers) capability gaps by leveraging leading edge technologies for rapid insertion into the operational force. The U.S. Army is presently undergoing a major transformation while conducting Operations Iraqi Freedom (OIF) which complicates this challenge immensely. The BCBL-G has focused its most recent support of the transformation effort by working to solve specific C4 shortfalls that were highlighted by the sub-marginal performance of the Army's tactical internal communications (Division and below communications systems) as experienced first hand during OIF.

DTIC

*Augmentation; Broadband; Command and Control; Computers; Technology Assessment; Time Division Multiple Access; Time Division Multiplexing*

**20070015376** Ministry of Defence, London, UK

**Developing a Coalition Battle Management Language to Facilitate Interoperability Between Operation CIS, and Simulations in Support of Training and Mission Rehearsal**

Tolk, Andreas; Hieb, Michael; Galvin, Kevin; Khimeche, Lionel; Pullen, Mark; Jun 2005; 22 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464202; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464202>

The Battle Management Language (BML) initiative started by the US Army Modeling and Simulation Office (AMSO) published a standard in 1999. It organized doctrinal terms into '5W's': 'Who, What, When, Where and Why', to facilitate interoperability between command and control systems and simulations. BML is an unambiguous language used to command and control forces conducting operations and support situational awareness and a common operational picture. It is being developed as a standard representation of a digitized commander's intent to be used by warfighters, simulated forces, and robots. A BML prototype was demonstrated in 2003. This prototype was used to analyze the applicability of BML to UK doctrine. A French Army BML was also prototypically implemented within their research program, and there is a US-German initiative, Project SINCE, that added the 'How' and 'Which' to give a 'W6H' construct. XML, the use of web services, and BML representation within the Command and Control Information Exchange Data Model (C2IEDM) has provided a common thread. The paper provides descriptions of these developments and insights into two initiatives that have started as a result of this work; the creation of a Simulation Interoperability Standards Organization (SISO) Study Group and NATO Exploratory Team-016.

DTIC

*Education; Interoperability; Simulation*

**20070015391** Space and Naval Warfare Systems Command, San Diego, CA USA

**CommandRESPONSE: An Open Source Instantiation of an Event-Driven and Services-Based Architecture for Net-Centric Warfare and Public Safety Applications**

Quashnock, Dee; Haleftiras, Pericles; Bennett, Mike; Dunaway, Dan; Ford, Jay; Vo, Khanh; Spencer, Myoki; Jun 2005; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464239; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464239>

Today's navy warfighting and domestic public safety professionals must deal with information overload, new types of threats and complex fields of engagement while attempting to achieve a shared situational awareness and make critical decisions under a high degree of uncertainty. The current information systems supporting these efforts were designed to accomplish singular functions with each system requiring its own information management and processing infrastructure. These systems are difficult to adapt or enhance and limited horizontal integration of information amongst the systems exists. Stove piped systems result in making the creation of a common operational picture of the point-of-problem difficult at best. Moreover, the organizations procuring such solutions pay for that infrastructure many times over. The nature of an asymmetric threat can change overnight. Warfighting and public safety systems designed to address such threats must themselves be flexible and capable of rapidly adapting to new threat scenarios. This dynamic, combined with the economic drivers to reduce total cost of ownership, operation and manning, has driven the adoption of net-centric technologies and architectures that facilitate the composability of mission capabilities and associated information environments while substituting networks, sensors and intelligence for manpower. New mission capabilities must be constructed on-the-fly. Joint/coalition/military-civilian/combined operations place further burdens on information sharing, the decision making process and distribution of command intent. First responders and military warfighters both need information management and interchange that supports secure, tailorable and timely access to all required information for realtime planning, resource allocation, control, and execution of the incident response mission.

DTIC

*Architecture (Computers); Communication Networks; Information Systems; Safety; Warfare*

**20070015392** Mitre Corp., Bedford, MA USA

**Lessons Learned in Applying Architecture to the Acquisition of Air Force Command and Control Systems**

Daniels, Murray E; Sespaniak, Ruth E; Jun 2005; 23 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464240; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464240>

At the Air Force Materiel Command Electronic Systems Center, we are using architecture in multiple programs to support the acquisition of Air Force Command and Control systems. This use ranges from informally augmenting traditional requirements documents to actually delivering architecture products to the contractor as a formal representation of requirements. We also use architecture to ensure that programs better understand their operational and system context within the enterprise. The architecture activities described in this paper span the time frame from 1997 to the present. During that time, we've had varying degrees of success. On the one hand, we have found the architecture to foster significant communication between the user, the acquirer, and the developer mostly by having operational subject matter experts work directly with the acquirer and contractor in developing parts of the operational architecture views. In general, we have found that the use of a disciplined approach to architecture helps all stakeholders better understand the operational, system, and technical context in which they must operate. Conversely, we've found that additional attention is needed relative to working with contractors to incorporate the use of architectures into their system/software development processes and in applying architecture to support Enterprise Integration.

DTIC

*Acquisition; Architecture (Computers); Command and Control*

**20070015393** Birmingham Univ., UK

**WESTT (Workload, Error, Situational Awareness, Time and Teamwork): An Analytical Prototyping Software Tool for C2**

Houghton, Robert J; Baber, Chris; Cowton, Mal; Jun 2005; 36 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464241; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464241>

In order to explore the potential impact of novel command and control configurations, it is useful to have some means of extrapolating from existing systems and comparing the outcome of change from existing to novel systems. By taking a

systems view of operations, it is possible to consider the impact of reconfiguration upon the performance of the system and upon the agents operating within the system. The aim of the WESTT analytical prototyping tool is to support systems analysis and to allow the analyst to explore the impact of reconfiguration through the manipulation of models. In this paper we describe the underlying approach behind the tool which emphasizes taking multiple perspectives (task/social network/knowledge network) with regard to the activity being analyzed and we describe the functionality of the present version of the software.

DTIC

*Command and Control; Errors; Prototypes; Situational Awareness; Software Development Tools; Workloads (Psychophysiology)*

**20070015399** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Communications Research for Command & Control: Human-Machine Interface Technologies Supporting Effective Air Battle Management**

Bolia, Robert S; Nelson, W T; Vidulich, Michael A; Simpson, Brian D; Brungart, Douglas S; Jun 2005; 41 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464251; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464251>

Battle management command and control (BMC2) is a communications intensive activity. Weapons directors and mission crew commanders on these platforms are required to monitor as many as eight simultaneous communications channels against a background of moderate to high ambient cabin noise while performing a number of visual and manual tasks, a combination which in the heat of battle is challenging even for the most highly trained operators. Researchers at the Air Force Research Laboratory's Human Effectiveness Directorate (AFRL/HE) have been investigating two technologies to ameliorate this problem: active noise reduction (ANR) headsets and spatial intercoms. ANR headsets cancel environmental noise while preserving speech signals presented via the communications network, while spatial intercoms enhance communications by increasing the effective signal-to-noise ratio of each individual communications channel, taking advantage of the listener's natural ability to efficiently segregate speech streams that are separated in space. This paper will describe investigations at AFRL/HE directed at the enhancement of speech intelligibility in multi-channel tactical BMC2 environments using ANR and spatial intercom technology. Results will be discussed from basic laboratory experimentation, simulated mission scenarios, and field evaluations, and interpreted in the context of the acquisition and integration of such technologies for current and future BMC2 weapons systems.

DTIC

*Active Control; Command and Control; Intelligibility; Man Machine Systems; Multichannel Communication; Noise Reduction*

**20070015421** Instituto Superior Tecnico, Lisbon, Portugal

**A C2 Framework for Dynamic Battlespace Resource Management Based on Networking Concepts and a 'Post and Smart Pull' Approach**

Grilo, Antonio; Nunes, Paulo; Nunes, Mario; Jun 2005; 36 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464281; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464281>

The effective networking of the warfighting enterprise enables Network Centric Warfare (NCW) concepts to be developed, namely the capability for self-synchronization and direct collaboration between battlespace entities, increasing the operational effectiveness. One of the advantages brought by self synchronization is the potential for a more efficient use of often scarce resources at the force's disposal, by allowing faster responses to battlespace developments and thus a more effective exploitation of fleeting opportunities. However, care must be taken to limit the required information flows (transactions) between decision entities by means of appropriate tools and procedures, otherwise self-synchronization may lead to extra burden of decision entities with the consequent inefficiency in the accomplishment of time-critical tasks. This paper presents a C2 framework that facilitates self-synchronization through dynamic allocation and tasking of resources. By extending the 'post and smart pull' concept to the management of resources other than information (e.g., ISTAR assets, warfighting platforms, formations, etc.), the proposed C2 framework allows a seamless and efficient transfer of resources between friendly battlespace entities for employment where they are in greater to respond more promptly and effectively to opportunities and contingencies.

DTIC

*Command and Control; Communication Networks; Management Planning; Resources Management; Synchronism*

**20070015422** Office of the Chief of Naval Operations, Washington, DC USA

**Amphibious Expeditionary Warfare C4I Modernization**

Tirrell, Richard P; Jun 2005; 25 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464282; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464282>

This paper describes a methodology for Amphibious Expeditionary Warfare C4I Modernization that is intended to achieve the tenets of Network Centric Operations and Warfare, attempts to balance the diametrically opposed forces of Moore's Law, the acquisition process, and advanced warfare concepts of Seabasing, Surface to Objective Maneuver (STOM) and Network Centric Warfare. Three functional areas of change were identified: Cultural and Social, Physical and Process, and Technological Change and a methodology was developed to facilitate change in those areas that would produce a C4I capability that is integrated, scaleable, additive, and flexible to respond to the immediate needs and preferences of the commander. In order to accomplish any military objective, effective C4I is the primary enabler. By examining the imperishable capabilities that are projected to exist in 2020, baselining existing systems that provide those capabilities, identifying gaps and influencing the emerging systems in the near term (2008-2015), we will be able to establish the requirements for the long term (2015-2020) solutions. This is an on-going and likely continued effort with immediate short term results.

DTIC

*Command and Control; Navy; Warfare*

**20070015431** Air Combat Command, Langley AFB, VA USA

**Joint Mission Capability Packages: The Future of Joint Combat**

Durkac, Louis M; Mar 15, 2005; 29 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464295; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464295>

This paper will describe the Joint Mission Capability Package (JMCP) concept - a capabilities-based force package composed of existing weapon systems possessing interoperable information network equipment. These weapon systems combine to not only mitigate each others weaknesses, but become a powerful entity unto themselves through the synergy of their combined strengths. The Stryker / F-16C+ JMCP is the first JMCP in development today. It advances several critical steps along the path to the future Joint Force. By using existing, fielded systems in a new way, it demonstrates the transformational concepts that are possible in the near term. By putting single service weapons systems together to form pre-planned capability-based force packages, it serves as a prototype for the future Joint Force in essence an operational laboratory. The capabilities possible with the combination of these two systems gives the joint commander enormous flexibility to conduct many missions currently unavailable to either system by itself, or even with current doctrinal cooperation methods. Many of the capabilities envisioned by the future Joint Force will be realized with this concept. The requirements for the JMCP concept will shape its organization and operation - providing a glimpse into one possible edge organization of the future.

DTIC

*Combat; Command and Control; Weapon Systems*

**20070015432** Gracar Corp., Dayton, OH USA

**Smart Systems for Logistics Command and Control (SSLC2) Spiral One**

Matthews, Elizabeth; Cagle, Ron; Gruenke, Jessica; Gallimore, Jennie J; Quill, Laurie; Iannacchione, Richard; Feb 2006; 162 pp.; In English

Contract(s)/Grant(s): FA8650-04-C-6404; Proj-2830

Report No.(s): AD-A464296; No Copyright; Avail.: CASI: **A08**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464296>

Smart Systems for Logistics Command and Control (SSLC2) is an Air Force Research Laboratory, Warfighter Readiness Research Division, Logistics Readiness Branch program to develop and apply technologies to collect the critical information required to effectively manage logistics resources in support of combat operations. The purpose of SSLC2 is to develop requirements that employ technologies and techniques to autonomously collect and fuse critical data in order to create decision quality information and effectively present information to support cognitive tasks performed by logistics and operations decision-makers. SSLC2 Spiral One was focused on wing-level personnel concentrating on one primary decision, the fix/swap decision of an aircraft. The technologies developed under this spiral can be applied to many logistics and operations settings to include the Space ground asset management area. This report documents the efforts associated with the data collection,

cognitive tasks analysis, storyboard development, and simulation test system development, along with the Scientific Study approach, methods, results, and recommendations.

DTIC

*Command and Control; Logistics*

**20070015445** Naval War Coll., Newport, RI USA

**Joint Air Command and Control Doctrine: A Help or Hindrance to the Joint Force Commander**

Troxel, Leonard E; Feb 14, 2005; 31 pp.; In English

Report No.(s): AD-A464322; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464322>

To complete a comprehensive review of the entire spectrum of Joint Air Command and Control Doctrine would require an in depth analysis of which there is neither time nor space with this work to cover. However, by narrowing the focus of this paper to one overarching topic and its subsequent branches a thoughtful consideration of the larger Doctrinal issues can be initiated. As such, this paper focuses on Joint Air Command and Control (C2) Doctrine and how it applies to the Joint Forces Air Component Commander (JFACC) concept and the subsequent branches of Air Tasking Order (ATO) generation/utilization and Service idiosyncrasies in dealing with the JFACC concept. As an analysis of three recent USA military operations will show (Desert Storm, Allied Force, Operation Enduring Freedom), current Joint Force Air C2 Doctrine is a hindrance to the Joint Force Commander when employing joint air forces within the existing Joint Air Command and Control Doctrine architecture.

DTIC

*Command and Control; Constraints*

**20070015457** Naval War Coll., Newport, RI USA

**Coalition Air Command and Control Interoperability and Net Centric Warfare: Who Manages Air C2 Interoperability in the Netted Environment**

Mahlock, Lorna M; Feb 14, 2005; 24 pp.; In English

Report No.(s): AD-A464345; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464345>

In the race to embrace net-centric warfare, many proponents laud its ability to revolutionize the way the USA and its coalition partners fight future wars. Net centric warfare is credited for much of the successes the coalition enjoyed in Operation Iraqi Freedom and Operation Enduring Freedom. While The net-centric warfare concept does hold great promise it poses extensive integration and execution challenges for the Combined/Joint Forces Air Component Commander (C/JFACC) in the Theater Air Ground System (TAGS) during coalition air operations. The idea of achieving seamless, fully integrated, interoperable command and control operations among coalition forces will be an elusive dream, unless efforts are made toward renewed emphasis on management and oversight by Congress, parity of resouces among the Services, and reinventing the Information Management Officer.

DTIC

*Command and Control; Interoperability*

**20070015513** Edell Shapiro and Finnan, LLC, Rockville, MD, USA

**Method and Apparatus for Multipoint Voice Operation in a Wireless, Ad-Hoc Environment**

Nerses, A.; Wetsein, R. M.; 4 Mar 05; 20 pp.; In English

Contract(s)/Grant(s): OTA-MDA 972-999-0007

Patent Info.: Filed Filed 4 Mar 05; US-Patent-Appl-SN-11-071 588

Report No.(s): PB2007-101694; No Copyright; Avail.: CASI: A03, Hardcopy

The present invention protocol offers guaranteed Quality of Service (QoS) for concurrent calls in a highly dynamic, scalable network. The invention employs a TDMA reservation technique to transmit voice traffic to multiple destinations and a CSMA/CA contention scheme to support data traffic. The present invention operates over a link-state based routing protocol that reliably floods routing and resource reservation information to network nodes. The present invention is suitable for general networking applications that require QoS for multimedia traffic in a mobile, Ad-Hoc network and enables conference calls to be established and operated in that type of network under various conditions. Moreover, the present invention capitalizes on certain properties of a radio, such as a RAKE type receiver, that sums up multiple, identical transmissions from multiple



sources. In addition, the present invention enables roaming between and/or within a group or island of network nodes during the lifetime of a call.

NTIS

*Patent Applications; Voice Communication; Wireless Communication*

**20070015524** Edell Shapiro and Finnan, LLC, Rockville, MD, USA

**Method and Apparatus for Dynamic Neighbor Discovery withing Wireless Networks using Time Division Multiple Access (TDMA)**

Liu, Y. J.; Wetstein, R.; 4 Mar 05; 21 pp.; In English

Contract(s)/Grant(s): DAAB07-03-9-K601

Patent Info.: Filed Filed 4 Mar 05; US-Patent-Appl-SN-11-071 235

Report No.(s): PB2007-101695; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An Ad-Hoc wireless network according to the present invention employs a TDMA based neighbor discovery protocol, where each network node is assigned a unique time slot to broadcast neighbor discovery packets or messages. A primary controller node is dynamically designated to perform the time slot assignments. A dynamic selection of a secondary or backup controller node is further provided in case of failure of the primary controller node. The present invention further includes flooding techniques based upon TDMA. A TDMA HELLO flood is used to distribute a small number of common parameters to network nodes by placing or piggybacking the information within the neighbor discovery messages. A CNR flood is based on the principles of a RAKE type receiver and used to distribute time slot assignments to the entire network.

NTIS

*Communication Networks; Patent Applications; Time Division Multiple Access; Wireless Communication*

**20070015708** Naval War Coll., Newport, RI USA

**Piecing Together the Network-Centric Puzzle: Using Operational Functions to Analyze Potential Coalition Partners**

Nicholson, Mark A; Feb 15, 2005; 24 pp.; In English

Report No.(s): AD-A464306; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Network Centric Warfare (NCW) proposes to radically enhance the USA future war fighting abilities by shifting from a platform-centric to network-centric military. However, it tends to minimize the challenges involved with seamlessly integrating future coalition partners into the network. Proponents of NCW theory argue that it can enhance the speed of operations, but applying it in a multilateral environment generates friction. This friction results from two conditions, the political desire or necessity to increase the number of coalition partners, and the military requirement to efficiently and effectively integrate these nations into the multinational force. Although the expense of technology, inability to create an integrated command and control structure, need for compatible equipment, integration of differing cultures, inability to share information, and lack of doctrine and training inevitably present challenges to operational efficiency and effectiveness, this does not mean that network-centric operations cannot work in a multinational environment. To overcome these challenges, we must identify those countries capable of being full-fledged partners and those that will have difficulty keeping up. By focusing on their capabilities through the lens of operational functions, joint staffs will have a foundation for the operational planning process. Then, where required, Combatant Commanders will be able to identify shortfalls and help develop these countries through Theater Security Cooperation Plans. Finally, these forces can be incorporated where they will have the least negative impact upon the system. In this paper, historical examples focused on three operational functions - protection, intelligence and logistics - are used to suggest where countries could fit into the NCW environment.

DTIC

*Command and Control; Warfare*

**20070015756** Naval Research Lab., Washington, DC USA

**Real-Time 1550 nm Retromodulated Video Link**

Gilbreath, G C; Rabinovich, William S; Mahon, Rita; Swingen, L; Oh, Eun; Meehan, Timothy; Goetz, Peter; Jan 2003; 8 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464426; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We report an eye-safe, 1550 nm, retromodulated infrared data link which supports real-time color video. The retromodulated link was 2 meters in the lab and supported 3 Mbps and 30 frames per second using wavelet compression. The

device consumes about 75-100 mW and is 10 grams, mounted. We will show a video sequence from the test. We will also discuss future plans for the device.

DTIC

*Quantum Wells; Real Time Operation; Satellite Communication; Video Signals*

**20070015784** Military Academy, Lisbon, Portugal

**Validation Method of a Telecommunications Blackout Attack**

Amado, Joao; Nunes, Paulo; Jun 2005; 24 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464475; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper presents an evaluation method of telecommunications infrastructure vulnerabilities, allowing the identification of components that can be attacked in order to achieve a communications blackout. Exploring those components it is possible to define a scenario and conduct case studies analysis and experiments that can be used to assess the vulnerabilities of a real world situation. The conceptual framework basic idea is to identify points that can be attacked using unsophisticated technology in order to achieve serious damages on the different network infrastructures, and to obtain the maximum disruptive effect over the services. The proposed method uses a top-down approach, starting on the service level and ending on the different network elements that can be identified in the end as the targets for the attack.

DTIC

*Communication Networks; Telecommunication; Vulnerability*

**20070015814** Naval War Coll., Newport, RI USA

**Armed UAVs in the Future Battlespace - The Need for Command and Control Doctrine**

Bailey, Sean R; Feb 14, 2005; 34 pp.; In English

Report No.(s): AD-A464529; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper will primarily seek to answer the following question: With the future proliferation of armed UAVs in the battlespace, can the current Command and Control (C2) doctrine effectively employ the full range of capabilities of these systems? The research focused on the current concept of operations (CONOPS) for the primary system in use, the MQ-1 Predator as well as the Air Force's newest armed UAV, the MQ-9 Hunter-Killer. The future technologies being developed for the next generation of armed UAV systems, namely the Joint Unmanned Combat Aerial System (J-UCAS) and the Unmanned Combat Armed Rotocraft (UCAR) were evaluated in order to access the viable range of missions for future operations. Since both of these programs are joint ventures with planned multi-service employment, the individual service perspectives and the need for joint service doctrine were considered and incorporated as well. Based on the research conducted and analysis of material, it is clear that the full integration of armed UAVs into the future battlespace will require fundamental changes to the current C2 structure and doctrine.

DTIC

*Command and Control; Military Operations*

**20070015849** Naval War Coll., Newport, RI USA

**Transforming the Joint Force Air Component Commander's Command and Control of Close Air Support**

Homola, Michael J; Feb 14, 2005; 27 pp.; In English

Report No.(s): AD-A464595; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Transformation initiatives in the Department of Defense have major implications on the development of command and control structures in the joint environment. Alternative methodology will be required to rupture outdated tactics, techniques, and procedures established under legacy systems and organizational architectures. Taking into account newly developed concepts, such as the Air Component Coordination Element (ACCE), future command and control systems must build on lessons learned and continue to seek improvements for critical mission taskings. Lessons learned in Operations ENDURING FREEDOM and IRAQI FREEDOM indicate close air support remains a controversial topic due to the availability of air assets and fratricide. Since command and control of close air support is tied to the authority of the Joint Air Operations Center (JAOC) in joint doctrine, the responsibility lies with the JAOC to ensure senior ground elements are supported according to the Joint Force Commander's priorities. Establishing a modular Joint Air Component Coordination Element (JACCE) in the command and control architecture with expanded authorities will in due course eliminate deficiencies and enhance the interconnectivity of the functional land component commander with the functional air component commander.

DTIC

*Command and Control; Support Systems*

**20070015961** Army Research Lab., Fort Huachuca, AZ, USA

**Manpower and Personnel Support for the C4ISR in the Transformed Division**

Anderson, B W; Jun 2005; 31 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464243; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464243>

The U.S. Army has created three interrelated initiatives that together impact support for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR). First is Digitization -- the process of increasing the combat multiplier effect by a more capable C4ISR network. Second is Modularization -- the Army's transformation of its warfighting organization from brigade and division into a Unit of Action and Unit of Employment structure to increase fielding flexibility and effectiveness. Third is the Army's 'tail to tooth' reduction program, which has effectively decreased Signal Corps personnel. These initiatives induced the Signal Corps to change its C4ISR support, thus making it necessary to evaluate the new Signal Corps supporting warfighting operations. When the Army fielded the Stryker Brigade Combat Team (SBCT), the Army Research Laboratory (ARL) conducted an analysis to determine if adequate signal personnel were in place. Those results indicated additional personnel were required in the SBCT. ARL reexamined this issue in light of the current transformation of the Third Infantry Division (3rd ID). The findings show that the 3rd ID has increased or shifted signal personnel levels that were of concern in the SBCT. Although some C4ISR support issues remain, the 3rd ID's new signal personnel levels appear to be appropriate.

DTIC

*Command and Control; Manpower; Personnel*

**20070015964** USA Joint Forces Command, Suffolk, VA USA

**Joint Force Command and Control: Synchronization, Adaptation, and Coordination (SAC) Capability for Effects-Based Operations**

Brandt, Kevin L; Richards, F R; Paradiso, Jr, Richard A; Jan 2002; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464519; No Copyright; Avail.: CASI: [A03](#), Hardcopy

In December 2000, the U.S. Joint Forces Command (USJFCOM) Joint Futures Lab (JFL) in concert with the U.S. Naval Warfare Development Center (NWDC) and the Naval Postgraduate School (NPS) conducted a limited objective experiment (LOE) in a simulated operational environment to gain insights and further develop the requirements for Joint forces to plan and execute effects-based operations. This experiment confirmed that future Joint command and control requires a dynamic ability to synchronize, adapt, and coordinate efforts across the Joint force and cooperating elements. Furthermore, insights gleaned from the experiment indicate a fundamental need for synchronization, adaptation, and coordination (SAC) procedures and tools that include at least four interwoven elements: a coherent time line, consistent graphics, an integrated SAC matrix -- providing rationale and details for all actions -- and a visualization tool to track process status and work flows. Future operational concepts require Joint forces capable of executing effects-based operations (EBO) against complex adaptive adversaries. Competitive success of complex adaptive systems (CAS) in dynamic environments favors those capable of quickly adapting operational activities, organization structure, and/or physical characteristics. The challenge to adapt while concurrently directing Joint operations falls into the domain of the future Joint command and control capability (JC2C). This JC2C requires the dynamic ability to synchronize, adapt, and coordinate efforts across Joint forces and cooperating elements.

DTIC

*Command and Control; Coordination; Mathematical Models; Military Operations; Synchronism*

**20070015966** Army Communications-Electronics Command, Fort Belvoir, VA USA

**Technical and Operational Design, Implementation and Execution Results for SINCE Experiment 1**

Mayk, Israel; Klose, Dirk R; Chan, Andrew; Mai, Mike; Negaran, Hobbie; Jun 2005; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464174; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464174>

In this paper, we describe the design, implementation, and execution results obtained from the SINCE experiment 1b (SINCEx1b) which took place in July, 2004 at the Fort Leavenworth facilities of the US Army 35th ID (Mech). The goals of this experiment were (a) to build upon the success of the SINCE Experiment 1a (SINCEx1a), which took place at the MIP facility of WTD-81, Greding, GE in November 2003, by operationalizing the information exchange among all of the US and German systems connected in the experimentation environment, and (b) to verify and validate with military users in control that the C2 functionality implemented is well understood and acceptable to support future planned operational experiments such as SINCEx2. Clearly, many compromises had to be made considering the limited resources and budget available. Many

trade-offs were made in establishing a balance between (a) developing the infrastructure not only for SINCEx1b but for the planned follow-on experiments and (b) developing the SINCEx1b configuration that was finally used in the conduct of the actual experiment. The infrastructure concepts illuminated issues pertaining to various bilateral and multilateral coupling mechanisms within each federation of C2 systems, within each federation of combat M&S systems, and within the super-federation of C2 and combat M&S systems.

DTIC

*Command and Control; Germany; Information Systems; Military Operations; Simulation*

**20070015967** Echelon 4, LLC, Mequon, WI USA

**Policy-Based Command and Control**

Bayne, Jay; Paul, Raymond; Jun 2005; 45 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464176; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464176>

Governance of large-scale dynamic systems [of systems] requires a management ethos and an associated set of policies and tools competent to allow the system and its subsystems to achieve and maintain viability. At the same time, such governance must actively guide the system's course grain behaviors. The DOD's present effort at transformation and implementation of joint or unified enterprise command and control (JEC2) are attempts at establishing, incrementally, a more formal and agile form of network centric governance over its distributed and traditionally stove-piped military and agency systems. JEC2 is therefore both a philosophy of management as well as an operational set of policies and mechanisms that must find widespread support among the Services, US allies, DOD agencies and the industrial machinery that supports the DOD's strategic and tactical missions. Our thesis is that, in alignment with and support of Jeffersonian principles of governance, a successful JEC2 capability will allow the DOD to govern itself with greater agility, with greater operational transparency, and with greater productively in the utilization of its human and material assets; with the basis of such a system including specific operational C2 capabilities for the dynamic and real-time management of policies that are competent to guide collaborative behavior within the federated DOD enterprise. We present our policy-based JEC2 system model.

DTIC

*Command and Control; Defense Program; Policies*

**20070015975** Army Command and Control Directorate, Fort Monmouth, NJ USA

**Modeling and Simulation Support for Answering Commanders' Priority Intelligence Requirements**

Pizzo, Christian J; Powell, Gerald M; Brown, III, Chester F; May, Jacqueline; Jun 2005; 21 pp.; In English

Report No.(s): AD-A464443; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A critical element of Command and Control decision-making support in the battlespace is answering the commanders priority intelligence requirements (PIRs) in a timely manner and with adequate accuracy. In 2003, the Army initiated a science and technology objective (STO) program entitled Fusion Based Knowledge for the Future Force to conduct the R&D necessary to provide automated support for answering PIRs at the Unit of Action (brigade-level force). The FBKFF STO program has discovered that the modeling and simulation capabilities of today fall short in numerous key areas underlying the required realism, scope, richness and complexity of battlespace scenarios of today and of the Future Force. This paper: (a) identifies and describes these shortfalls in detail, (b) describes the software development and manual work arounds we have carried out to address some of them, and (c) explains why these capabilities are needed to support R&D targeted at solving problems involving information analysis, interpretation, and gathering that underpin the ability to answer PIRs. We also present our current view of what a sophisticated modeling and simulation environment would have as capabilities to adequately support such data fusion R&D. integrated into an automated simulation environment; the ability to generate, and adjust, the volume of reports to reflect the severe information overload on analysts; and interoperability with the current and future force intelligence and other Army Battle Command System processors.

DTIC

*Command and Control; Intelligence; Priorities; Simulation*

**20070015997** Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, The Hague, Netherlands

**Netforce Principles: An Elementary Foundation of NEC and NCO**

Keus, Hans E; Jun 2005; 56 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463913; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463913>

The debate on NCO and NEC continues to suffer from definitional and conceptual imprecision. This paper introduces a modelling framework that provides elementary netcentric principles with which NCO and NEC concepts can be constructed and derived. In a stepwise derivation process, starting with a simple network-node paradigm, a set of elementary modelling concepts is defined. This set, which we call the Netforce Reference Model comprises the basic notion of netcentric nodes, a description of the elementary properties of nodes, node integration properties with a network, interacting nodes and resulting multi-node behavior like functions and services. These so-called Netforce Principles (NP) can be used to derive and design systems and procedures in a netcentric environment. It allows commonly used NEC and NCO concepts to be explained by their fundamental underlying principles. Examples of these are situational awareness, synchronized decision making and agile mission groups (AMG). By adopting NP for modelling NEC, NCO and systems in the netcentric environment, interoperability on the information and especially the procedural levels can be substantially improved. This paper describes the current status of the Netforce Reference Model.

DTIC

*Communication Networks; Nodes (Standing Waves)*

**20070016003** Air Force Research Lab., Rome, NY USA

**AF2T2EA - An Illustrative Example of the C2 Conceptual Model**

Phister, Jr, Paul W; Jun 2006; 58 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463942; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463942>

Over the past three years, a NATO panel (SAS-050) has developed the first version of a Command and Control (C2) Conceptual Model. The Conceptual Model's purpose is to support the exploration of new, networked enabled approaches to C2 and compare their characteristics, performance, effectiveness, and agility to traditional approaches to C2. The Air Force's Kill Chain is a lengthy process that's subdivided into seven events, namely: anticipate, find, fix, track, target, engage, and assess (AF2T2EA). As an illustrative example of the C2 Conceptual Model, the Model's attributes were applied to each of the seven areas in two test cases. Test case one, the Conceptual Model's variables were mapped into each of the AF2T2EA events via five bins (environment, information, awareness, understanding and decision). The result represented the Conceptual Model's process view. Test case two, the Conceptual Model's variables were mapped into a set of AF2T2EA required capabilities. For a sub-set of the AF2T2EA capabilities, the Conceptual Model variables were evaluated as to having a high, medium or low correlation to the stated AF2T2EA capabilities. The result represented the Conceptual Model's 'value view'. Both test cases yielded expected results reaffirming the Conceptual Model's variable listing did not have any major discrepancies.

DTIC

*Command and Control; System Effectiveness*

**20070016042** Defence Research and Development Canada, Dartmouth, Nova Scotia Canada

**A Work-Centred Approach to Seeding the Development of Design Concepts to Support Shipboard Command and Control**

Chalmers, Bruce A; Lamoureux, Tab; Jun 2005; 38 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464146; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464146>

We present results from an ongoing investigation using a work-centred framework to design computer-based tools to support the cognitive and collaborative work of Command Teams on a HALIFAX Class frigate. Based on emerging concepts in Cognitive Systems Engineering, the design approach hinges on analyzing the operators work demands and finding ways to use technology to improve the performance of the joint cognitive system of operators and their aids. Specifically, we describe our use of two work-modeling tools within the framework that contribute to developing a traceable design thread, directly linking knowledge elicitation and work analysis outputs to specific design hypotheses for supporting the work demands of Command and Control operators. The two tools are drawn from Rasmussen and Vicente's Cognitive Work Analysis framework. The first is an Abstraction-Decomposition Space. It uses an Abstraction Hierarchy to describe how the functional purposes of the work domain are achieved. There is also a Part-Whole Hierarchy that decomposes the work domain into components that contribute to achieving those purposes. The second tool is a set of decision ladders representing the information processing and knowledge states of operators in conducting control tasks. We also briefly illustrate one interface concept that was derived with the approach.

DTIC

*Command and Control; Ships; Cognition*

**20070016043** University of Central Queensland, Rockhampton, Australia

**Informal Communications and Situation Awareness in C2 Environments**

O'Brien, Fergus; Martinsson, Daniel; Lennartsson, Henrick; Jun 2005; 21 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A464181; No Copyright; Avail.: CASI: [A03](#), Hardcopy  
ONLINE: <http://hdl.handle.net/100.2/ADA464181>

The paper examines the role of informal information flows and situation awareness in the context of command and control environments for emergency services. The studies are based on investigations into the outcomes for fire brigades dealing with emergencies that exceed their capacity to handle the situations. The objective of the reported research is to design an approach to the effective and complementary use of both formal and informal information flows to enhance situation awareness, and hence effective decision making, at all levels within an emergency organization. The case studies of actual and major wild fires illustrated that there were well-defined limits to an organization's capacity to handle the flow of communications, and that there were no strategies in place to cope when these limits were reached. As a consequence a number of ad hoc peer to peer informal communication strategies were adopted by the operational staff. These practically enforced informal flows have an implication that the senior decision makers at headquarters were no longer in the C2 loop. The paper addresses the reaction of the headquarters to this reality, and proposes a design strategy for a communications network that is a combination of formal and informal flows. This combination is designed to scale seamlessly as the scale of the emergency increases, and is designed to maintain situation awareness at all levels.

DTIC

*Command and Control; Fires; Global Positioning System; Mobile Communication Systems; Situational Awareness; System Effectiveness*

**20070016044** Marine Corps Systems Command, Quantico, VA USA

**Network-Centric Strategic-Level Deception**

Erdie, Philip B; Michael, James B; Jun 2005; 28 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A464184; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper explores strategic-level deception in the context of network-centric information operations. Advances in information technology and the global connectedness of communications networks have created new opportunities and challenges for conducting strategic and operational level deception campaigns with significant utilization of cyberspace. Planning and executing concurrent strategic-level deceptions among distributed participants and against multiple targets requires speed, flexibility, and accurate situational assessment. This paper begins with a historical account of twentieth century use of strategic-level deception, followed by a definition of network deception, considerations for achieving network-based deception, and a proposed model for the planning and execution of network-centric deception campaigns. The command and control structure proposed in this paper is a framework that integrates complex elements of information infrastructures across public and private spectrums.

DTIC

*Camouflage; Command and Control; Deception; Masking; Terrain*

**20070016049** Battle Command, Fort Gordon, GA USA

**Bridging the Capability Gap for Battle Command On-the-Move**

Eidson, Edward H; Campbell, Clay; Dunn, III, Charles; Jun 2005; 19 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A464207; No Copyright; Avail.: CASI: [A03](#), Hardcopy  
ONLINE: <http://hdl.handle.net/100.2/ADA464207>

The U.S. Army recognizes their commanders lack adequate mobile command and control. This capability gap is based largely on lessons learned from ongoing operations in Iraq and Afghanistan. Interim bridging capabilities need to be inserted into the current Army force structure until objective systems can be fielded. However, since other Joint services have also voiced similar concerns for improving their mobile command and control systems, the Joint Systems Integration Center (JSIC) has been designated the Joint lead for the federated Joint Prototyping Battle Command On-the-Move (BCOTM) experiment program for fiscal year 2005. This experiment will investigate and evaluate emerging off-the-shelf technologies that can be rapidly adopted and inserted into Joint forces. This technology will focus particularly on improving the warfighter's broadband network connectivity to better enable battle command applications to contribute to the commander's decision-making process while on the move. Modem technologies include direct sequence spread spectrum (DSSS), multifrequency time division multiple access (MF-TDMA), and frequency division multiple access (FDMA) that employ IP technologies such as Direct Video Broadcast, Paired Carrier Multiple Access (PCMA), and slotted ALOHA. Antenna candidate systems that will be compared include new Ku-band parabolic satellite antennas (apertures equal to or less than 24 inches). The Battle Command

Battle Laboratory located at Fort Gordon, Georgia (BCBL-G) is the Army's lead in the Joint federated BCOTM prototype experiment. In this capacity, BCBL-G's primary responsibility is to recommend to an Army acquisition Project Manager broadband satellite on-the-move alternative packaged with doctrine, training, manning, and maintenance strategies.

DTIC

*Command and Control; Mobile Communication Systems*

**20070016061** Space and Naval Warfare Systems Center, San Diego, CA USA

**Utilization of a Multi-Disciplinary Approach to Building Effective Command Centers: Process and Products**

Galdorisi, George; Tolentino, Glenn; Jun 2005; 42 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464125; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464125>

The Space and Naval Warfare Center San Diego (SSC SD) has evolved a process and a number of disciplines over the course of the last decade-plus that believes is worth sharing as a process model for conceptualizing, designing, engineering and building command centers in the future. The approach to building a command center must evolve from a blending of a number of disciplines, among them; work and process flow, cognitive task analysis, organizational information dissemination and interaction, systems engineering, collaboration and communications processes, decision-making processes, and data collection and organization. By blending these diverse disciplines command centers can be designed to support decision-making, cognitive analysis, information technology, and the human factors engineering aspects of Command and Control (C2). This model can then be used as a baseline when dealing with work in areas of business processes, workflow engineering, information management, and IT. We base our analysis on the 'best practices' of command center conceptualization, design and engineering as well as on the work multi-disciplinary teams at SSC SD that have built a number of command centers. This multi-disciplinary approach provides more effective and user-centered command centers as well as a process methodology that enables hardware, software and middleware to be refreshed faster, cheaper and more easily as new technologies evolve. This is especially important, given the rapid refresh rate of C4ISR technologies. Ultimately, this paper will show that the way we have evolved the piece-parts of the KM discipline over the years, and the way we have brought those piece-parts together into a multi-disciplinary whole defines a process of building command centers that ultimately delivers the optimal product to the warfighter. Additionally, this process is based on the lessons learned from delivering a number of command centers to a wide array of customers.

DTIC

*Systems Engineering; Navy; Command and Control*

**20070016534** Air Force Research Lab., Rome, NY USA

**Power to the Edge...Sometimes**

Brown, Joel N; Jun 2005; 11 pp.; In English

Report No.(s): AD-A464284; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464284>

'Power to the Edge...Sometimes' evolves the criteria used to set the locus of command. The next logical step in command theory turns on several key considerations. First, traditional models place the locus of command statically. This leaves an organization susceptible to risks and emerging challenges it was not designed to meet. Second, a clear distinction exists between an information-rich environment and an understanding-rich environment. Those in an information-rich environment may be able to see the situation but will not always be able to understand the situation. Third, game theory strongly suggests that when resources are limited, individuals will compete for them at the expense of self-synchronization and working toward a global maximum. Understanding imparts no motive to achieve a global maximization. The conclusion: the correct model for placing the locus of command should no longer set command statically within the organization. Command should be allocated dynamically to wherever the understanding of information along with the motivation to achieve a global maximization of desired effects is present -- this is agile command and control.

DTIC

*Command and Control; Information Systems*

**20070016535** Commit Enterprises, Inc., Fairfax Station, VA USA

**Building an Ontology for Command & Control**

Curts, Raymond J; Campbell, Douglas E; Mar 17, 2005; 39 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464304; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464304>

The definition of Command & Control is still being debated within the Department of Defense and a consensus has yet to emerge. As historically shown, striving for a common language, or a common lexicon in any domain tends to be difficult at best. The authors find that the problem may be that we are wrestling with various Command & Control definitions rather than discussing the environments in which Command & Control exists. So, rather than trying to define the term Command & Control, the authors believe we must focus on the environments in which Command & Control functions exist. Once the environments are defined and understood, then the boundaries and limitations of Command & Control also come into focus. These borders are defined by the domain of discourse, (in this case, the concepts, classes, or Ontology of Command & Control ). We need to build such a construct. The authors contend that the domain of Command & Control does not require a hard and fast definition, per se, but is in need of an ontology to identify the content and boundaries. The role of ontology is to provide a better structuring of what Command & Control is or is not, and to help index and retrieve domain-related information. This paper proposes to: describe and promote the understanding of how ontology relates to Command & Control and possibly begin to establish a basis from which an interoperable Command & Control ontology can be developed. Finally, and probably more importantly at this stage, this paper should open the dialogue for further discussion on ontological constructs and their applicability to the Command & Control domain.

DTIC

*Command and Control; Interoperability*

**20070016677** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Implementation of an Antenna Array Signal Processing Breadboard for the Deep Space Network**

Navarro, Robert; June 27, 2006; 16 pp.; In English; Engineering Forum Workshop: Next Generation Correlators for Radio Astronomy, 27-30 June 2006, Groningen, Netherlands; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39939>

The Deep Space Network Large Array will replace/augment 34 and 70 meter antenna assets. The array will mainly be used to support NASA's deep space telemetry, radio science, and navigation requirements. The array project will deploy three complexes in the western U.S., Australia, and European longitude each with 400 12m downlink antennas and a DSN central facility at JPL. This facility will remotely conduct all real-time monitor and control for the network. Signal processing objectives include: provide a means to evaluate the performance of the Breadboard Array's antenna subsystem; design and build prototype hardware; demonstrate and evaluate proposed signal processing techniques; and gain experience with various technologies that may be used in the Large Array. Results are summarized..

Derived from text

*Antenna Arrays; Antenna Design; Deep Space Network; Signal Processing*

**20070016678** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Applications of Microwave Photonics in Radio Astronomy and Space Communication**

D'Addario, Larry R.; Shillue, William P.; June 17, 2006; 30 pp.; In English; IEEE International Microwave Symposium, 17 Jun. 2006, San Francisco, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39938>

An overview of narrow band vs wide band signals is given. Topics discussed included signal transmission, reference distribution and photonic antenna metrology. Examples of VLA, ALMA, ATA and DSN arrays are given. . Arrays of small antennas have become more cost-effective than large antennas for achieving large total aperture or gain, both for astronomy and for communication. It is concluded that emerging applications involving arrays of many antennas require low-cost optical communication of both wide bandwidth and narrow bandwidth; development of round-trip correction schemes enables timing precision; and free-space laser beams with microwave modulation allow structural metrology with approx 100 micrometer precision over distances of 200 meters.

Derived from text

*Antenna Arrays; Radio Astronomy; Space Communication; Photonics*



**ELECTRONICS AND ELECTRICAL ENGINEERING**

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment; and microelectronics and integrated circuitry. For related information see also *60 Computer Operations and Hardware*; and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar*.

**20070014803** McDermott Will and Emery, LLP, Boston, MA, USA

**Transparent Wideband Antenna System**

Cohen, N.; 2 Feb 05; 6 pp.; In English

Contract(s)/Grant(s): MCSYC-M67854-03-C-7022

Patent Info.: Filed Filed 2 Feb 05; US-Patent-Appl-SN-11-049-231

Report No.(s): PB2007-105970; No Copyright; Avail.: CASI: [A02](#), Hardcopy

An antenna includes an electrically conductive conformal portion that is substantially defined by a triangular portion and self-similar extensions. The antenna also includes an electrically non-conductive conformal portion. Both the electrically conductive conformal portion and the electrically non-conductive portion are substantially transparent at visual wavelengths.

NTIS

*Antenna Design; Antennas; Broadband; Patent Applications; Transparence*

**20070014805** Berenato, White and Stavish, LLC, Bethesda, MD, USA

**Fabrication and Integration of Polymeric BioMEMS**

Park, J. J.; Ghodssi, R.; Rubloff, G. W.; Kaastantin, M. J.; Sheng, L.; 3 Dec 04; 27 pp.; In English

Contract(s)/Grant(s): NSF-DMR 4-32291

Patent Info.: Filed Filed 3 Dec 04; US-Patent-Appl-SN-11-003-005

Report No.(s): PB2007-105973; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A micro-electro-mechanical system (MEMS) device is provided, along with means for its fabrication and operation for microfluidic and/or biomicrofluidic applications. The MEMS device includes a substrate, optional electrodes on the substrate, a patterned structure on the substrate, the patterned structure having a fluidic microchannel aligned with one or more of the optional electrodes, an encapsulation membrane covering the microchannel, and an optional reactive layer deposited over the electrode in the microchannel. MEMS devices of preferred embodiments permit a leak-tight seal to be formed around the microchannel and fluidic interconnects established for robust operation of fluidics-based processes. MEMS devices of other preferred embodiments permit reversible attachment and separation of the encapsulation membrane relative to the patterned structure.

NTIS

*Fabrication; Microelectromechanical Systems; Microelectronics; Patent Applications; Substrates*

**20070014806** Wells Saint John, P.S, Spokane, WA, USA

**Power Semiconductor Switching Devices and Power Semiconductor Devices**

Eden, R. C.; Smetana, B. A.; 24 Mar 05; 29 pp.; In English

Contract(s)/Grant(s): NSA-MDA-904-99-C-2644/0000

Patent Info.: Filed Filed 24 Mar 05; US-Patent-Appl-SN-11-088-551

Report No.(s): PB2007-105974; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Power semiconductor switching devices, power converters, integrated circuit assemblies, integrated circuitry, power current switching methods, methods of forming a power semiconductor switching device, power conversion methods, power semiconductor switching device packaging methods, and methods of forming a power transistor are described. One exemplary aspect provides a power semiconductor device including a semiconductive substrate having a surface; and a power transistor having a planar configuration and comprising a plurality of electrically coupled sources and a plurality of electrically coupled drains formed using the semiconductive substrate and adjacent the surface.

NTIS

*Electric Switches; Patent Applications; Semiconductor Devices; Switching*

**20070014808** Los Alamos National Lab., NM USA

**Colloidal Quantum Dot Light Emitting Diodes**

Mueller, A. H.; Hoffbauer, M. A.; Kilmov, V. I.; 25 Mar 05; 10 pp.; In English

Contract(s)/Grant(s): DE-W-7405-ENG-36

Patent Info.: Filed Filed 25 Mar 05; US-Patent-Appl-SN-11-089-726

Report No.(s): PB2007-105975; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The present invention is directed to light emitting devices including a first layer of a semiconductor material from the group of a p-type semiconductor and a n-type semiconductor, a layer of colloidal nanocrystals on the first layer of a semiconductor material, and, a second layer of a semiconductor material from the group of a p-type semiconductor and a n-type semiconductor on the layer of colloidal nanocrystals.

NTIS

*Colloids; Light Emitting Diodes; Patent Applications; Quantum Dots*

**20070014812** Ratnerpretia, Valley Forge, PA, USA

### **T-Ray Microscope**

Zhang, X. C.; Xu, J.; Yuan, T.; 8 May 03; 13 pp.; In English

Contract(s)/Grant(s): DAAD199910333; DAAD1999C0045

Patent Info.: Filed Filed 8 May 03; US-Patent-Appl-SN-10-434-329

Report No.(s): PB2007-105977; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A microscope for producing an image of a target using THz radiation. The microscope comprises a source for providing an optical pump pulse and an optical probe pulse; a THz emitter for activation by pump pulse to emit a THz pulse that irradiates the target to form a target-modified THz pulse; a THz detector for modulating the probe pulse with the target-modified THz pulse to create a modulated optical probe pulse characteristic of the target; an optical detection system for modifying and detecting the modulated optical probe pulse and converting the modulated optical probe pulse to electronic information; and a processor for receiving the electronic information and producing an image of the sample using the electronic information. The THz emitter and detector comprise one or more EO crystals. The target is positioned on one of the EO crystals in a near-field of the THz pulse.

NTIS

*Microscopes; Patent Applications*

**20070014823** National Inst. for Occupational Safety and Health, Washington, DC, USA

### **Fatality Assessment and Control Evaluation (FACE) Report for Maryland: Appliance Repair Person Was Electrocuted in a Repair Shop While Diagnosing the Problem With a Microwave Oven**

Jul. 1999; 4 pp.; In English

Report No.(s): PB2007-107276; FACE-94-MD-038; No Copyright; Avail.: CASI: [A01](#), Hardcopy

A 43-year-old male appliance repair-person (the victim) was electrocuted while performing diagnostic tests on a malfunctioning microwave oven. The victim had stopped by another appliance repair shop to pick up overflow work he had left for service. Before departing he brought a microwave oven into the shop and asked if he could spend a few minutes diagnosing a problem with the oven. The victim removed the cover of the oven to access the circuitry. The oven was plugged in and turned on when the victim began to handle the circuitry. The witnesses heard a 'pop', saw the victim jerk his hand out of the oven, and fall to the ground. One witness unplugged the equipment while the other witness checked the condition of the victim and then telephoned 911 to summon the emergency medical services (EMS). Paramedics responded within several minutes. The victim was transported to the hospital where he died from his injuries one hour and 15 minutes after the incident.

NTIS

*Accident Investigation; Death; Microwaves; Ovens*

**20070014839** Reinhart Boerner Van Deuren S.C., Milwaukee, WI, USA

### **Storage Control System**

Sambasivan, S.; Barnett, S. A.; Kim, I.; Rechner, J. W.; 7 Feb 05; 31 pp.; In English

Contract(s)/Grant(s): DOD-F33615.99.C.2967

Patent Info.: Filed Filed 7 Feb 05; US-Patent-Appl-SN-11-052-337

Report No.(s): PB2007-105983; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention relates to oxides on suitable substrates, as converted from nitride precursors.

NTIS

*Epitaxy; Nitrides; Oxides; Patent Applications; Superconducting Films*

**20070014841** Clark-Atlanta Univ., GA, USA

**Characterization of Hydrogen Complex Formation in III-V Semiconductors. Final Report**

Williams, M. D.; Sep. 28, 2006; 26 pp.; In English

Report No.(s): DE2007-892995; No Copyright; Avail.: Department of Energy Information Bridge

Atomic hydrogen has been found to react with some impurity species in semiconductors. Hydrogenation is a methodology for the introduction of atomic hydrogen into the semiconductor for the express purpose of forming complexes within the material. Efforts to develop hydrogenation as an isolation technique for AlGaAs and Si based devices failed to demonstrate its commercial viability. This was due in large measure to the low activation energies of the formed complexes. Recent studies of dopant passivation in long wavelength (0.98 - 1.55 $\mu$ m) materials suggested that for the appropriate choice of dopants much higher activation energies can be obtained. This effort studied the formation of these complexes in InP, This material is extensively used in optoelectronics, i.e., lasers, modulators and detectors. The experimental techniques were general to the extent that the results can be applied to other areas such as sensor technology, photovoltaics and to other material systems. The activation energies for the complexes have been determined and are reported in the scientific literature. The hydrogenation process has been shown by us to have a profound effect on the electronic structure of the materials and was thoroughly investigated. The information obtained will be useful in assessing the long term reliability of device structures fabricated using this phenomenon and in determining new device functionalities.

NTIS

*Hydrogen; Semiconductors (Materials)*

**20070014899** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Aquarius Ocean Salinity Mission High Stability L-band Radiometer**

Pellerano, Fernando A.; Piepmeier, Jeffrey; Triesky, Michael; Horgan, Kevin; Forgiione, Joshua; Caldwell, James; Wilson, William J.; Yueh, Simon; Spencer, Michael; McWatters, Dalia; Freedman, Adam; [2006]; 18 pp.; In English; IGARSS, 31 Jul. - 4 Aug. 2006, Denver, CO, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014899>

The NASA Earth Science System Pathfinder (ESSP) mission Aquarius, will measure global ocean surface salinity with approx. 120 km spatial resolution every 7-days with an average monthly salinity accuracy of 0.2 psu (parts per thousand). This requires an L-band low-noise radiometer with the long-term calibration stability of less than or equal to 0.15 K over 7 days. The instrument utilizes a push-broom configuration which makes it impractical to use a traditional warm load and cold plate in front of the feedhorns. Therefore, to achieve the necessary performance Aquarius utilizes a Dicke radiometer with noise injection to perform a warm - hot calibration. The radiometer sequence between antenna, Dicke load, and noise diode has been optimized to maximize antenna observations and therefore minimize NEDT. This is possible due the ability to thermally control the radiometer electronics and front-end components to 0.1 Crms over 7 days.

Author

*Ocean Surface; Salinity; Earth Sciences; Calibrating; Spatial Resolution; Dicke Radiometers; Stability*

**20070014906** NASA Langley Research Center, Hampton, VA, USA

**New Basis Functions for the Electromagnetic Solution of Arbitrarily-shaped, Three Dimensional Conducting Bodies Using Method of Moments**

Mackenzie, Anne I.; Baginski, Michael E.; Rao, Sadasiva M.; [2007]; 7 pp.; In English; 23rd International Review of Progress in Applied Computational Electromagnetics (ACES 2007), 19-23 Mar. 2007, Verona, Italy

Contract(s)/Grant(s): WBS 732759.07.19; Copyright; Avail.: CASI: [A02](#), Hardcopy

In this work, we present a new set of basis functions, defined over a pair of planar triangular patches, for the solution of electromagnetic scattering and radiation problems associated with arbitrarily-shaped surfaces using the method of moments solution procedure. The basis functions are constant over the function subdomain and resemble pulse functions for one and two dimensional problems. Further, another set of basis functions, point-wise orthogonal to the first set, is also defined over the same function space. The primary objective of developing these basis functions is to utilize them for the electromagnetic solution involving conducting, dielectric, and composite bodies. However, in the present work, only the conducting body solution is presented and compared with other data.

Author

*Electromagnetic Scattering; Method of Moments; Three Dimensional Bodies; Radiation; Numerical Analysis*

**20070014909** Lawrence Livermore National Lab., Livermore, CA USA

**Study of Vacuum Insulator Flashover for Pulse Lengths of Multi-Microseconds**

Houck, T. L.; Goerz, D. A.; Javedani, J. B.; Lauer, E. J.; Tully, L. K.; Jun. 30, 2006; 5 pp.; In English

Report No.(s): DE2006-895995; UCRL-CONF-223361; No Copyright; Avail.: National Technical Information Service (NTIS)

We are studying the flashover of vacuum insulators for applications where high voltage conditioning of the insulator and electrodes is not practical and for pulse lengths on the order of several microseconds. The study is centered about experiments performed with a 100-kV, 10-ms pulsed power system and supported by a combination of theoretical and computational modeling. The base line geometry is a cylindrically symmetric, +45(sup o) insulator between flat electrodes. In the experiments, flashovers or breakdowns are localized by operating at field stresses slightly below the level needed for explosive emissions with the base line geometry. The electrodes and/or insulator are then seeded with an emission source, e.g. a tuft of velvet, or a known mechanical defect. Various standard techniques are employed to suppress cathode-originating flashovers/breakdowns. We present the results of our experiments and discuss the capabilities of modeling insulator flashover.

NTIS  
*Flashover; Insulators; Vacuum; Simulation; Mathematical Models*

**20070014950** Sandia National Labs., Albuquerque, NM USA

**Stable Local Oscillator Microcircuit**

Brocato, R. W.; Oct. 2006; 26 pp.; In English

Report No.(s): DE2006-895408; SAND-2006-414; No Copyright; Avail.: Department of Energy Information Bridge

This report gives a description of the development of a Stable Local Oscillator (StaLO) Microcircuit. The StaLO accepts a 100MHz input signal and produces output signals at 1.2, 3.3, and 3.6 GHz. The circuit is built as a multi-chip module (MCM), since it makes use of integrated circuit technologies in silicon and lithium niobate as well as discrete passive components. The StaLO uses a comb generator followed by surface acoustic wave (SAW) filters. The comb generator creates a set of harmonic components of the 100MHz input signal. The SAW filters are narrow bandpass filters that are used to select the desired component and reject all others. The resulting circuit has very low sideband power levels and low phase noise (both less than -40dBc) that is limited primarily by the phase noise level of the input signal.

NTIS

*Microelectronics; Oscillators; Circuits*

**20070015057** Oak Ridge National Lab., TN USA, Deere and Co., Moline, IL, USA

**CRADA Final Report: Application of Dual-Mode Inverter Control to Commercially Available Radial-Gap Permanent Magnet Motors - Vol. 1**

Lawler, J. S.; McKeever, J. W.; Downing, M. E.; Stahlhut, R. D.; Bremmer, R.; May 01, 2006; 115 pp.; In English

Report No.(s): DE2006-890028; ORNL 04-0691; No Copyright; Avail.: National Technical Information Service (NTIS)

John Deere and Company (Deere), their partner, UQM Technologies, Inc. (UQM), and the Oak Ridge National Laboratory's (ORNL's) Power Electronics and Electric Machinery Research Center (PEEMRC) recently completed work on the cooperative research and development agreement (CRADA) Number ORNL 04-0691 outlined in this report. CRADA 04-0691 addresses two topical issues of interest to Deere: (1) Improved characterization of hydrogen storage and heat-transfer management; and (2) Potential benefits from advanced electric motor traction-drive technologies. This report presents the findings of the collaborative examination of potential operational and cost benefits from using ORNL/PEEMRC dual-mode inverter control (DMIC) to drive permanent magnet (PM) motors in applications of interest to Deere. DMIC was initially developed and patented by ORNL to enable PM motors to be driven to speeds far above base speed where the back-electromotive force (emf) equals the source voltage where it is increasingly difficult to inject current into the motor. DMIC is a modification of conventional phase advance (CPA). DMIC's dual-speed modes are below base speed, where traditional pulse-width modulation (PWM) achieves maximum torque per ampere (amp), and above base speed, where six-step operation achieves maximum power per amp. The modification that enables DMIC adds two anti-parallel thyristors in each of the three motor phases, which consequently adds the cost of six thyristors. Two features evaluated in this collaboration with potential to justify the additional thyristor cost were a possible reduction in motor cost and savings during operation because of higher efficiency, both permitted because of lower current. The collaborative analysis showed that the reduction of motor cost and base cost of the inverter was small, while the cost of adding six thyristors was greater than anticipated. Modeling the DMIC control displayed inverter efficiency gains due to reduced current, especially under light load and higher speed. This current reduction, which is the salient feature of DMIC, may be significant when operating duty cycles have low loads at high frequencies. Reduced copper losses make operation more efficient thereby reducing operating costs. In the Deere applications

selected for this study, the operating benefit was overshadowed by the motor's rotational losses. Rotational losses of Deere 1 and Deere 2 dominate the overall drive efficiency so that their reduction has the greatest potential to improve performance. A good follow-up project would be to explore cost effective ways to reduce the rotational losses by 66%.

NTIS

*Electric Motors; Hydrogen; Inverters; Permanent Magnets*

**20070015058** Oak Ridge National Lab., TN USA

**Evaluation of 2004 Toyota Prius Hybrid Electric Drive System. FY 2006**

Olszewski, M.; May 01, 2005; 95 pp.; In English

Report No.(s): DE2006-890029; No Copyright; Avail.: National Technical Information Service (NTIS)

The 2004 Toyota Prius is a hybrid automobile equipped with a gasoline engine and a battery- and generator-powered electric motor. Both of these motive-power sources are capable of providing mechanical-drive power for the vehicle. The engine can deliver a peak-power output of 57 kilowatts (kW) at 5000 revolutions per minute (rpm) while the motor can deliver a peak-power output of 50 kW over the speed range of 1200-1540 rpm. Together, this engine-motor combination has a specified peak-power output of 82 kW at a vehicle speed of 85 kilometers per hour (km/h). In operation, the 2004 Prius exhibits superior fuel economy compared to conventionally powered automobiles. To acquire knowledge and thereby improve understanding of the propulsion technology used in the 2004 Prius, a full range of design characterization studies were conducted to evaluate the electrical and mechanical characteristics of the 2004 Prius and its hybrid electric drive system. These characterization studies included (1) a design review, (2) a packaging and fabrication assessment, (3) bench-top electrical tests, (4) back-electromotive force (emf) and locked rotor tests, (5) loss tests, (6) thermal tests at elevated temperatures, and most recently (7) full-design-range performance testing in a controlled laboratory environment. This final test effectively mapped the electrical and thermal results for motor/inverter operation over the full range of speeds and shaft loads that these assemblies are designed for in the Prius vehicle operations. This testing was undertaken by the Oak Ridge National Laboratory (ORNL) as part of the U.S. Department of Energy (DOE)-Energy Efficiency and Renewable Energy (EERE) FreedomCAR and Vehicle Technologies (FCVT) program through its vehicle systems technologies subprogram. The thermal tests at elevated temperatures were conducted late in 2004, and this report does not discuss this testing in detail. The thermal tests explored the derating of the Prius motor design if operated at temperatures as high as is normally encountered in a vehicle engine. The continuous ratings at base speed (1200 rpm) with different coolant temperatures are projected from test data at 900 rpm. A separate, comprehensive report on this thermal control study is available.

NTIS

*Automobiles; Electric Motors; Energy Conservation*

**20070015093** Emrich and Dithmar, LLC, Chicago, IL, USA

**Layered CU-Based Electrode for High-Dielectric Constant Oxide Thin Film-Based Devices**

Auciello, O.; 3 Mar 05; 12 pp.; In English

Contract(s)/Grant(s): W-31-109-ENG-38

Patent Info.: Filed 3 Mar 05; US-Patent-Appl-SN-11-073 263

Report No.(s): PB2007-101731; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A layered device including a substrate; an adhering layer thereon. An electrical conducting layer such as copper is deposited on the adhering layer and then a barrier layer of an amorphous oxide of TiAl followed by a high dielectric layer are deposited to form one or more of an electrical device such as a capacitor or a transistor or MEMS and/or a magnetic device.

NTIS

*Dielectric Properties; Electrodes; Oxide Films; Patent Applications; Permittivity; Thin Films*

**20070015125** L-3 Communications Corp., Torrance, CA USA

**TWT Coatings Improvement Investigation**

Feicht, Jon R; Martin, Russell H; Williams, Brian C; Feb 1, 2007; 25 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9550-05-C-0173; Proj-FIATA05035B924

Report No.(s): AD-A463632; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463632>

Gain stability has long been identified as a key attribute for successful long-term operation of both space and terrestrial helix traveling wave tubes (TWTs), whose mission life may extend to 15 or more years. Gain change associated with attenuator (carbon) thin film resistivity change has been observed for at least 30 years; however no definitive experimental

evidence to support the various resistance change theories has been available. Using a modified ion source, changes in film resistivity caused by low energy hydrogen ion bombardment of the carbon attenuator have now been positively identified as the cause of gain growth in helix TWTs. Carbon films experimentally damaged by ion bombardment compare identically to those removed from TWTs with thousands of operating hours. An unusual thermal annealing effect seen in TWT films has also been duplicated. Two potential methods to mitigate gain change have also been proposed based on this work.

DTIC

*Coatings; Traveling Wave Tubes*

**20070015128** Stanford Univ., Stanford, CA USA

**Efficient THz Source Based on Cascaded Optical Down-Conversion in Orientation-Patterned GaAs Structures**

Fejer, M M; Vodopyanov, K; Route, R; Schaar, J; Kuo, P; Dec 29, 2006; 32 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9550-04-1-0465

Report No.(s): AD-A463635; SPO-30750; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463635>

The goal of this TIFT I-A program was to demonstrate an efficient room temperature source for THz imaging systems based on optical down-conversion in an orientation-patterned GaAs microstructure, incorporated into a resonant cavity, and pumped by a compact solid-state laser. Research was focused on (1) fabrication of quasi-phase-matched (QPM) GaAs microstructures with periodic reversal of crystalline orientation, including orientation-patterned GaAs (OP-GaAs), diffusion-bonded GaAs (DB-GaAs) and optically-contacted GaAs (OC-GaAs), (2) producing THz radiation in periodic GaAs structures outside the laser cavity using both optical rectification (using femtosecond optical pump pulses) and difference frequency generation (with picosecond pulses), and, finally (3) demonstration of efficient resonantly enhanced THz wave generation with GaAs inside the cavity of an optical parametric oscillator, where 1 mW of average THz power was produced at 2.8 THz.

DTIC

*Cavity Resonators; Down-Converters; Gallium Arsenides; Images; Optical Materials; Solid State Lasers*

**20070015171** Universal Technology Corp., Dayton, OH USA

**Collaborative Research and Development. Delivery Order 0006: Transmission Electron Microscope Image Modeling and Semiconductor Heterointerface Characterization**

Mahalingam, Krishnamurthy; Sep 2006; 46 pp.; In English

Contract(s)/Grant(s): F33615-03-D-5801-0006; Proj-4349

Report No.(s): AD-A463820; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463820>

This research in support of the Air Force Research Laboratory, Materials and Manufacturing Directorate was conducted at Wright-Patterson AFB, Ohio from 19 May 2003 through 18 May 2006. Transmission electron microscope (TEM) characterization studies were performed on a variety of novel III-V semiconductor heterostructures being developed for advanced optoelectronic device applications. A new approach is developed for true atomic scale compositional mapping of interfaces in mixed cation-anion III-V semiconductor heterostructures. This approach is applied for quantifying stoichiometry of interfaces in InAs/InGaSb superlattices. Detailed TEM studies were performed on short-period InAs/GaSb superlattices with periods ranging from 50Å to 11Å. Significant degradation in structural quality was observed with reduction in the superlattice period. Improvement in quality is however achieved by reducing the growth rate (specifically in the GaSb growth rate). The formation of heterojunction quantum dots (QD) composed of a combination of InAs and GaSb is demonstrated. The composite dot is achieved by first forming InAs QDs by normal self assembly process followed by growth of a GaSb crown atop the InAs QD structure. Transmission electron microscopy indicated a clear boundary between the GaSb and InAs regions with energy dispersive spectroscopy analysis showing an In rich core and a Sb rich cap.

DTIC

*Characterization; Electron Microscopes; Electro-Optics; Microscopy; Semiconductors (Materials)*

**20070015304** Massachusetts Univ., Amherst, MA USA

**Proceedings of the Antenna Applications Symposium (30th) Held in Monticello, Illinois on 20-22 September, 2006. Volume 1**

Schaubert, Daniel; Feb 26, 2007; 251 pp.; In English

Contract(s)/Grant(s): F33615-02-D-1283

Report No.(s): AD-A464058; No Copyright; Avail.: CASI: A12, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464058>

The Proceedings of the 2006 Antenna Applications Symposium is a collection of state-of-the art papers relating to antenna arrays, millimeter wave antennas, simulation and measurement of antennas, integrated antennas, and antenna bandwidth and radiation improvements.

DTIC

*Antennas; Conferences*

**20070015316** Northwestern Univ., Evanston, IL USA

**First Demonstration of ~10 Microns FPAs in InAs/GaSb SLS**

Razeghi, Manijeh; Delaunay, Pierre-Yves; Nguyen, Binh M; Hood, Andrew; Hoffman, Darin; McClintock, Ryan; Wei, Yajun; Michel, Erick; Nathan, Vaidya; Tidrow, Meimei Z; Oct 2006; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464072; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464072>

The concept of Type II InAs/GaSb superlattice was first brought by Nobel Laureate L. Esaki, et al. in the 1970s. There had been few studies on this material system until two decades later when reasonable quality material growth was made possible using molecular beam epitaxy. With the addition of cracker cells for the group V sources and optimizations of material growth conditions, the superlattice quality become significantly improved and the detectors made of these superlattice materials can meet the demand in some practical field applications. Especially in the LWIR regime, it provides a very promising alternative to HgCdTe for better material stability and uniformity, etc. We have developed the empirical tight binding model (ETBM) for precise determination of the superlattice bandgap.

DTIC

*Focal Plane Devices; Gallium Antimonides; Indium Arsenides; Superlattices*

**20070015317** Colorado Univ., Boulder, CO USA

**Wavefront Aberration Correction Using Zernike Polynomial Parameterizations of Optical Phased Arrays**

Butterworth, Jeffrey A; Hindman, Charles; Lacy, Seth; Jan 2006; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464076; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464076>

High performance laser communication systems require adaptive optics based wavefront correction systems to correct aberrations that result from imperfections in optical hardware and atmospheric conditions. Traditionally, deformable membrane mirrors are used for wavefront correction. These mirrors are bulky and require excessive amounts of power, both of which can be detrimental to a space application. Liquid crystal based optical phased arrays (OPAs) offer an attractive alternative to these traditional devices. This paper presents a method of correcting wavefront aberrations with an OPA device by utilizing phase reconstruction of point-source images and Zernike polynomial parameterizations of the OPA. Limitations of common OPA architectures that reduce the effectiveness of the proposed wavefront correction method will be discussed. A simulation will demonstrate the effectiveness of the proposed technique.

DTIC

*Aberration; Defects; Independent Variables; Parameterization; Phased Arrays; Polynomials; Wave Fronts*

**20070015336** Icosystem Corp., Cambridge, MA USA

**Dynamic Resource Allocation for a Sensor Network**

Gaudio, Paolo; Trifonov, Iavor; Martin, Martin C; Bonabeau, Eric; Jun 2005; 22 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464105; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464105>

We describe a project that analyzes the performance of a sensor network trying to detect enemy agents in an urban environment. We simulate a network of units that can detect different enemy types using a variety of sensors. Our work aims to address key issues about networked systems, including the effectiveness of cooperative strategies, the balance of multiple constraints, and the tradeoffs between resource allocation and performance. We make use of evolutionary computing algorithms to search the space of possible configurations, carrying out parameter sweeps to test how various dimensions of the design space impact performance over a range of scenarios. Our results provide some quantitative insights into the performance of networked systems.

DTIC

*Detectors; Resource Allocation; Warfare*

**20070015343** Air Force Research Lab., Hanscom AFB, MA USA

**The Multi-Lens Array Architecture**

Luu, Danh; Feb 26, 2007; 26 pp.; In English

Contract(s)/Grant(s): Proj-4916

Report No.(s): AD-A464115; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464115>

As communication and radar systems migrate toward wider bandwidths, the quantization lobes inherent in conventional phased array systems manifest as one of the foremost challenges for array designers who must consider not only the need for a large and inexpensive array with wideband requirements but also practical issues, such as the ease of transporting and realizing such an array. Large phased arrays based on conventional subarray architecture, with time delays at the subarray level, exhibit very high quantization lobes when scanned over a wide bandwidth. This paper describes a multi-lens (ML) array architecture that is suitable for very large arrays with wideband (bandwidth to center frequency ratio greater than 0.2) scanning requirements. In addition to having low quantization lobes, the ML array architecture is modular, scalable, and compact in volume. The proposed architecture approximates the ideal gradient time delay network with a combination of time delays at the subarray level, time delays of Rotman lenses, and small phase shifts. The basic idea behind the ML architecture is to concatenate multiple modified Rotman lenses together to form a large array with non-periodic phase settings across the large array to lessen the accumulation of quantization lobes at any specific angle.

DTIC

*Antennas; Lenses; Millimeter Waves; Phased Arrays*

**20070015356** Arizona State Univ., Tempe, AZ USA

**Study of Quantum Point Contact via Low Temperature Scanning Gate Microscopy**

Aoki, N; Burke, A; da Cunha, C R; Akis, R; Ferry, D K; Ochiai, Y; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464163; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464163>

Two types of quantum point contacts have been studied by low temperature scanning gate microscopy. In addition to the usual bright spot, which corresponds to a large conductance change at the constriction, ring structures are observed near the center of the quantum point contact. The ring diameter shrinks with increasing base conductance when the side gate voltage is changed. The rings are thought to relate to the observation of impurity potentials in the constriction region.

DTIC

*Electric Contacts; Low Temperature; Microscopy; Quantum Theory*

**20070015419** Raytheon Systems Co., Tucson, AZ USA

**Integrated Sensing and Processing (ISP) Phase II: Demonstration and Evaluation for Distributed Sensor Networks and Missile Seeker Systems**

Schmitt, Harry A; Feb 28, 2007; 42 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-04-C-0437

Report No.(s): AD-A464278; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464278>

The primary goal of this effort is to bring to maturity a select set of basic algorithms, hardware, and approaches developed under the Integrated Sensing and Processing (ISP) Phase I program, implement them on representative hardware, and demonstrate their performance in a realistic field environment. We have identified a few promising research thrusts investigated in ISP Phase I where field demonstrations are cost prohibitive but collected data sets are available. Here, we will conduct a thorough performance evaluation.

DTIC

*Algorithms; Detection; Homing Devices; Missile Systems; Performance Tests*

**20070015420** Hampton Univ., VA USA

**Nonlinear Optical Properties of Nanostructured Supramolecular Organic Semiconductor**

Seo, JaeTae; Yang, Qiguang; Ma, SeongMin; Creekmore, Liawood; Battle, Russell; Jackson, Ashley; Skyles, Tifney; Brown, Herbert; Tabibi, Bagher; Sun, Sam-Shajing; Zhang, Chen; Jan 2006; 5 pp.; In English

Contract(s)/Grant(s): DAAD-02-C-0107; DAAD19-03-1-0011

Report No.(s): AD-A464280; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464280>



Resonant third-order optical susceptibility and hyperpolarizability of donor polymer in chloroform were revealed to be  $\sim 2.5 - 9.1 \times 10^{(-20)}$  sq m/V<sup>2</sup> and  $\sim 8.6 \times 10^{(-42)}$  m<sup>5</sup>/V<sup>2</sup> by degenerate four-wave mixing in nanosecond scale at 532 nm, which was attributed to the resonant enhancement.

DTIC

*Nonlinear Systems; Nonlinearity; Optical Properties; Organic Semiconductors; Quantum Electronics; Semiconductors (Materials)*

**20070015443** Seed Intellectual Property Law, Seattle, WA, USA, Battelle Memorial Inst., Arlington, VA, USA

**System for Routing and Tracking Deliverables**

Carrender, C. L.; Gilbert, R. W.; Scott, J. W.; Clark, D. A.; 13 Nov 03; 9 pp.; In English

Contract(s)/Grant(s): DE-AC0676RLO1830

Patent Info.: Filed Filed 13 Nov 03; US-Patent-Appl-SN-10-712 983

Report No.(s): PB2007-101588; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A system for routing and tracking deliverables, the system including a flexible label having a flexible transponder associated therewith or formed therein for association with a respective deliverable, at least one transceiver configured to communicate with the transceivers to receive control signals; and a routing device coupled to the transceiver and configured to route and sort deliverables in response to control signals received at the transceiver from the transponder.

NTIS

*Delivery; Electronic Equipment; Patent Applications*

**20070015447** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Investigation of Gate Current in Neutron Irradiated Al(x)Ga(1-x)N/GaN Heterogeneous Field Effect Transistors Using Voltage and Temperature Dependence**

Gray, Thomas E; Mar 2007; 125 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464330; AFIT/GNE/ENP/07-02; No Copyright; Avail.: CASI: [A06](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464330>

The gate current of Al<sub>27</sub>Ga<sub>73</sub>N/GaN heterogeneous field effect transistors (HFETs) is investigated using current-voltage (IV) and current-temperature (IT) measurement demonstrating that trap assisted tunneling (TAT) is the primary current mechanism. A thermionic trap assisted tunneling (TTT) model is used with variables of Schottky barrier height, trap energy, donor density and trap density. This results in a  $\sigma$  of  $1.38 \times 10^{(-8)}$  A for IT data measured between 85K and 290K and for IV data measured between 0.0 V and -4.0 V. High energy ( $\sim 0.5$  MeV) neutron irradiation confirms an increase of gate current with fluence. An increase in magnitude of threshold voltage is also observed. The TTT model suggests that increased trap density is responsible for increased gate current at a fluence of  $1.2 \times 10^{12}$ . An increase in trap density from the unirradiated fit value of  $4.593 \times 10^{21}$  to  $5.737 \times 10^{21}$  traps/m<sup>3</sup> and an increase in the position of traps in the energy band from 0.896 to 0.9028 V results in a fit with  $\sigma$  of  $1.77 \times 10^{(-9)}$  A. An increase in donor defect density is modeled resulting in a  $\sigma$  of  $5.00 \times 10^{-9}$  A and an increase in threshold voltage magnitude consistent with the observed change in measured IV behavior.

DTIC

*Electric Potential; Field Effect Transistors; Heterogeneity; Irradiation; Neutrons; Temperature Dependence*

**20070015449** Howard and Howard Attorneys, PC, Bloomfield Hills, MI, USA

**Position Tracking System**

Neal, H. A.; Ye, C.; Herr, J.; Irrer, J. C.; 7 Mar 06; 13 pp.; In English

Contract(s)/Grant(s): 033358

Patent Info.: Filed Filed 7 Mar 06; US-Patent-Appl-SN-11-369 572

Report No.(s): PB2007-101692; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A position tracking system includes an infrared-sensitive device, such as an infrared camera that generates signals in response to detected infrared light in a field of view of the infrared-sensitive device. A processor is responsive to the signals generated by the infrared-sensitive device for determining a position of the detected infrared light. The processor also generates tilt and pan signals based on the position of the detected infrared light. A tilt and pan mechanism moves a visible-light video camera in response to the tilt and pan signals from the processor. The active infrared light-emitting device includes a loop having at least two infrared light-emitting elements disposed along the loop, on opposite sides of the loop. A control box is disposed in the loop and is in electrical communication with the infrared light-emitting elements. When the loop

is disposed around an object that rotates relative to the infrared-sensitive device, a constantly unimpeded viewing channel is provided between the infrared-sensitive device and at least one of the elements due to the positioning of the elements. The position information obtained from the infrared-sensitive device is used to direct a visible-light camera to track the active infrared light-emitting device in a manner similar to that performed by a human camera operator.

NTIS

*Cameras; Patent Applications; Tracking (Position)*

**20070015458** California Inst. of Tech., Pasadena, CA USA

**Interconnection of Uncertain Behavioral Systems for Robust Control**

D'Andrea, Raffaello; Paganini, Fernando; Oct 15, 1993; 20 pp.; In English

Report No.(s): AD-A464346; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464346>

This paper attempts to relate robust control and behavioral frameworks by incorporating structured uncertainty into the description of behavioral systems. Behavioral equations are expressed as linear fractional transformations (LFTs) on an uncertainty structure, and a method of interconnection is outlined. A method for obtaining input- output maps from LFT representations of behavioral systems is also presented. This extension of the behavioral framework is compatible with existing robust control methods, such as p analysis, which can be used to provide robustness tests in behaviors. A simple example is presented that illustrates some of the issues which arise in this extension. A major theme in robust control has been to supply the engineer with a theoretical and computational framework that handles a rich variety of modeling uncertainty so that physically motivated uncertainty descriptions can be treated in a natural manner. In particular, it has been important to provide computational tools that analyze systems with mixtures of unstructured uncertainties and possibly large numbers of uncertain real parameters. Behavioral models are in turn very natural when modeling physical systems from first principles, or when a large system is built up from subsystem models. While the final interconnected model used in a robust control design may have well-defined inputs and outputs, it is almost always the case that components are modeled in terms of mass, momentum, or energy balances or physical laws such as Newton's second law, Ohm's law, and so on. These components do not

DTIC

*Electric Connectors; Law (Jurisprudence); Uncertain Systems*

**20070015706** Inlustra Technologies, LLC, Santa Barbara, CA USA

**Development of On-Demand Non-Polar and Semi-Polar Bulk Gallium Nitride Materials for Next Generation Electronic and Optoelectrode Devices**

Fini, P; Mar 2007; 21 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W911NF-06-C-0133

Report No.(s): AD-A464197; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report was developed under STTR contract for topic 'A06-T019'. Inlustra Technologies and the University of California, Santa Barbara conducted a Phase I STTR research program to grow and characterize thick non-polar and semi-polar gallium nitride (GaN) wafers that will act as seeds for subsequent GaN boule growth in Phase II. Inlustra developed non-polar a-plane and m-plane GaN films with smooth surfaces and minimal wafer bowing and cracking. The growth conditions for each crystallographic plane were primarily optimized with respect to surface morphology. Defect reduction methods were then applied to achieve low average extended defect density across the seed wafers. UCSB researchers conducted detailed microstructural characterization on these non-polar and semi-polar GaN thick films to evaluate their utility as seeds for equiaxed GaN boule growth in Phase II.

DTIC

*Electronic Equipment; Electro-Optics; Gallium Nitrides*

**20070015779** Toyo Univ., Kawagoe, Japan

**Proposal of Carbon Nanotube Inductors**

Tsubaki, K; Nakajima, Y; Hanajiri, T; Yamaguchi, H; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464464; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The inductors made of carbon Nanotube (CNT) have been proposed. Though the fabrication of the proposed inductor is still challenging and has many problems, merits of the proposed inductor are following, (i)The magnetic field induced by the current in CNT is about one thousand times larger than that induced by the current in normal copper wire. (ii)The large

magnetic field results in the large inductance, according to the relation between magnetic field and inductance. (iii)The inductor made of CNT is smaller than the inductor in IC circuits, because CNT can be bent with small curvature.

DTIC

*Carbon Nanotubes; Inductors*

**20070015787** Knobbe Marens Olson and Bear, LLP, Irvine, CA, USA

**Buffer Layer in Flat Panel Display**

Hanson, R. J.; Kim, W. J.; Pugh, M. E.; 2 May 06; 15 pp.; In English

Contract(s)/Grant(s): DABT63-97-C-0001

Patent Info.: Filed Filed 2 May 06; US-Patent-Appl-SN-11-415 530

Report No.(s): PB2007-101715; No Copyright; Avail.: CASI: [A03](#), Hardcopy

In devices such as flat panel displays, an aluminum oxide layer is provided between an aluminum layer and an ITO layer when such materials would otherwise be in contact to protect the ITO from optical and electrical defects sustained, for instance, during anodic bonding and other fabrication steps. This aluminum oxide barrier layer is preferably formed either by: (1) partially or completely anodizing an aluminum layer formed over the ITO layer, or (2) an in situ process forming aluminum oxide either over the ITO layer or over an aluminum layer formed on the ITO layer. After either of these processes, an aluminum layer is then formed over the aluminum oxide layer.

NTIS

*Display Devices; Flat Panel Displays; Patent Applications*

**20070015815** Naval Research Lab., Washington, DC USA

**Modulating Retroreflector Architecture Using Multiple Quantum Wells for Free Space Optical Communications**

Gilbreath, G C; Rabinovich, W S; Mahon, Rita; Katzer, D S; Ikossi-Anastasiou, K; Corson, Michael R; Kline, John F; Resnick, Joshua; Merk, H C; Vilcheck, Michael J; Jan 1998; 8 pp.; In English

Report No.(s): AD-A464530; No Copyright; Avail.: CASI: [A02](#), Hardcopy

In this paper, the authors describe a demonstration using a Multiple Quantum Well modulator combined with an optical retroreflector that supported a high-speed, free space optical data link. Video images were transmitted over an 859-nanometer link at a rate of 460 kilo bits per second, where rate of modulation was limited by demonstration hardware, not the modulator. Reflection architectures for the modulator were used; transmission architectures also were investigated but are not discussed in this paper. The modulator was a GaAs/Al(sub 0.3)Ga(sub 0.7)As quantum well that was designed and fabricated for use as a shutter at the Naval Research Laboratory. These may be the first results reported demonstrating a high-speed, free space optical data link using multiple quantum well shutters combined with retroreflectors for viable free space optical communications.

DTIC

*Data Links; Free-Space Optical Communication; Images; Laser Beams; Modulation; Modulators; Optical Communication; Quantum Wells; Retroreflectors*

**20070015816** Osaka Inst. of Tech., Japan

**Electron Transport in InAs/AlGaSb Ballistic Rectifiers**

Maemoto, Toshihiko; Koyama, Masatoshi; Furukawa, Masashi; Takahashi, Hiroshi; Sasa, Shigehiko; Inoue, Masataka; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464532; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Nonlinear transport properties of a ballistic rectifier fabricated from InAs/AlGaSb heterostructures are reported. The operation of the ballistic rectifier is based on the guidance of carriers by a square anti-dot structure. The structure was defined by electron beam lithography and wet chemical etching. The DC characteristics and magneto-transport properties of the ballistic rectifier have been measured at 77 K and 4.2 K. Rectification effects relying on the ballistic transport were observed. From the four-terminal resistance measured at low magnetic fields, we also observed magneto-resistance fluctuations corresponding to the electron trajectories and symmetry-breaking electron scattering, which are influenced by the magnetic field strength.

DTIC

*Electron Beams; Electron Scattering; Electron Transfer; Lithography; Magnetoresistivity; Rectifiers*

**20070015818** Arizona State Univ., Tempe, AZ USA

**Electron Transport in Si Nanowires**

Ramayya, E; Vasileska, D; Goodnick, S M; Knezevic, I; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464534; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We investigate electron transport in silicon nanowires taking into account acoustic, non-polar optical phonons and surface/interface roughness scattering. We find that at very high transverse fields the reduced density of final states to which the carriers can scatter into gives rise to a reduced influence of interface-roughness scattering, which is promising result from a fabrication point of view.

DTIC

*Additives; Electron Gas; Electron Transfer; Nanowires; Semiconductors (Materials); Silicon; SOI (Semiconductors)*

**20070015820** Nippon Telegraph and Telephone Public Corp., Kanagawa, Japan

**Magneto-Optics of GaAs Quantum Wire Lattices Grown by Selective-Area MOVPE**

Tamura, H; Nomura, S; Yamaguchi, M; Akazaki, T; Takayanagi, H; Mohan, P; Motohisa, J; Fukui, T; Jan 2006; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464537; No Copyright; Avail.: Defense Technical Information Center (DTIC)

We report the magneto-optical measurement of GaAs quantum wire lattices of 0.7 micrometer period grown on GaAs(111)B substrates by using the selective-area MOVPE technique. We measure the photoluminescence (PL) spectra at 60 mK from the triangular and the Kagome lattice patterns as well as from the unpatterned single quantum well (SQW) as a reference. While the PL from acceptors is dominant in all the samples, the PL spectra have a different peak between the wire structures and the SQW. When we apply a perpendicular magnetic field to the samples, the PL intensities slightly decrease up to 100 mT and then increase at higher magnetic fields with periodic oscillations in the triangular and the Kagome lattices. This oscillation is possibly attributed to the interference effect of electrons in the lattice patterns threaded by the magnetic flux.

DTIC

*Epitaxy; Gallium Arsenides; Lattice Vibrations; Magneto-Optics; Nanotechnology; Photoluminescence; Quantum Wells; Semiconductors (Materials); Vapor Deposition; Wire*

**20070015822** Zagreb Univ., Zagreb, Croatia

**CyMPA - Program For Analyzing Microstrip Patch Arrays On Circular-Cylindrical Structures**

Sipus, Zvonimir; Apr 13, 2000; 48 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F61775-99-W-E040

Report No.(s): AD-A464539; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This report results from a contract tasking University of Zagreb as follows: The contractor will investigate analyze arrays of rectangular patches on multilayer circular cylinder that is placed periodically in the circumferential and axial directions, The contractor shall investigate the following antenna characteristics: (a) current distribution at each patch in the array; (b) input impedance of each patch in the array; (c.) mutual coupling between each two patches in the array (d) radiation pattern of the array when all mutual couplings are taken into account; (e) radiation pattern of the array without taking mutual coupling into account (fast calculations of the radiation pattern needed for making the first design of the army)

DTIC

*Antennas; Cylindrical Bodies; Microstrip Antennas; Phased Arrays*

**20070015823** Osaka Univ., Osaka, Japan

**Transport Properties of Beam-Deposited Pt Nanowires**

Wakaya, F; Tsukatani, Y; Yamasaki, N; Murakami, K; Abo, S; Takai, M; Jan 2006; 7 pp.; In English

Report No.(s): AD-A464540; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Pt wires were fabricated by using electron-beam (EB) and Ga focused-ion-beam (FIB) irradiation while providing C<sub>5</sub>H<sub>5</sub>Pt(CH<sub>3</sub>)<sub>3</sub> gas through a nozzle. Electron transport properties of the wires were investigated. The resistance of the EB-deposited wires was quite high as deposited but was reduced by 3-4 orders of magnitude after 400-500 degrees C annealing. The electron transport of the as-deposited EB-deposited wire was dominated by the variable range hopping and the Coulomb blockade simultaneously, and showed the antilocalization effect after 400 degrees C annealing. The electron phase-breaking length in the EB-deposited wire with 400 degrees C annealing, which was derived from a theoretical fitting, is ~10 nm at ~4 K and increases with decreasing temperature. This means that ~10 nm fabrication technology and

improvement of coherence length are required for coherent vacuum nanoelectronics.

DTIC

*Deposition; Electron Transfer; Nanostructures (Devices); Nanowires; Platinum; Transport Properties; Wire*

**20070015828** National Inst. of Advanced Industrial Science and Technology, Ibaraki, Japan

**Negative Differential Resistance of InGaAs Dual Channel Transistors**

Sugaya, T; Yamane, T; Hori, S; Komori, K; Yonei, K; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464546; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We demonstrate a new type of velocity modulation transistor (VMT) with an InGaAs dual channel structure fabricated on an InP (001) substrate. The dual channel structure consists of a high mobility 10 nm In(0.53)Ga(0.47)As quantum well, a 2 nm In(0.52)Al(0.48)As barrier layer, and a low mobility 1 nm In(0.26)Ga(0.74)As quantum well. The VMTs have a negative differential resistance (NDR) effect with a low source-drain voltage of 0.38 V. The NDR characteristics can be clearly seen in the temperature range of 50 to 220 K with a gate voltage of 5 V. The NDR mechanism is thought to be the carrier transfer from the high mobility to the low mobility channels. Three-terminal VMTs are favorable for applications to high-frequency, high-speed, and low-power consumption devices.

DTIC

*Indium Gallium Arsenides; Transistors; Velocity Modulation*

**20070015829** Arizona State Univ., Tempe, AZ USA

**Phonon Limited Performance of III-V Nanowire Transistors**

Gilbert, M J; Ferry, D K; Jan 2006; 7 pp.; In English

Report No.(s): AD-A464547; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We use a fully self-consistent three-dimensional quantum mechanical transport formalism to examine the performance of InAs based quantum wire transistors both in the ballistic limit and with phonon scattering included. We present a method for the inclusion of polar optical phonon scattering as a real-space self-energy term. We find that the ballistic performance of the devices can be recovered if the dopants in the system are kept away from the channel entrance and exit. When dopants are present at these key points, we find that the altered carrier energy, particularly in the source, has a significant impact on the device. This ballistic recovery is aided by the fact that at higher energies, polar optical phonon scattering loses its non-locality which leads to a reduced scattering rate in these confined systems.

DTIC

*Nanotechnology; Nanowires; Phonons; Quantum Wires; Transistors*

**20070015830** Hampton Univ., VA USA

**Z-Scan and Four-Wave Mixing Characterization of Semiconductor Cadmium Chalcogenide Nanomaterials**

Yang, Qiguang; Tae Seo, Jae; Creekmore, Santiel; Tan, Guolong; Brown, Herbert; Min Ma, Seong; Creekmore, Linwood; Wang, Huitian; Jung, SungSoo; Namkung, Min; Jan 2006; 5 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAD17-02-C-0107; DAAD19-03-1-0011

Report No.(s): AD-A464549; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The possible physical origin of third-order nonlinearity of cadmium chalcogenide (Te, Se, and S) semiconductor nanocrystals were discussed based on the results of both Z-scan and degenerate four-wave mixing spectroscopies of 532, 775, 800, and 1064 nm in nanosecond, picosecond, and femtosecond time scale for nonlinear photonic applications.

DTIC

*Cadmium; Chalcogenides; Four-Wave Mixing; Nanotechnology; Semiconductors (Materials)*

**20070015851** Naval Research Lab., Washington, DC USA

**CMOS Readout System for a Double-sided Germanium Strip Detector**

Kroeger, R A; Johnson, W N; Kurfess, J D; Schwarz, W G; Read, M E; Allen, M D; Alley, G T; Britton, C L; Clonts, L C; Ericson, M N; Jan 1997; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464601; No Copyright; Avail.: CASI: [A01](#), Hardcopy

A wide variety of applications require a hard X-ray or gamma ray detector which combine both good spatial resolution and energy resolution. Double-sided solid-state strip detectors provide this capability. We report on the development of CMOS electronics designed for photon detection with strip detectors. These electronics include a low noise preamplifier, semi-gaussian shaping amplifier, discriminator, and peak detection circuitry. All circuits are designed to operate at low power.

Circuits have been duplicated in both NMOS and PMOS to provide both polarities of signals. We have constructed an 8x8 channel system to test these prototype chips. Power consumption for the preamplifier through peak-detector circuit is 4 mW/channel. The test system has a conversion gain of ~35 mV/fC, system noise (equivalent noise charge) of ENC\h220 e rms (0 pF), and a dynamic range of  $\sqrt{100}$ :1 in both NMOS and PMOS circuits.

DTIC

*CMOS; Germanium; Readout*

**20070015865** Naval War Coll., Newport, RI USA

**Defeating a Transformed U.S. Military**

Puntney, G T; Feb 14, 2005; 27 pp.; In English

Report No.(s): AD-A464625; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Network-centric warfare (NCW), as a theory of war, relies on the premise that ubiquitously networked forces and capabilities will outperform forces that are not. Put another way, all things being equal, the side with the ability to network will generally win. Fundamentally, then, the key enabler of NCW is represented by the functioning of the network that connects sensors, shooters, and decision makers in a system exploiting the synergy of its dispersed parts. While the ubiquity and health of the network is therefore paramount, weapons designed to attack the electronic components of that network can, in an instant, vaporize U.S. technological and operational superiority and render future, NCW-based combatant commanders and military forces impotent. This paper explores the relationships between NCW, systems and chaos theories, Col. John R. Boyd's decision-making model, and their impact on a potential operational center of gravity and its subsequent vulnerabilities; identification of likely threats posed by potential adversaries to hold U.S. networked forces at risk; and recommended solutions to defend against those threats.

DTIC

*Communication Networks; Computer Networks; Electromagnetic Pulses; Electronic Warfare; Protection; Vulnerability; Warfare*

**20070015870** Glasgow Univ., UK

**Monte Carlo Simulation of Implant Free InGaAs MOSFET**

Kalna, K; Asenov, A; Passlack, M; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464653; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The performance potential of n-type implant free In(0.25)Ga(0.75)As MOSFETs with high-kappa dielectric is investigated using ensemble Monte Carlo device simulations. The implant free MOSFET concept takes advantage of the high mobility in III-V materials to allow operation at very high speed and low power. A 100 nm gate length implant free In(0.25)Ga(0.75)As MOSFET with a layer structure derived from heterojunction transistors may deliver a drive current of 1800 A/m and transconductance up to 1342 mS/mm. This implant free transistor is then scaled in both lateral and vertical dimensions to gate lengths of 70 and 50 nm. The scaled devices exhibit continuous improvement in the drive current up to 2600 A/m and 3259 A/m and transconductance of 2076 mS/mm and 3192 mS/mm, respectively. This demonstrates the excellent scaling potential of the implant free MOSFET concept.

DTIC

*Field Effect Transistors; Indium Gallium Arsenides; Metal Oxide Semiconductors; Monte Carlo Method; Semiconductors (Materials); Simulation*

**20070016024** NASA Langley Research Center, Hampton, VA, USA

**1st Order Modeling of a SAW Delay Line using MathCAD(Registered)**

Wilson, William C.; Atkinson, Gary M.; [2007]; 6 pp.; In English; IEEE SoutheastCon 2007, 22-25 Mar. 2007, Richmond, VA, USA

Contract(s)/Grant(s): WBS 645846.02.07.07; Copyright; Avail.: CASI: [A02](#), Hardcopy

To aid in the development of SAW sensors for Integrated Vehicle Health Monitoring applications, a first order model of a SAW Delay line has been created using MathCadA. The model implements the Impulse Response method to calculate the frequency response, impedance, and insertion loss. This paper presents the model and the results from the model for a SAW delay line design. Integrated Vehicle Health Monitoring (IVHM) of aerospace vehicles requires rugged sensors having reduced volume, mass, and power that can be used to measure a variety of phenomena. Wireless systems are preferred when retro-fitting sensors onto existing vehicles [1]. Surface Acoustic Wave (SAW) devices are capable of sensing: temperature, pressure, strain, chemical species, mass loading, acceleration, and shear stress. SAW technology is low cost, rugged,

lightweight, and extremely low power. Passive wireless sensors have been developed using SAW technology. For these reasons new SAW sensors are being investigated for aerospace applications.

Author

*Delay Lines; Impedance; Insertion Loss; Frequency Response; Surface Acoustic Wave Devices; Aerospace Vehicles; Aerospace Engineering; Shear Stress*

**20070016036** Central Research Inst. for Machine Building, Moscow, Russian Federation  
**Demonstration Tests And An Analysis Of Critical Issues Associated With Low Power TAL**  
Semenkin, Alexander V; Jan 25, 2000; 40 pp.; In English; Original contains color illustrations  
Contract(s)/Grant(s): F61775-99-W-E092  
Report No.(s): AD-A464614; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report results from a contract tasking TSNIIMASH - EXPORT, JSC as follows: The goal of proposed SOW is to demonstrate current status and performances of low power (0.1...1 kW) Thrusters with Anode Layer ( TAL) with using Xenon propellant, provide an analysis of critical issues associated with low power TAL development and potential level of low power TAL characteristics, propose draft of the program for breadboard low power thruster development.

DTIC

*Anodes; Aerospace Engineering; Electronics*

**20070016611** NASA Goddard Space Flight Center, Greenbelt, MD, USA  
**A Discussion of the Discrete Fourier Transform Execution on a Typical Desktop PC**  
White, Michael J.; July 29, 2006; 1 pp.; In English; National Technical Association 2006 Annual Conference, 26-29 Jul. 2006, Chicago, IL, USA; No Copyright; Avail.: Other Sources; Abstract Only

This paper will discuss and compare the execution times of three examples of the Discrete Fourier Transform (DFT). The first two examples will demonstrate the direct implementation of the algorithm. In the first example, the Fourier coefficients are generated at the execution of the DFT. In the second example, the coefficients are generated prior to execution and the DFT coefficients are indexed at execution. The last example will demonstrate the Cooley- Tukey algorithm, better known as the Fast Fourier Transform. All examples were written in C executed on a PC using a Pentium 4 running at 1.7 Ghz. As a function of N, the total complex data size, the direct implementation DFT executes, as expected at order of  $N^2$  and the FFT executes at order of  $N \log_2 N$ . At  $N=16K$ , there is an increase in processing time beyond what is expected. This is not caused by implementation but is a consequence of the effect that machine architecture and memory hierarchy has on implementation. This paper will include a brief overview of digital signal processing, along with a discussion of contemporary work with discrete Fourier processing.

Author

*Discrete Functions; Fast Fourier Transformations; Algorithms; Signal Processing; Microelectronics; Digital Techniques*

**20070016648** NASA Langley Research Center, Hampton, VA, USA  
**Robust Fuzzy Controllers Using FPGAs**  
Monroe, Author Gene S., Jr.; March 25, 2007; 6 pp.; In English; IEEE SoutheastCon 2007, 22-25 Mar. 2007, Richmond, VA, USA; Original contains color and black and white illustrations  
Contract(s)/Grant(s): WBS 305295.02.07.07.01; No Copyright; Avail.: CASI: [A02](#), Hardcopy  
ONLINE: <http://hdl.handle.net/2060/20070016648>

Electro-mechanical device controllers typically come in one of three forms, proportional (P), Proportional Derivative (PD), and Proportional Integral Derivative (PID). Two methods of control are discussed in this paper; they are (1) the classical technique that requires an in-depth mathematical use of poles and zeros, and (2) the fuzzy logic (FL) technique that is similar to the way humans think and make decisions. FL controllers are used in multiple industries; examples include control engineering, computer vision, pattern recognition, statistics, and data analysis. Presented is a study on the development of a PD motor controller written in very high speed hardware description language (VHDL), and implemented in FL. Four distinct abstractions compose the FL controller, they are the fuzzifier, the rule-base, the fuzzy inference system (FIS), and the defuzzifier. FL is similar to, but different from, Boolean logic; where the output value may be equal to 0 or 1, but it could also be equal to any decimal value between them. This controller is unique because of its VHDL implementation, which uses integer mathematics. To compensate for VHDL's inability to synthesis floating point numbers, a scale factor equal to  $10(\sup(N/4))$  is utilized; where N is equal to data word size. The scaling factor shifts the decimal digits to the left of the decimal point for increased precision. PD controllers are ideal for use with servo motors, where position control is effective. This paper

discusses control methods for motion-base platforms where a constant velocity equivalent to a spectral resolution of 0.25 cm(exp -1) is required; however, the control capability of this controller extends to various other platforms.

Author

*Field-Programmable Gate Arrays; Fuzzy Systems; Robustness (Mathematics); Electromechanical Devices; Proportional Control*

**20070016650** Fish and Richardson, Minneapolis, MN, USA

**Microwave Bonding of MEMS Component**

Barmatz, M. B., Inventor; Mai, J. D., Inventor; Jackson, H. W., Inventor; Budraa, N. K., Inventor; Pike, W. T., Inventor; February 9, 2006; 7 pp.; In English

Contract(s)/Grant(s): NAS7-1407

Patent Info.: Filed 14 Jun. 05; US-Patent-Appl-SN-153248; US-Patent-Appl-SN-198656; US-Patent-Appl-SN-130842

Report No.(s): PB2007-103887; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016650>

Bonding of MEMS materials is carried out using microwave. High microwave absorbing films are placed within a microwave cavity, and excited to cause selective heating in the skin of the material. This causes heating in one place more than another. Thereby minimizing the effects of the bonding microwave energy.

Author

*Bonding; Microelectromechanical Systems; Microwaves*

**20070016662** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Effect of High Temperature Storage in Vacuum, Air, and Humid Conditions on Degradation of Gold/Aluminum Wire Bonds in PEMS**

Teverovsky, Alexander; Oct. 8, 2006; 8 pp.; In English; 39th International Symposium on Microelectronics, 8-12 Oct. 2006, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A02](#), Hardcopy

Microcircuits encapsulated in three plastic package styles were stored in different environments at temperatures varying from 130 C to 225 C for up to 4,000 hours in some cases. To assess the effect of oxygen, the parts were aged at high temperatures in air and in vacuum chambers. The effect of humidity was evaluated during long-term highly accelerated temperature and humidity stress testing (HAST) at temperatures of 130 C and 150 C. High temperature storage testing of decapsulated microcircuits in air, vacuum, and HAST chambers was carried out to evaluate the role of molding compounds in the environmentally-induced degradation and failure of wire bonds (WB). This paper reports on accelerating factors of environment and molding compound on WB failures. It has been shown that all environments, including oxygen, moisture, and the presence of molding compounds reduce time-to-failures compared to unencapsulated devices in vacuum conditions. The mechanism of the environmental effect on KB degradation is discussed.

Author

*Bonding; High Temperature; Wire; Encapsulating; Microelectronics; Gold; Aluminum; Humidity; Vacuum; Air*

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### FLUID MECHANICS AND THERMODYNAMICS

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics*.

**20070014846** Lawrence Livermore National Lab., Livermore, CA USA

**Experimental Study of the Turbulent Development of Rayleigh-Taylor and Richtmyer-Meshkov Instabilities**

Jacobs, J. W.; January 2006; 6 pp.; In English

Report No.(s): DE2007-894249; No Copyright; Avail.: National Technical Information Service (NTIS)

The objective of this three-year research program is to study the development of turbulence in Rayleigh-Taylor (RT) and Richtmyer-Meshkov (RM) instabilities. Incompressible RT and RM instabilities are studied in an apparatus in which a box containing two unequal density liquids is accelerated on a linear rail system either impulsively (by bouncing it off of a spring) to produce RM instability, or at a constant downward rate (using a weight and pulley system) to produce RT instability. These experiments are distinguished from others in the field in that they are initialized with well defined, measurable initial perturbations and are well visualized utilizing planar laser induced fluorescence imaging. New experiments are proposed



aimed at generating fully turbulent RM and RT instabilities and quantifying the turbulent development once fully turbulent flows are achieved.

NTIS

*Stability; Turbulence*

**20070014908** NASA Langley Research Center, Hampton, VA, USA

**Flutter Analysis of the Shuttle Tile Overlay Repair Concept**

Bey, Kim S.; Scott, Robert C.; Bartels, Robert E.; Waters, William A.; Chen, Roger; March 2007; 18 pp.; In English

Contract(s)/Grant(s): WBS 377816.06.03.03.14

Report No.(s): NASA/TM-2007-214857; L-19334; Copyright; Avail.: CASI: [A03](#), Hardcopy

The Space Shuttle tile overlay repair concept, developed at the NASA Johnson Space Center, is designed for on-orbit installation over an area of damaged tile to permit safe re-entry. The thin flexible plate is placed over the damaged area and secured to tile at discreet points around its perimeter. A series of flutter analyses were performed to determine if the onset of flutter met the required safety margins. Normal vibration modes of the panel, obtained from a simplified structural analysis of the installed concept, were combined with a series of aerodynamic analyses of increasing levels of fidelity in terms of modeling the flow physics to determine the onset of flutter. Results from these analyses indicate that it is unlikely that the overlay installed at body point 1800 will flutter during re-entry.

Author

*Flutter Analysis; Space Shuttles; Tiles; Spacecraft Maintenance; Computational Fluid Dynamics*

**20070014947** State Univ. of New York, Stony Brook, NY, USA

**Multiscale Stochastic Simulation and Modeling. Final Report. Reporting period January 1, 1990-December 14, 2005**

Glimm, J.; Li, X.; January 2005; 32 pp.; In English

Contract(s)/Grant(s): DE-FG02-90ER25084

Report No.(s): DE2006-862194; No Copyright; Avail.: Department of Energy Information Bridge

Acceleration driven instabilities of fluid mixing layers include the classical cases of Rayleigh-Taylor instability, driven by a steady acceleration and Richtmyer-Meshkov instability, driven by an impulsive acceleration. Our program starts with high resolution methods of numerical simulation of two (or more) distinct fluids, continues with analytic analysis of these solutions, and the derivation of averaged equations. A striking achievement has been the systematic agreement we obtained between simulation and experiment by using a high resolution numerical method and improved physical modeling, with surface tension. Our study is accompanied by analysis using stochastic modeling and averaged equations for the multiphase problem. We have quantified the error and uncertainty using statistical modeling methods.

NTIS

*Simulation; Stochastic Processes; Mathematical Models; Taylor Instability; Interfacial Tension*

**20070015097** Turkish Chamber of Civil Engineers, Ankara, Turkey

**Technical Journal of Turkish Chamber of Civil Engineers, Volume 16, December 2006. Extended Summaries from Teknik Dergi (Technical Journal)**

Tankut, T.; Dec. 2006; 68 pp.; In English

Report No.(s): PB2007-107285; No Copyright; Avail.: CASI: [A04](#), Hardcopy

;Contents: Physical and Numerical Modeling of Bed Level Changes of a Harbor Due to Tidal Motion; Determining the Engineering Properties of Bentonite-Zeolite Mixtures; Evaluation of Goodness of Fit Criteria in Time Series Analysis; Geometrically Non-Linear Analysis of Rectangular Plates on Elastic Foundation by the Coupling of the Polynomial.Differential Quadrature (PDQ) and Finite Difference (FD) Methods; The Use of Optical Microscope and Image Processing Techniques for Clinker Investigations; Multi-objective Fuzzy Optimization of Plane Frame Systems; Velocity and Discharge Measurements in Open Channel Flow; Shape and Size Optimization of 3D Trusses with Genetic Algorithm; Dynamic Impedance Functions for Rectangular Rigid Foundations; Optimization of Complex Water Distribution Networks Using Genetic Algorithms; Effect of Plasticizing Admixtures on Water Reduction-Strength Relationship of Mortars; Evaluation of Load Distributions in Pushover Analysis; Properties of Composite Portland Cement Produced With Steel and Blast Furnace Slags; Fuzzy Logic Vehicular Delay Modeling at Signalized Intersections; Optimum Design of Steel Space Frames Using Tabu Search and Genetic Algorithm; Analyses of Reinforced Concrete Beam Sections by Artificial Neural Networks; Use of Waste Marble as Aggregate in Asphalt Pavement; Evaluation of the Value of Plastic Collapse Load Factor in Two Span Steel Beams Under Concentrated Loads, By Fuzzy Logic; Shape Optimization of Arch Dams Under Dynamic

Loading; Dynamic Analysis of Cylindrical and Conical Helices by Mixed FEM.  
NTIS  
*Asphalt; Concretes; Pavements; Personnel; Structural Engineering*

**20070015127** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Reactive Conformal Inlet Technology Enhancement**

Scribber, Angela; Withrow, Melissa; Feb 2006; 5 pp.; In English

Contract(s)/Grant(s): Proj-A0A2

Report No.(s): AD-A463634; AFRL-VA-WP-TM-2006-3199; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463634>

As part of its Reactive Conformal Inlet Technology Enhancement (RECITE) program, AFRL is examining conformal inlet technology. Because they are flush to an air vehicle's fuselage, conformal engine air inlets cause less drag than other inlet designs. AFRL recently investigated a conformal inlet and two active flow control slot variations. Test results showed that the smaller flow control slot performed as desired and was most effective at lower wind tunnel Mach numbers and at higher active flow control mass flow rates. AFRL engineers will incorporate these valuable data into future RECITE inlet designs that require smaller amounts of active flow control air.

DTIC

*Aircraft Engines; Augmentation; Reactivity*

**20070015145** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Fuel-Air Injection Effects on Combustion in Cavity-Based Flameholders in a Supersonic Flow (Postprint)**

Allen, William; King, Paul I; Gruber, Mark R; Carter, Campbell D; Hsu, Kuang-Yu; Jul 2005; 14 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-3012

Report No.(s): AD-A463676; AFRL-PR-WP-TP-2006-248; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463676>

The effect of direct fuel and air injection was experimentally studied in a cavity-based flameholder in a supersonic flow. Cavity-based fuel injection and flameholding offer an obstruction-free flow path in hydrocarbon-fueled supersonic combustion ramjet (scram jet) engines. Additionally, this study included characterization of the operational limits (i.e., sustained combustion limits) over a variety of fuel and air flow rates. The cavity rearward ramp includes 10 spanwise injection ports at each of 3 axial stations configured to inject air, fuel, and air, respectively. Planar laser-induced fluorescence (PLIF) techniques were utilized to collect planar distributions of the OH radical at various axial locations within the cavity under different flow conditions. A high-speed emissions camera was used to evaluate the combustion across the cavity. Direct injection of both fuel and air provided additional capability to tune the cavity such that a more stable decentralized flame results. The addition of air injection provided the most improvement over the baseline case (fuel only) near the upstream portion of the cavity close to the cavity step.

DTIC

*Cavities; Combustion; Flame Holders; Fuel Injection; Injection; Supersonic Combustion; Supersonic Flow*

**20070015146** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Upstream Mixing Cavity Coupled with a Downstream Flameholding Cavity Behavior in Supersonic Flow (Postprint)**

Quick, Adam; King, Paul I; Gruber, Mark R; Carter, Campbell D; Hsu, Kuang-Yu; Jul 2005; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-3012

Report No.(s): AD-A463678; AFRL-PR-WP-TP-2006-249; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463678>

Experimental investigations of the flowfield associated with three upstream direct injection acoustic resonance cavities coupled with a previously designed downstream combustion cavity in a non-reacting flow are described. All of the upstream mixing cavities were acoustically open (shear layer reattachment on the downstream wall of the cavity) with the length-to-depth ratio (L/D) on the order of 1. The previously established downstream combustion cavity had an L/D of 4.7 and an aft ramp angle of 22.5 degrees. The three upstream mixing cavities were characterized in Mach 2 freestream flow with injection at three locations (upstream wall, center, downstream wall) within each cavity. Injection at the upstream wall of the cavity provided greater penetration height into the freestream as well as faster mixing with the freestream compared with

injection at the center or downstream wall of the cavity. Injection at the center of the cavity resulted in the injectant diffusing laterally in the cavity before being ejected into the freestream. Injection at the downstream cavity wall displayed characteristics of both injection at the upstream wall and center of the cavity.

DTIC

*Cavities; Cavity Flow; Flame Holders; Supersonic Flow; Upstream*

**20070015160** Wright State Univ., Dayton, OH USA

**Hypersonic Inlet With Plasma Induced Compression (Postprint)**

Shang, J S; Menart, J; Kimmel, Roger L; Hayes, J; Jan 2006; 15 pp.; In English

Contract(s)/Grant(s): Proj-A03U

Report No.(s): AD-A463775; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463775>

A path-finding experimental investigation has been successfully accomplished to show the combined effect of an electromagnetic perturbation and viscous-inviscid interaction is a viable mechanism for improving hypersonic inlet performance. The plasma-induced compression is produced by a direct current discharge from electrodes embedded in the sidewalls of a rectangular constant cross-sectional area inlet. This repeatable compression acts as the sidewall compression of a variable area inlet but without the parasitic effect when deactivated. The accompanying numerical simulation is first calibrated with the measured Pitot pressures and then used to evaluate the overall flow structure within the inlet. The magneto-fluid-dynamics interaction is found to be unsteady and characterized with low amplitude and high frequency fluctuations. The validated result reveals that a plasma generating power supply of 19.12 watts per centimeter of electrode length produces an 11.6% pressure rise at the inlet exit.

DTIC

*Charged Particles; Fluid Mechanics; Flux Density; Hypersonic Inlets; Inviscid Flow; Plasma Compression*

**20070015173** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Application of a Spectroscopic Measuring Technique to Plasma Discharge in Hypersonic Flow**

Stanfield, Scott A; Menart, James; Shang, Joseph; Kimmel, Roger L; Hayes, James R; Jan 2006; 14 pp.; In English

Report No.(s): AD-A463822; AFRL-VA-WP-TP-2006-335; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463822>

Spatially resolved rotational temperatures have been obtained within the boundary layer of a flat plate model in a Mach 5.1 flow using emission spectroscopy. The temperatures were obtained by matching the measured nitrogen second positive 0-2 rovibrational band with a calculated one. Temperature profiles are given above the cathode and the anode. The maximum temperature obtained above the cathode did not correspond to the surface of the model, but rather at an elevation 0.55 mm above the surface. This indicates that heat is traveling from the discharge into the plate for a period of time after the discharge is ignited. This characteristic in the temperature profile sheds light on some of the effects a plasma has on the flow field as determined by Pitot probe measurements and total lift measurements.

DTIC

*Aerospace Systems; Emission Spectra; Gas Discharges; Hypersonic Flow; Plasma Jets; Spectroscopic Analysis*

**20070015315** Naval Research Lab., Stennis Space Center, MS USA

**Eruptive Flow Response in a Multi-Component Driven System by an Interacting Lattice Gas Simulation**

Pandey, R B; Gettrust, J F; Jan 2006; 8 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464071; NRL/JA/7430-06-01; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464071>

An interacting lattice gas model is used to study flow of immiscible components A and B by Monte Carlo simulations. Concentration gradients and hydrostatic pressure bias drive these constituents from their source at the bottom against gravitational sedimentation in an effective medium. Response of their flux densities to the hydrostatic bias H are examined. If both constituents are released with equal probabilities (a non-interacting source), their flux densities respond linearly to bias except at the extreme bias. Flow response becomes complex if the constituents from their source are released according to their current lattice concentrations. Constituent with the lower molecular weight (A) responds linearly on increasing the bias except at very high bias where the response becomes negative. The heavier component (B) responds non-linearly: a high response

at low values of H is followed by a linear response before the onset of eruptive response at high range of H. The volatility parameter diverges as eruption occurs at H yields 1.

DTIC

*Computerized Simulation; Gas Flow; Responses; Sediments; Simulation*

**20070015331** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Performance of Pylons Upstream of a Cavity-Based Flameholder in Non-Reacting Supersonic Flow (Postprint)**

Haubelt, Lane C; King, Paul I; Gruber, Mark R; Carter, Campbell D; Hsu, Kuang-Yu; Oct 2006; 22 pp.; In English

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A464096; AIAA-2006-4679; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464096>

Cavity-based fuel injection and flame holding, typically found in hydrocarbon-fueled scramjet applications, are of current interest for use in supersonic combustors. Both the Air Force Research Lab (AFRL) and the Air Force Institute of Technology (AFIT) at Wright-Patterson Air Force Base in Ohio are investigating the enhancement of fuel-air mixing with small pylons that project into the supersonic flow upstream of a flame holder cavity. The pylons were of three sizes (medium, tall, and wide) and shaped as a thin triangular wedge with a 300 inclination angle. A total of four configurations (pylons plus baseline) were tested at two different fuel injection pressures in a Mach continuous flow wind tunnel housed at AFRL. The goal was to measure the mixing efficiency and shock loss of each pylon setup for comparison to the baseline condition of transverse injection without pylons. Non-reacting flow was measured using intrusive and non intrusive techniques to obtain pitot pressure, total temperature, cone-static pressure and laser induced Raman spectroscopy to determine species concentration over the cavity.

DTIC

*Cavities; Flame Holders; Fuel Injection; Pylons; Reacting Flow; Supersonic Flow; Upstream*

**20070015340** Department of Energy, Las Vegas, NV, USA

**EBS Radionuclide Transport Abstraction**

Prouty, J.; Jul. 14, 2006; 122 pp.; In English

Report No.(s): DE2007-893806; ANL-WIS-PA-000001-REV2; No Copyright; Avail.: National Technical Information Service (NTIS)

The purpose of this report is to develop and analyze the engineered barrier system (EBS) radionuclide transport abstraction model, consistent with Level I and Level II model validation, as identified in Technical Work Plan for: Near-Field Environment and Transport: Engineered Barrier System: Radionuclide Transport Abstraction Model Report Integration (BSC 2005 (DIRS 173617)). The EBS radionuclide transport abstraction (or EBS RT Abstraction) is the conceptual model used in the total system performance assessment (TSPA) to determine the rate of radionuclide releases from the EBS to the unsaturated zone (UZ). The EBS RT Abstraction conceptual model consists of two main components: a flow model and a transport model. Both models are developed mathematically from first principles in order to show explicitly what assumptions, simplifications, and approximations are incorporated into the models used in the TSPA. The flow model defines the pathways for water flow in the EBS and specifies how the flow rate is computed in each pathway. Input to this model includes the seepage flux into a drift. The seepage flux is potentially split by the drip shield, with some (or all) of the flux being diverted by the drip shield and some passing through breaches in the drip shield that might result from corrosion or seismic damage. The flux through drip shield breaches is potentially split by the waste package, with some (or all) of the flux being diverted by the waste package and some passing through waste package breaches that might result from corrosion or seismic damage. Neither the drip shield nor the waste package survives an igneous intrusion, so the flux splitting submodel is not used in the igneous scenario class. The flow model is validated in an independent model validation technical review. The drip shield and waste package flux splitting algorithms are developed and validated using experimental data.

NTIS

*Radioactive Isotopes; Radioactive Wastes; Waste Management; Mathematical Models*

**20070015374** Naval Research Lab., Stennis Space Center, MS USA

**Bubble Growth and Rise in Soft Sediments**

Boudreau, Bernard P; Algar, Chris; Johnson, Bruce D; Croudace, Ian; Reed, Allen; Furukawa, Yoke; Dorgan, Kelley M; Jumars, Peter A; Grader, Abraham S; Gardiner, Bruce S; Jun 2005; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464199; NRL/JA/7430-04-8; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464199>

The mechanics of uncemented soft sediments during bubble growth are not widely understood and no rheological model has found wide acceptance. We offer definitive evidence on the mode of bubble formation in the form of X-ray computed tomographic images and comparison with theory. Natural and injected bubbles in muddy cohesive sediments are shown to be highly eccentric oblate spheroids (disks) that grow either by fracturing the sediment or by reopening preexisting fractures. In contrast, bubbles in soft sandy sediment tend to be spherical, suggesting that sand acts fluidly or plastically in response to growth stresses. We also present bubble-rise results from gelatin, a mechanically similar but transparent medium, that suggest that initial rise is also accomplished

DTIC

*Bubbles; Gases; Sediments*

**20070015395** Cincinnati Univ., OH USA

**A Computational Assessment of Independent Stage Control of a Cascade Injector (Postprint)**

Meicenheimer, H L; Gutmark, E J; Carter, C D; Eklund, D R; Gruber, M R; Oct 2006; 16 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A464247; AIAA-2006-4863; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464247>

A computational assessment of independent stage control of a cascade injector was performed. This investigation used computational fluid dynamics to gain understanding of the mechanics governing the penetration characteristics of the cascade injector. Comparison to experimental data, the effects of the first injection stage, and a turbulence model study are presented. The computational solutions predicted penetration height with good accuracy compared to the experimental data, based on planar laser-induced fluorescence of the NO molecule, but were not as successful predicting injectant plume width. Penetration in the near-field was found to correspond with the position of the shock wave generated by the injectant. The Menter turbulence model produced higher values of eddy viscosity in the vicinity of the plume and more spreading, which agreed better with the experimental data. The computational data was also used to generate a synthetic laser-induced fluorescence signal, which was used to improve the penetration boundary prediction.

DTIC

*Fuel Injection; Injectors; Supersonic Flow*

**20070015450** Vanderbilt Univ., Nashville, TN USA

**Hydroxyl Tagging Velocimetry in Cavity-Piloted Mach 2 Combustor (Postprint)**

Lahr, Michael D; Pitz, R W; Douglas, Z W; Jan 2006; 17 pp.; In English

Contract(s)/Grant(s): F40600-03-D-0001; Proj-2308

Report No.(s): AD-A464332; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464332>

Hydroxyl tagging velocimetry (HTV) measurements of velocity were made in a Mach 2 scramjet combustor with a wall cavity flameholder. In the HTV method, ArF excimer laser (193 nm) beams pass through a humid gas flow and dissociate H<sub>2</sub>O into H + OH to form a tagging grid of OH molecules. Previously demonstrated with a 7x7 grid of hydroxyl (OH) molecules, HTV is now demonstrated with an 11x11 grid of OH tracked by planar laser-induced fluorescence to yield about 120 velocity vectors of the two-dimensional flow over a fixed time delay. Instantaneous, single-shot measurements of two-dimensional flow patterns were made in the non-reacting Mach 2 flow from step to step in the cavity under low- and high-backpressure conditions. Single-shot profiles were analyzed to yield mean and rms velocity profiles in the Mach 2 non-reacting flow. A set of velocity data (spanning the entire length of the cavity) for an open wall cavity in a supersonic flow under low and high backpressure conditions was compiled for validation of CFD models.

DTIC

*Cavities; Combustion Chambers; Marking; Supersonic Flow; Supersonic Speed; Velocity Measurement*

**20070015705** Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA

**Development of a Particle Counting Method for Assessing the Biological Protection Factor of Respirators**

Gardner, Paul D; Coyne, Karen M; Eshbaugh, Jonathan P; Ching, Cindy R; Nov 2006; 49 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-20602384BPO

Report No.(s): AD-A464194; ECBC-TR-512; No Copyright; Avail.: CASI: A03, Hardcopy

This investigation developed and validated a highly sensitive method based on particle counting technology for assessing the protection afforded by chemical, biological, radiological, and nuclear respirators against biological threat agents. Inert monodisperse and polydisperse aerosols, representative in size to biological agents, were used to challenge a respirator fitted to a headform or worn by a human test participant. An aerosol spectrometer was used to measure aerosol penetration into the facepiece of the respirator. To demonstrate the method, monodisperse test aerosols and controlled mask leaks were used to generate an array of simulated protection factors (SPF) on the headform test apparatus. Human test participants were challenged with a polydisperse aerosol, which allowed for the measurement of several size specific protection factor (PF) values from a single test. Each test participant wore at least one expertly fitted respirator and several respirators with induced leaks in the peripheral seal to generate a wide range of PF measurements. A test to determine the effect of human generated background particles within the respirator was also conducted. In general, SPF and PF values were found to increase as the challenge aerosol particle size increased. Although subject generated in-mask background particles were found to limit the maximum measurable PF, the particle counting method sensitivity was sufficient to measure PF values up to 100,000.

DTIC

*Aerosols; Counting; Masks; Protection; Radiation Counters; Respirators*

**20070015956** Naval Research Lab., Washington, DC USA

**Calibration and Performance of the ISO Long-Wavelength Spectrometer**

Swinyard, B M; Clegg, P E; Ade, P A; Armand, C; Baluteau, J -P; Barlow, M J; Berges, J -C; Burgdorf, M; Caux, E; Ceccarelli, C; Jan 1996; 7 pp.; In English

Report No.(s): AD-A464476; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The wavelength and flux calibration, and the in orbit performance of the Infrared Space Observatory Long-Wavelength Spectrometer (LWS) are described. The LWS calibration is mostly complete and the instrument's performance in orbit is largely as expected before launch. The effects of ionizing radiation on the detectors, and the techniques used to minimize them are outlined. The overall sensitivity figures achieved in practice are summarized. The standard processing of LWS data is described.

DTIC

*Calibrating; Spectrometers*

**20070016015** Naval Research Lab., Washington, DC USA

**The ISO Long-Wavelength Spectrometer**

Clegg, P E; Ade, P A; Armand, C; Baluteau, J -P; Barlow, M J; Buckley, M A; Berges, J -C; Burgdorf, M; Caux, E; Ceccarelli, C; Jan 1996; 6 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464621; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The Long-Wavelength Spectrometer (LWS) is one of two complementary spectrometers aboard the European Space Agency's Infrared Space Observatory (ISO) (Kessler et al., 1996). It operates over the wavelength range 43 - 196.9 micrometers at either medium (about 150 to 200) or high (6800 to 9700) spectral resolving power. This Letter describes the instrument and its modes of operation; a companion paper (Swinyard et al, 1996) describes its performance and calibration.

DTIC

*Spectrometers; Infrared Space Observatory (ISO)*

**20070016020** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Fluid Merging Viscosity Measurement (FMVM) Experiment on the International Space Station**

Antar, Basil N.; Ethridge, Edwin; Lehman, Daniel; Kaukler, William; [2007]; 1 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA; Copyright; Avail.: Other Sources; Abstract Only

The concept of using low gravity experimental data together with fluid dynamical numerical simulations for measuring the viscosity of highly viscous liquids was recently validated on the International Space Station (ISS). After testing the proof of concept for this method with parabolic flight experiments, an ISS experiment was proposed and later conducted onboard the ISS in July, 2004 and subsequently in May of 2005. In that experiment a series of two liquid drops were brought manually together until they touched and then were allowed to merge under the action of capillary forces alone. The merging process was recorded visually in order to measure the contact radius speed as the merging proceeded. Several liquids were tested and for each liquid several drop diameters were used. It has been shown that when the coefficient of surface tension for the liquid is known, the contact radius speed can then determine the coefficient of viscosity for that liquid. The viscosity is determined by fitting the experimental speed to theoretically calculated contact radius speed for the same experimental parameters.

Experimental and numerical results will be presented in which the viscosity of different highly viscous liquids were determined, to a high degree of accuracy, using this technique.

Author

*International Space Station; Interfacial Tension; Viscosity; Liquids; Drops (Liquids)*

## 35

### INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation*; and *19 Spacecraft Instrumentation and Astrionics*.

**20070014933** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **The GLAST mission**

McEnergy, Julie; [2006]; 1 pp.; In English; 4th Workshop on: Science with the New Generation of High Energy Gamma-ray Experiments, 20-22 Jun. 2006, Pisa Elba, Italy; No Copyright; Avail.: Other Sources; Abstract Only

The Gamma-ray Large Area Space Telescope (GLAST) is a next-generation high-energy gamma-ray telescope for studying high energy gamma-ray emission from astrophysical sources. The main instrument is the Large Area Telescope (LAT) which operated in the energy band from 20 MeV to greater than 300 GeV. A second instrument, the Glast Burst Monitor to provide supportive observations of gamma-ray bursts at lower energies. The LAT is a solid state pair-conversion telescope which will have capabilities well beyond those achieved by the highly successful EGRET instrument on the Compton Gamma-ray Observatory. The sensitivity achieved on the entire sky after a single day's observation is similar to the point source sensitivity of EGRET for its entire mission. The large effective area will allow flares from AGN to be detected at much lower flux levels and on far shorter time intervals that has previously been possible from space. The very large field of view will make it possible to monitor approx. 20% of the sky at any instant, and the entire sky on timescale of a few hours. In this talk I will describe the design of the GLAST instruments and discuss their science capabilities.

Author

*Astrophysics; Gamma Ray Telescopes; Space Missions; Spaceborne Telescopes*

**20070014935** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **PSD Determination using a Simultaneous-Phase Acquisition Interferometer for the Constellation-X Spectroscopy X-ray Telescope (SXT) Mirrors**

Lehan, J. P.; Saha, T.; Zhang, W. W.; [2006]; 1 pp.; In English; Optical Society of America, 9-11 Oct. 2006, Rochester, NY, USA; No Copyright; Avail.: Other Sources; Abstract Only

We investigated the use of a simultaneous-phase acquisition interferometer (a 4D FizCam™ 1500) for determining the PSD of the extremely-high aspect ratio (500: 1) glass mirrors for the Constellation-X SXT telescope. We found that the results obtained are strongly influenced by the methodology employed while collecting the data and outline a best method for this type of measurement.

Author

*Constellation-X; Interferometers; Mirrors; Spectroscopy; X Ray Telescopes*

**20070015126** Nebraska Univ., Lincoln, NE USA

#### **High-Performance Digital Imaging System for Development and Characterization of Novel Materials and Processes**

Dzenis, Y; Feng, R; Aug 8, 2006; 26 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9550-04-1-0360

Report No.(s): AD-A463633; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463633>

The objective of this DURIP project was to acquire a new high-performance digital imaging system for visualization and quantitative characterization of high-speed dynamic fracture in advanced composite materials and flow instabilities in nanomanufacturing processes. Full-field dynamic stress analysis of fracture required high spatial resolution while ballistic processes needed ultrahigh-speed imaging. Observations of jet motion and instabilities in nanofiber manufacturing required flexible frame rate and long time (high frame number) videography. As a result of thorough market search, a system of three cameras was selected and acquired, including ultrahigh-spatial resolution Model 550-24 rotating mirror CCD camera by Cordin, ultrahigh-speed Model 214-8 image-intensified gated CCD camera by Cordin, and flexible, ultrahigh-frame number

HG-100K color CMOS camera by Redlake. The cameras have overlapping resolution, recording rate/length, and sensitivity performance characteristics. This unique, state-of-the-art ultrahigh-resolution/speed imaging system will be used for quantitative experimental characterization of impact fracture and ballistic performance of novel advanced laminated composites with nanofiber-reinforced ply interfaces and for observation of electrohydrodynamics instabilities in electrospinning process.

DTIC

*Charge Coupled Devices; Composite Materials; Digital Cameras; Digital Systems; High Speed Cameras; Images; Imaging Techniques; Systems Engineering*

**20070015334** Mitre Corp., Griffiss AFB, NY USA

**Tracking Moving Ground Targets from Airborne SAR via Keystoning and Multiple Phase Center Interferometry**

Sanyal, P K; Zasada, D M; Perry, R P; Jan 2006; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464100; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464100>

Without some form of motion compensation, SAR images experience significant range walk and be quite blurred. In 1997, MITRE reported development of the Keystone Process Keystone Formatting simultaneously compensates for multiple target motion at multiple radial velocities. The target motion causes the moving targets to appear at locations different from their true instantaneous locations on the ground. In a corresponding interferometric phase image, all points on the ground nominally appear as a continuum of phase differences while the moving targets appear as discontinuities. By threshold comparisons within the intensity and the phase images, we and others have shown that it is possible to detect and georegister moving targets in the SAR.

DTIC

*Detection; Interferometry; Synthetic Aperture Radar; Targets*

**20070015359** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Hyperspectral Imagery Target Detection Using the Iterative RX Detector**

Taitano, Yuri P; Mar 2007; 102 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464168; AFIT/GOR/ENS/07-25; No Copyright; Avail.: CASI: [A06](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464168>

The purpose of this research was to expand the current catalog of hyperspectral imagery (HSI) anomaly detector algorithms by proving the effectiveness of a new detector dubbed Iterative RX. Specifically, the Iterative RX detector is measured against the established HSI 'benchmark' detector known as RX. Principal component analysis was employed as a data reduction technique. Design of experiments was used to ascertain the significance of three factors including algorithm used. Detector performance was measured both by the standard operating characteristic curve and by the novel clump operating characteristic curve. Matlab code for the Iterative RX algorithm, Baseline RX algorithm, and a clump grading function are provided. Furthermore, recommended algorithm settings and procedures for the application of the Iterative RX detector are also provided.

DTIC

*Detection; Imagery; Target Acquisition*

**20070015728** Naval Research Lab., Washington, DC USA

**Performance of a Compton Telescope using Position-Sensitive Germanium Detectors**

Philips, B F; Inderhees, S E; Kroeger, R A; Johnson, W N; Kinzer, R L; Kurfess, J D; Graham, B L; Gehrels, N; Jan 1995; 5 pp.; In English

Report No.(s): AD-A464390; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We describe the use of position sensitive planar germanium detectors in a Compton telescope/camera. This Compton telescope achieves the very good energy resolution ( $\Delta E_{total} \approx 4$  keV) associated with germanium detectors and good position resolution (2 mm). By combining a 25 x 25 strip (2 mm pitch) detector with a 5 x 5 strip detector (9 mm pitch), we created a telescope with 625 x 25 pixel combinations. Using this detector pair, we have reconstructed positions with an angular resolution of  $\sim 1$  degree FWHM and 15 arcminute centroiding. Point sources are identified with less than 100 full energy events with simple image reconstruction. The angular resolution is currently limited by the uncertainty in the absolute position of the detectors and the size of the second detector pixels. We show the expected angular resolution when the pixel size no



longer dominates the angular resolution and discuss proposed applications.

DTIC

*Detectors; Germanium; Sensitivity; Telescopes*

**20070015832** Miami Univ., FL USA

**Optical Remote Sensing of Benthic Habitats and Bathymetry in Coastal Environments at Lee Stocking Island, Bahamas: A Comparative Spectral Classification Approach**

Louchard, Eric M; Reid, R P; Stephens, F C; Davis, Curtiss O; Leathers, Robert A; Downes, T V; Jul 4, 2002; 12 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-97-1-0010; N0014-99-1-0130

Report No.(s): AD-A464551; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Remote sensing is a valuable tool for rapid identification of benthic features in coastal environments. Past applications have been limited, however, by multispectral models that are typically difficult to apply when bottom types are heterogeneous and complex. We attempt to overcome these limitations by using a spectral library of remote sensing reflectance ( $R_{rs}$ ), generated through radiative transfer computations, to classify image pixels according to bottom type and water depth.  $R_{rs}$  spectra were calculated for water depths ranging from 0.5 to 20 m at 0.5- to 1.0-m depth intervals using measured reflectance spectra from sediment, seagrass, and pavement bottom types and inherent optical properties of the water. To verify the library, computed upwelling radiance and downwelling irradiance spectra were compared to field measurements obtained with a hyperspectral tethered spectral radiometer buoy (TSRB). Comparisons between simulated spectra and TSRB data showed close matches in signal shape and magnitude. The library classification method was tested on hyperspectral data collected using a portable hyperspectral imager for low light spectroscopy (PHILLS) airborne sensor near Lee Stocking Island, Bahamas. Two hyperspectral images were classified using a minimum-distance method. Comparisons with ground truth data indicate that library classification can be successful at identifying bottom type and water depth information from hyperspectral imagery. With the addition of diverse sediments types and different species of corals, seagrass, and algae, spectral libraries will have the potential to serve as valuable tools for identifying characteristic wavelengths that can be incorporated into bottom classification and bathymetry algorithms.

DTIC

*Bathymeters; Classifications; Coasts; Habitats; Imagery; Ocean Bottom; Reflectance; Remote Sensing; Spectrum Analysis*

**20070015930** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Aquarius Mission Technical Overview**

LeVine, D. M.; Lagerloef, G. S. E.; Yueh, S.; Dinnat, E.; Pellerano, F.; [2007]; 3 pp.; In English; IGARSS, 31 Jul. - 4 Aug. 2006, Denver, CO, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: [A01](#), Hardcopy

Aquarius is an L-band microwave instrument being developed to map the surface salinity field of the oceans from space. It is part of the Aquarius/SAC-D mission, a partnership between the USA (NASA) and Argentina (CONAE) with launch scheduled for early in 2009. The primary science objective of this mission is to monitor the seasonal and interannual variation of the large scale features of the surface salinity field in the open ocean with a spatial resolution of 150 km and a retrieval accuracy of 0.2 psu globally on a monthly basis.

Author

*Microwave Sensors; Space Missions; Ultrahigh Frequencies; Remote Sensing; Oceans; Radiometers; Scatterometers*

**20070015935** Defence Science and Technology Organisation, Victoria, Australia

**Basic Operations Guide to the Analysis of Sulfur Using the Varian 3400 Pulsed Flame Photometric Detector (PFPD)**

Moore, Rachel; Nov 2006; 25 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463880; DSTO-GD-0485; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463880>

This step-by-step manual is intended to provide instructions for first-time users in the use and maintenance of the Varian 3400 Gas Chromatograph (GC) with Pulsed Flame Photometric Detector (PFPD). The instructions are specific for the analysis of sulfur mustard (HD) in diethyl phthalate (DEP) and are not intended as an exhaustive reference and therefore do not provide any insight into the theory of the PFPD or gas chromatographic principles. The instructions provide guidance for: preparing standards, generation of calibration curves, creation of sample lists and the selection of GC methods for the subsequent

analysis of samples. There is also a troubleshooting section which outlines simple techniques to combat common problems that may arise whilst using the Varian 3400 GD with PFPD.

DTIC

*Detectors; Flames; Gas Chromatography; Photometry; Sulfur*

## 36

### LASERS AND MASERS

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also 76 *Solid-State Physics*.

**20070015300** Stanford Univ., Stanford, CA USA

#### **Near-Infrared Diode Laser Absorption Diagnostic for Temperature and Water Vapor in a Scramjet Combustor (Postprint)**

Liu, Jonathan T C; Rieker, Gregory B; Jeffries, Jay B; Gruber, Mark R; Carter, Campbell D; Mathur, Tarun; Hanson, Ronald K; Nov 2005; 13 pp.; In English

Contract(s)/Grant(s): Proj-3012

Report No.(s): AD-A464053; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464053>

Tunable diode laser absorption measurements of gas temperature and water concentration were made at the exit of a model scramjet combustor fueled on JP-7. Multiplexed, fiber-coupled, near-infrared distributed feedback lasers were used to probe three water vapor absorption features in the 1.34 to 1.47  $\mu\text{m}$  spectral region ( $2\nu_1$  and  $\nu_1 + \nu_3$  overtone bands). Ratio thermometry was performed using direct absorption wavelength scans of isolated features at a 4-kHz repetition rate, as well as 2f wavelength modulation scans at a 2-kHz scan rate. Large signal-to-noise ratios demonstrate the ability of the optimally engineered optical hardware to reject beam steering and vibration noise. Successful measurements were made at full combustion conditions for a variety of fuel/air equivalence ratios and at eight vertical positions in the duct to investigate spatial uniformity. The use of three water vapor absorption features allowed for preliminary estimates of temperature distributions along the line of sight. The improved signal quality afforded by 2f measurements, in the case of weak absorption, demonstrates the utility of a scanned wavelength modulation strategy.

DTIC

*Absorption Spectroscopy; Combustion Chambers; Diodes; Laser Spectroscopy; Semiconductor Lasers; Supersonic Combustion Ramjet Engines; Water Vapor*

**20070015335** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

#### **Stimulated Brillouin Scattering Beam Cleanup and Beam Phasing Through Two Passive Channels**

Gamboa, Omar; Mar 2007; 65 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464104; AFIT/GAP/ENP/07-03; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464104>

Stimulated Brillouin scattering (SBS) beam cleanup and SBS piston correction properties are explored. This research measures the beam cleaning and phase-conjugating properties of stimulated Brillouin scattering in an optical fiber. The first stage of this research began by coupling an aberrated beam into a long multimode 62.5 micron core fiber to demonstrate its beam cleanup properties. The Stokes beam obtained was shown to be the fundamental fiber mode, LP<sub>01</sub>. The second stage spatially divided the pump beam into two equal halves. Each half was then sent through two different channels. The path length of one channel remained fixed while the other path contained a retroreflector mounted on a piezoelectric movable stage to allow path length variation. The two channels were then tiled next to each other and the fringes were analyzed with a lateral shearing interferometer. Phasing from the two channels was not observed. This was observed by discontinuity of the fringes across three regions of interference. The fringes were able to be aligned by shifting the movable stage by less than a wavelength.

DTIC

*Brillouin Effect; Cleaning; Laser Weapons*

**20070015723** Boeing-SVS, Inc., Albuquerque, NM USA

**Inertially Stabilized Platforms for Precision Pointing Applications to Directed-Energy Weapons and Space-Based Lasers (Preprint)**

Negro, J; Griffin, S; Aug 17, 2006; 55 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464385; No Copyright; Avail.: CASI: [A04](#), Hardcopy

Tactical and space-based high-energy-laser weapon systems present interesting challenges for precision line-of-sight control. Sub-Murad pointing accuracies are required against dynamic targets. In addition, absolute pointing and inertial angular-rate measurements are required to support mission requirements. This article addresses directed-energy-weapon (DEW) precision pointing requirements and implementation alternatives in the context of strapdown and stable-platform inertial-reference technologies. Prior work has addressed details of stable platform design and test results. The contributions of the present article include the broader issues of DEW requirements drivers, integration of the stabilization system with the remaining optical system, and design tradeoffs between stable-platform and strapdown stabilization mechanizations.

DTIC

*High Power Lasers; Lasers; Pointing Control Systems; Stabilized Platforms; Weapon Systems*

**20070015827** Osaka Univ., Osaka, Japan

**Much Improved Self-Organized In(0.53)Ga(0.47)As Quantum Wire Lasers Grown on (775)B InP Substrates by Molecular Beam Epitaxy**

Ohmori, K; Hino, H; Fujita, T; Kitada, T; Shimomura, S; Hiyamizu, S; Jan 2006; 6 pp.; In English

Report No.(s): AD-A464545; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A self-organized In(0.53)Ga(0.47)As/(In(0.53)Ga(0.47)As)<sub>2</sub>(In(0.44)Al(0.56)As)<sub>2</sub> quantum wire (QWR) laser was grown on a (775)B InP substrate by molecular beam epitaxy (MBE). Well lattice-matched and flat cladding layers were grown at a rather high temperature (595 degrees C). Lateral confinement potential was induced by a nano-meter scale interface corrugation of InGaAs/(InGaAs)<sub>2</sub>(InAlAs)<sub>2</sub> with an amplitude of 2 nm and a period of 40 nm. A 50 micrometers x 500 micrometers stripe-contact QWR laser with uncoated cleaved mirrors oscillated with a threshold current density (J<sub>th</sub>) of 1.2 kA/sq cm and a lasing wavelength of 1370 nm at 250 K under pulsed current condition.

DTIC

*Indium Gallium Arsenides; Indium Phosphides; Lasers; Molecular Beam Epitaxy; Quantum Wires; Substrates; Wire*

**37**

**MECHANICAL ENGINEERING**

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

**20070014925** Kansas State Univ., Manhattan, KS, USA

**Report 15: Cost-Effective Reciprocating Engine Emission Control and Monitoring for E and P Field and Gathering Engines. Technical Progress Report for July 1, 2006 to September 30, 2006**

Chapman, K. S.; Warren, S. R.; Oct. 01, 2006; 24 pp.; In English

Report No.(s): DE2006-895909; No Copyright; Avail.: National Technical Information Service (NTIS)

Continuing work in controlled testing uses a one cylinder Ajax DP-115 (a 13.25 in bore OE 16 in stroke, 360 rpm engine) to assess a sequential analysis and evaluation of a series of engine upgrades. As with most of the engines used in the natural gas industry, the Ajax engine is a mature engine with widespread usage throughout the gas gathering industry. The end point is an assessment of these technologies that assigns a cost per unit reduction in NOX emissions. Technologies including one pre-combustion chamber, in-cylinder sensors, the means to adjust the air-to-fuel ratio, and modification of the air filter housing have been evaluated in previous reports. Current work tests non-production, prototype, mid-pressure fuel valves and begins analysis of these tests. This analysis reveals questions which must be answered before coming to any firm conclusions about the use of the 180 psig fuel valve. The research team plans to continue with the remaining pre-combustion chamber tests in the coming quarter. By using the Ajax DP-115 these tests are completed in a low-cost and efficient manner. The various technologies can be quickly exchanged with different hardware, and it is inexpensive to run the engine. Progress in moving toward field testing is discussed, and a change in strategy is suggested.

NTIS

*Cost Effectiveness; Engine Control; Internal Combustion Engines; Natural Gas; Piston Engines*

**20070015387** Applied Research Associates, Inc., Tyndall AFB, FL USA

**Viral Penetration of High Efficiency Particulate Air (HEPA) Filters**

Helmbuch, Brian K; Hodge, Jennifer K; Wander, Joseph D; Feb 2007; 25 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F08637-03-C-6006; Proj-DODT

Report No.(s): AD-A464232; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464232>

High Efficiency Particulate Air (HEPA) filters are the primary technology used for particulate removal in many individual and collective protection applications. HEPA filters are commonly thought to be impenetrable to particulate matter, but in fact they are only 99.97% efficient at collecting the most penetrating particle (~ 0.2 micrometer). While this is an impressive collection efficiency, HEPA filters may be vulnerable to certain types of threats: Viruses are submicron in size and most have very small minimum infections doses (MID). Therefore, an appropriate viral challenge will yield penetration that exceeds the MID, for many of the threat agent viruses. Nonetheless, the overall particle size (agglomerated viruses and/or viruses attached to inert carriers) will determine the capture efficiency by HEPA filters. Aerosolized viruses are commonly thought to exist as agglomerates, which would increase the particle size and render them more prone to capture. However many of the threat agent viruses can be highly agglomerated and still exist as submicron particles. Furthermore the stability of aggregates is not well understood, and they may break apart during filtration. We have demonstrated in our laboratory that biological aerosols of MS2 coli phage, a common viral simulant, can penetrate both Carbon HEPA Aerosol Canisters (CHAC) and flat sheet HEPA material. The penetration is linear over time, thus viral penetration exceeding the MID is expected to occur in minutes following a viral challenge. We are currently investigating the particle size of the MS2 coli phage aerosol and our aim is to shift the particle size to see what effect it has on penetration. Furthermore, we are evaluating the penetration characteristics of a mammalian virus, which may better represent the threat agent viruses.

DTIC

*Air Filters; Fluid Filters; Particulates; Penetration; Viruses*

**20070016672** NASA Johnson Space Center, Houston, TX, USA

**Applicability of a Conservative Margin Approach for Assessing NDE Flaw Detectability**

Koshti, ajay M.; Apr. 16, 2007; 29 pp.; In English; Aging Aircraft 2007, 16-19 Apr. 2007, Palm Springs, CA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 377816.06.02.05.03.08.01; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016672>

Nondestructive Evaluation (NDE) procedures are required to detect flaws in structures with a high percentage detectability and high confidence. Conventional Probability of Detection (POD) methods are statistical in nature and require detection data from a relatively large number of flaw specimens. In many circumstances, due to the high cost and long lead time, it is impractical to build the large set of flaw specimens that is required by the conventional POD methodology. Therefore, in such situations it is desirable to have a flaw detectability estimation approach that allows for a reduced number of flaw specimens but provides a high degree of confidence in establishing the flaw detectability size. This paper presents an alternative approach called the conservative margin approach (CMA). To investigate the applicability of the CMA approach, flaw detectability sizes determined by the CMA and POD approaches have been compared on actual datasets. The results of these comparisons are presented and the applicability of the CMA approach is discussed.

Author

*Nondestructive Tests; Probability Theory; Defects; Estimates*

**42**

**GEOSCIENCES (GENERAL)**

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

**20070015989** Army Command and General Staff Coll., Fort Leavenworth, KS USA

**Assessing Water Security in the Amu Darya River Basin, Afghanistan**

DiPasquale, Joseph A; Jun 16, 2006; 148 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463809; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463809>

New data and previous studies were used with quantitative analysis to assess Afghanistan's effect on water security in the

Amu Darya river basin from 1995 to 2005. An event database constructed from open source news reporting and a geographic information system (GIS) of the basin combined to evaluate the basin's risk for water-related conflict relative to six factors: overall relations; population density, per capita income; freshwater treaty status; internationalization potential of the basin; and water development projects. The thesis evaluated the quantitative techniques employed for their utility in planning, executing, and assessing military operations in relation to water resources. Afghanistan's effect on water security marginally increased the risk of conflict over water while increasing non-water-related levels of cooperation among riparian neighbors. Population density and internationalization potential did not contribute to increased risk, but income level, treaty status, and development projects did contribute to increased risk for conflict. The techniques demonstrated their utility for military planners, principally at the operational and strategic levels as a tool for long-range assessment and monitoring. Tactical utility was found to be limited, but modifications to database and GIS layer development show potential for more use of the techniques in the tactical environment.

DTIC

*Afghanistan; Geographic Information Systems; Geography; Global Positioning System; River Basins; Security; Water; Water Resources*

**20070016000** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Multi-Scale Modeling of Magnetospheric Reconnection**

Kuznetsova, M. M.; Hesse, M.; Rastatter, L.; Toth, G.; Dezeeuw, D.; Gomobosi, T.; [2007]; 2 pp.; In English; 2006 GEM Workshop, 24-30 Jun. 2006, Snowmass, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

One of the major challenges in modeling the magnetospheric magnetic reconnection is to quantify the interaction between large-scale global magnetospheric dynamics and microphysical processes in diffusion regions near reconnection sites. There is still considerable debate as to what degree microphysical processes on kinetic scales affect the global evolution and how important it is to substitute numerical dissipation and/or ad hoc anomalous resistivity by a physically motivated model of dissipation. Comparative studies of magnetic reconnection in small scale geometries demonstrated that MHD simulations that included non-ideal processes in terms of a resistive term  $\eta J$  did not produce the fast reconnection rates observed in kinetic simulations. For a broad range of physical parameters in collisionless magnetospheric plasma, the primary mechanism controlling the dissipation in the vicinity of the reconnection site is non-gyrotropic effects with spatial scales comparable with the particle Larmor radius. We utilize the global MHD code BATSRUS and incorporate nongyrotropic effects in diffusion regions in terms of corrections to the induction equation. We developed an algorithm to search for magnetotail reconnection sites, specifically where the magnetic field components perpendicular to the local current direction approaches zero and form an X-type configuration. Spatial scales of the diffusion region and magnitude of the reconnection electric field are calculated selfconsistently using MHD plasma and field parameters in the vicinity of the reconnection site. The location of the reconnection sites is updated during the simulations. To clarify the role of nongyrotropic effects in diffusion region on the global magnetospheric dynamic we perform simulations with steady southward IMF driving of the magnetosphere. Ideal MHD simulations with magnetic reconnection supported by numerical resistivity produce steady configuration with almost stationary near-earth neutral line (NENL). Simulations with non-gyrotropic corrections demonstrate dynamic quasi-periodic response to the steady driving condition. The loading/unloading cycle in non-gyrotropic MHD results has a non-stationary reconnection site in the magnetotail, with the retreating during the stretching phase and then a new NENL forming in the resulting thin plasma sheet. We expect that this model will lead to improved representations of space weather event in the magnetosphere.

Author

*Magnetic Field Reconnection; Magnetohydrodynamics; Atmospheric Models; Earth Magnetosphere*

**20070016601** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Variations in the Sea Ice Edge and the Marginal Ice Zone on Different Spatial Scales as Observed from Different Satellite Sensor**

Markus, Thorsten; Henrichs, John; [2006]; 2 pp.; In English; IGARSS, 31 Jul - 4 Aug. 2006, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

The Marginal sea Ice Zone (MIZ) and the sea ice edge are the most dynamic areas of the sea ice cover. Knowledge of the sea ice edge location is vital for routing shipping in the polar regions. The ice edge is the location of recurrent plankton blooms, and is the habitat for a number of animals, including several which are under severe ecological threat. Polar lows are known to preferentially form along the sea ice edge because of induced atmospheric baroclinicity, and the ice edge is also the location of both vertical and horizontal ocean currents driven by thermal and salinity gradients. Finally, sea ice is both a driver and indicator of climate change and monitoring the position of the ice edge accurately over long time periods enables

assessment of the impact of global and regional warming near the poles. Several sensors are currently in orbit that can monitor the sea ice edge. These sensors, though, have different spatial resolutions, different limitations, and different repeat frequencies. Satellite passive microwave sensors can monitor the ice edge on a daily or even twice-daily basis, albeit with low spatial resolution - 25 km for the Special Sensor Microwave Imager (SSM/I) or 12.5 km for the Advanced Microwave Scanning Radiometer (AMSR-E). Although special methods exist that allow the detection of the sea ice edge at a quarter of that nominal resolution (PSSM). Visible and infrared data from the Advanced Very High Resolution Radiometer (AVHRR) and from the Moderate Resolution Imaging Spectroradiometer (MODIS) provide daily coverage at 1 km and 250 m, respectively, but the surface observations are limited to cloud-free periods. The Landsat 7 Enhanced Thematic Mapper (ETM+) has a resolution of 15 to 30 m but is limited to cloud-free periods as well, and does not provide daily coverage. Imagery from Synthetic Aperture Radar (SAR) instruments has resolutions of tens of meters to 100 m, and can be used to distinguish open water and sea ice on the basis of surface and volume scattering characteristics. The Canadian RADARSAT C-band SAR provides data that cover the Arctic Ocean and the MIZ every 3 days. A change-point detection approach was utilized to obtain an ice edge estimate from the RADARSAT data. The Quikscat scatterometer provides ice edge information with a resolution of a few kilometers on a near-daily basis. During portions of March and April of 2003 a series of aircraft flights were conducted over the ice edge in the Bering Sea carrying the Polarimetric Scanning Radiometer (PSR), which provides spectral coverage identical with the AMSR-E instrument at a resolution of 500 meters. In this study we investigated these different data sets and analyzed differences in their definition of the sea ice edge and the marginal ice zone and how these differences as well as their individual limitations affect the monitoring of the ice edge dynamics. We also examined how the nature of the sea ice edge, including its location, compactness and shape, changes over the seasons. Our approach was based on calculation of distances between ice edges derived from the satellite and aircraft data sets listed above as well as spectral coherence methods and shape parameters such as tortuosity, curvature, and fractional dimension.

Author

*Remote Sensing; Satellite Instruments; Sea Ice; Spatial Resolution; Ice Formation*

**20070016632** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Assessment of the AMSR-E Sea Ice Concentration Product at the Ice Edge Using RADARSAT-1 and MODIS Imagery**

Henrichs, John F.; Cavalieri, Donald J.; Markus, Thorsten; IEEE Transactions on Geoscience and Remote Sensing; Nov. 2006; ISSN 0196-2892; Volume 44, No. 11, pp. 3070-3080; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-11369; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1109/TGRS.2006.880622>

Imagery from the C-band synthetic aperture radar (SAR) aboard RADARSAT-1 and the Moderate Resolution Imaging Spectroradiometer (MODIS) was used to evaluate the performance of the Advanced Microwave Scanning Radiometer- EOS (AMSR-E) ice concentration product near the sea ice edge in the Bering Sea for four days during March 2003, which is concurrent with the AMSR-Ice03 field/aircraft campaign. The AMSR-E products were observed to perform very well in identifying open-water and pack-ice areas, although the AMSR-E products occasionally underestimate ice concentration in areas with thin ice. The position of the ice edge determined from AMSR-E data using a 15% concentration threshold was found to be, on average, within one AMSR-E grid square (12.5 km) of the ice edge determined from the SAR data, with the AMSR-E edge tending to be outside the SAR-derived edge

Author

*MODIS (Radiometry); Synthetic Aperture Radar; Microwave Frequencies; Sea Ice*

**20070016635** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**In Orbit Performance of Si Avalanche Photodiode Single Photon Counting Modules in the Geoscience Laser Altimeter System on ICESat**

Sun, X.; Jester, P. L.; Palm, S. P.; Abshire, J. B.; Spinhome, J. D.; Krainak, M. A.; [2006]; 1 pp.; In English; SPIE Optics East, Advanced Photon Counting, 30 Sep. - 2 Oct. 2006, Boston, MA, USA; Copyright; Avail.: Other Sources; Abstract Only

Si avalanche photodiode (APD) single photon counting modules (SPCMs) are used in the Geoscience Laser Altimeter System (GLAS) on Ice, Cloud, and land Elevation Satellite (ICESat), currently in orbit measuring Earth surface elevation and atmosphere backscattering. These SPCMs are used to measure cloud and aerosol backscatterings to the GLAS laser light at 532-nm wavelength with 60-70% quantum efficiencies and up to 15 millions/s maximum count rates. The performance of the SPCMs has been closely monitored since ICESat launch on January 12, 2003. There has been no measurable change in the quantum efficiency, as indicated by the average photon count rates in response to the background light from the sunlit earth. The linearity and the afterpulsing seen from the cloud and surface backscatterings profiles have been the same as those during ground testing. The detector dark count rates monitored while the spacecraft was in the dark side of the globe have increased

almost linearly at about 60 counts/s per day due to space radiation damage. The radiation damage appeared to be independent of the device temperature and power states. There was also an abrupt increase in radiation damage during the solar storm in 28-30 October 2003. The observed radiation damage is a factor of two to three lower than the expected and sufficiently low to provide useful atmosphere backscattering measurements through the end of the ICESat mission. To date, these SPCMs have been in orbit for more than three years. The accumulated operating time to date has reached 290 days (7000 hours). These SPCMs have provided unprecedented receiver sensitivity and dynamic range in ICESat atmosphere backscattering measurements.

Author

*Avalanches; Geophysics; Ice, Cloud and Land Elevation Satellite; Laser Altimeters; Photodiodes; Silicon; Modules*

## 43

### EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis of remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photography. For related instrumentation see *35 Instrumentation and Photography*.

**20070014865** NASA Dryden Flight Research Center, Edwards, CA, USA

#### **The NASA Earth Research-2 (ER-2) Aircraft: A Flying Laboratory for Earth Science Studies**

Navarro, Robert; March 2007; 13 pp.; In English; 32nd International Symposium on Remote Sensing Environment, 25-29 Jun. 2007, San Jose, USA; Original contains black and white illustrations

Report No.(s): NASA/TM-2007-214615; H-2691; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014865>

The National Aeronautics and Space Administration Dryden Flight Research Center, Edwards, California, has two Lockheed Martin Corporation (Bethesda, Maryland) Earth Research-2 (ER2) aircraft that serve as high-altitude and long-range flying laboratories. The ER-2 aircraft has been successfully utilized to conduct scientific studies of stratospheric and tropospheric chemistry, land-use mapping, disaster assessment, preliminary testing and calibration and validation of satellite sensors. The research missions for the ER-2 aircraft are planned, implemented, and managed by the Dryden Flight Research Center Science Mission Directorate. Maintenance and instrument payload integration is conducted by Dryden personnel. The ER-2 aircraft provides experimenters with a wide array of payload accommodations areas with suitable environment control with required electrical and mechanical interfaces. Missions may be flown out of Dryden or from remote bases worldwide, according to research requirements. The NASA ER-2 aircraft is utilized by a variety of customers, including U.S. Government agencies, civilian organizations, universities, and state governments. The combination of the ER-2 aircraft's range, endurance, altitude, payload power, payload volume and payload weight capabilities complemented by a trained maintenance and operations team provides an excellent and unique platform system to the science community and other customers.

Author

*Earth Sciences; High Altitude; U-2 Aircraft; Avionics; Loran; Flying Platforms*

**20070014869** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Real-time Models at the Community Coordinated Modeling Center and their Capabilities**

Hesse, Michael; [2006]; 4 pp.; In English; 2006 Space Weather Week, 25-27, Apr. 2006, Boulder, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

Real-time models at the Community Coordinated Modeling Center and their capabilities The Community Coordinated Modeling Center serves both scientific research and space weather operations communities through access to and evaluation of modern space environment models. Critical to both objectives is an unbiased assessment of model capabilities, which includes scientific validity, performance verification, and model robustness. While all of these assessments are relevant to operational customers, the latter plays a particularly important role. For this reason, as well as for testing model validity, CCMC established a set of fully automated real-time execution systems, which are based on models provided by the research community. This presentation will provide a summary of these activities, and a report on experiences and model validity. Finally, this presentation will invite feedback from CCMC customers regarding future directions of real time modeling at CCMC.

Author

*Aerospace Environments; Environment Models; Real Time Operation; Space Weather*

**20070014871** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**An Overview of Inter-comparison Methodologies for Terra and Aqua MODIS Calibration**

Xiong, X.; Wu, A.; Sun, J.; [2006]; 1 pp.; In English; The International Society for Optical Engineering (SPIE) Conference on Optics and Photonics 2006, 13-17 Aug. 2006, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

With increasing efforts on data fusion and long-term climate data records (CDR) using observations made by multiple sensors, on the same or different platforms, their cross-calibration and validation work has become more and more important. The uncertainties of the climate models and data records depend not only on the calibration quality of individual sensors but also on their calibration consistency. This paper provides an overview of methodologies used by the MODIS Characterization Support Team (MCST) at NASA GSFC for the inter-comparison studies of Terra and Aqua MODIS on-orbit calibration. Each MODIS was built with a set of onboard calibrators (OBC) that include a blackbody (BB), a solar diffuser (SD), and a solar diffuser stability monitor (SDSM). The BB is primarily used for the thermal emissive bands (TEB) calibration and the SD/SDSM system for the reflective solar bands (RSB) calibration. Although the instrument design and calibration approach are nearly identical for both Terra and Aqua MODIS and they all went through an extensive and similar pre-launch calibration and characterization process, still their on-orbit calibration consistency needs to be carefully examined and validated as many science products have been generated from observations made by both instruments. Methodologies discussed in this paper include inter-comparison studies using the Moon, a third sensor, and ground targets. Our results show that Terra and Aqua reflective solar bands and thermal emissive bands have been calibrated consistently with excellent long-term stabilities. For the 11 and 12 micrometers sea surface temperature (SST) bands, the calibration difference of Terra and Aqua MODIS is less than 0.2K.

Author

*Aqua Spacecraft; Calibrating; MODIS (Radiometry); Terra Spacecraft; General Overviews*

**20070014872** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Results and Lessons from MODIS Thermal Emissive Bands Calibration: Pre-launch to On-orbit**

Xiong, X.; Chiang, K.; Barnes, W. L.; Guenther, B.; [2006]; 1 pp.; In English; The International Society for Optical Engineering (SPIE) Conference on Optics and Photonics 2006, 13-17 Aug. 2006, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

MODIS is a major instrument for the NASA EOS Terra (launched in December 1999) and Aqua (launched in May 2002) missions. It was designed and built to enhance and extend its heritage sensors' measurements and data records with applications covering a wide range of studies of the Earth's land, oceans, and atmosphere. Its 16 thermal emissive bands (TEB), each with 10 detectors, are located on the two cold focal plane assemblies (FPAs) controlled by a passive radiative cooler. Because of instrument design complexity and stringent calibration requirements, extensive calibration and characterization activities were conducted pre-launch by the sensor vendor for both Terra and Aqua MODIS. For TEB, these activities include characterization of detectors' noise and non-linearity and evaluation of their radiometric performance in thermal vacuum at difference instrument temperatures and FPA temperatures. In addition TEB system level response versus scan-angle (RVS) and relative spectral response (RSR) were characterized. MODIS TEB radiometric calibration transfer from pre-launch to on-orbit was performed using spectral bands' responses to the instrument on-board blackbody and a laboratory blackbody calibration source (BCS) traceable to NIST standards. This paper provides a summary of MODIS TEB pre-launch and on-orbit calibration and characterization activities, challenges, data analysis results, and lessons learned with focus on sensors' radiometric performance. A comparison between Terra and Aqua MODIS TEB performance is also presented. A similar summary for the reflective solar bands (RSB) is reported in a separate paper in these proceedings.

Author

*Calibrating; MODIS (Radiometry); Thermal Emission; Earth Observing System (EOS); Spacecraft Launching*

**20070014875** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Results and Lessons from MODIS Reflective Solar Bands Calibration: Pre-launch to On-orbit**

Xiong, X.; Che, N.; Barnes, W. L.; Guenther, B.; [2006]; 1 pp.; In English; The International Society for Optical Engineering (SPIE) Conference on Optics and Photonics 2006, 13-17 Aug. 2006, San Diego, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

MODIS is a major instrument for the NASA EOS Terra (launched in December 1999) and Aqua (launched in May 2002) missions. It was designed and built to enhance and extend its heritage sensors' measurements and data records with applications covering a wide range of studies of the Earth's land, oceans, and atmosphere. MODIS has 36 spectral bands (0.41 - 14.4 micrometers) located on four focal plane assemblies (FPAs). It makes measurements at three nadir spatial resolutions: 250m (bands 1-2), 500m (bands 3-7), and 1km (bands 8-36). Because of instrument design complexity and stringent calibration



requirements, extensive calibration and characterization activities were conducted pre-launch by the sensor vendor (Raytheon / Santa Barbara Remote Sensing) for both Tesa and Aqua MODIS. For the 20 reflective solar bands (RSB), these activities include measurements for the detectors noise characterization and radiometric performance, system level response versus scan-angle (RVS), polarization sensitivity, and relative spectral response (RSR). Key radiometric performance was evaluated using thermal vacuum observations. On-orbit MODIS RSB calibration is performed using a solar diffuser (SD) and solar diffuser stability monitor (SDSM) system. The SD bi-directional reflectance factor (BRF) was characterized pre-launch by the sensor vendor with reference samples traceable to NIST reflectance standards. This paper provides a summary of Terra and Aqua MODIS RSB pre-launch and on-orbit calibration and characterization activities and results with focus on the detectors' noise characterization and radiometric performance. Challenging and concerning issues and lessons learned from RSB pre-launch calibration and their impact on post launch performance are also presented. A similar summary for MODIS thermal emissive bands (TEB) is reported in a separate paper in these proceedings.

Author

*Calibrating; MODIS (Radiometry); Remote Sensing; Spectral Bands; Spectral Reflectance*

**20070014893** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **Role of Ionospheric Plasmas in Earth's Magnetotail**

Moore, Thomas E.; [2007]; 1 pp.; In English; GEM meeting, 26-29 Jun. 2006, Snowmass, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

This tutorial will summarize observations and theories indicating a prominent role of ionospheric plasma in the Earth's magnetotail. At the Global scale, I will argue that it is ionospheric plasma momentum and dynamic pressure that are responsible for the production of plasmoids, through the action of a transient near-Earth neutral or X-line, which serves to release excessive plasma pressure from the magnetotail field. Ionospheric plasma gains the momentum and energy to produce plasmoids and their related effects through its interaction with the solar wind, beginning at the dayside reconnection region and extending across the polar caps through the magnetotail lobes. This distant neutral line can be depicted as a feature much like that found in cometary magnetospheres, where disconnection limits the amount of IMF hung up on the cometary coma. On the other hand, the near-Earth neutral one can be seen as a feature unique to planets with an intrinsic magnetic field and internal source of plasma, the heating of which produces pressures too large to be restrained. Ionospheric plasmas also have other more local roles to play in the magnetotail. The circulation influences the composition of the plasma sheet, and the resultant wave environment, giving rise to reduced wave propagation speeds. Important heavy ion cyclotron resonances, and enhanced finite gyro-radius effects including non-adiabatic particle acceleration. At minimum, the presence of ionospheric plasma must influence the rate of reconnection via its enhanced mass density. Other non-MHD effects of ionospheric plasma presence are likely to be important but need much more investigation to be well understood. The MMS mission is designed to penetrate the subtle diffusion region physics that is involved, and its ability to observe ionospheric plasma involvement in reconnection will contribute significantly toward that goal.

Author

*Earth Ionosphere; Plasmas (Physics); Earth Sciences; Geomagnetic Tail*

**20070014930** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **VIIRS Product Aggregation and Packaging**

Wolfe, Robert; August 08, 2006; 10 pp.; In English; No Copyright; Avail.: CASI: [A02](#), Hardcopy  
ONLINE: <http://hdl.handle.net/2060/20070014930>

Areas where the end-users can help define the Visible/Infrared Imager Radiometer Suite (VIIRS) products distributed by NOAA include: temporal aggregation, band packaging, and geolocation packaging. Proposals in these areas are presented along with background information, advantages and disadvantages of each proposal. The proposals are based on experience with NASA EOS missions and programs (MODIS and SeaWiFS).

Derived from text

*Imaging Spectrometers; Infrared Radiometers; MODIS (Radiometry); Data Products; Spatial Resolution; Temporal Resolution*

**20070014931** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **A Gateway to Support Interoperability of OPeNDAP and OGC Protocols**

McDonald, Kenneth; Enloe, Yonsook; Di, Liping; Holloway, Daniel; [2007]; 2 pp.; In English; 2006 IGARSS, 31 Jul. 4 Aug. 2006, Denver, CO, USA; Copyright; Avail.: CASI: [A01](#), Hardcopy

Data access and analysis tools that are developed within specific disciplines and the protocols that they are built upon provide valuable services to their respective users but can actually be a barrier to the interaction of data from a broad set of data sources. An example of this is data supported by OPeNDAP that is widely used in the ocean and atmospheric sciences, and data provided through the interface specifications of the Open Geospatial Consortium (OGC) that typically serves the land science community. This paper described a project that is developing a gateway to bridge these two data system infrastructures, in response to a specific need expressed by CEOP, an international science program.

Author

*Interoperability; Oceanography; Climatology; Open Source Licensing (Computers); Protocol (Computers); Computer Networks; EOS Data and Information System; Geophysics*

**20070015172** Naval Research Lab., Stennis Space Center, MS USA

**Moving Map Composer - Personal Computer (MMCP), Version 1.0: Acceptance Test Procedures Developed for the Finnish Air Force**

Trenchard, Michael E; Myrick, Stephanie A; Layne, Geary; Lohrenz, Maura C; Mar 2, 2007; 26 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463821; NRL/FR/7440-07-10120; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463821>

This document provides detailed Acceptance Test Procedures (ATP) to be followed during the final test and evaluation of the Naval Research Laboratory (NRL) Moving Map Composer - Personal Computer (MMCP) System, Version 1.0, developed for the Finnish Air Force (FiAF). The ATP was successfully completed by NRL and FiAF representatives at FiAF headquarters in Halli, Finland, in August 2005.

DTIC

*Acceptability; Digital Data; Mapping; Maps; Microcomputers; Personal Computers*

**20070015287** Naval Research Lab., Stennis Space Center, MS USA

**Imaging Marine Geophysical Environments With Vector Acoustics**

Lindwall, Dennis; Sep 2006; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464039; NRL/JA/7430-05-7; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464039>

Using vector acoustic sensors for marine geoacoustic surveys instead of the usual scalar hydrophones enables one to acquire three dimensional (3D) survey data with instrumentation and logistics similar to current 2D surveys. Vector acoustic sensors measure the sound wave direction directly without the cumbersome arrays that hydrophones require. This concept was tested by a scaled experiment in an acoustic water tank that had a well-controlled environment with a few targets. Using vector acoustic data from a single line of sources, the three-dimensional tank environment was imaged by directly locating the source and all reflectors.

DTIC

*Acoustics; Geophysics; Imaging Techniques; Marine Environments; Signal Detectors; Sound Waves; Vector Analysis*

**20070015322** Naval Research Lab., Stennis Space Center, MS USA

**Secondary Mineral Formation Associated With Respiration of Nontronite, NAu-1 by Iron Reducing Bacteria**

O'Reilly, S E; Watkins, Janet; Furukawa, Yoko; Dec 2005; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464083; NRL/JA/7430-04-15; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464083>

Experimental batch and miscible-flow cultures were studied in order to determine the mechanistic pathways of microbial Fe(III) respiration in ferruginous smectite clay, NAu-1. The primary purpose was to resolve if alteration of smectite and release of Fe precedes microbial respiration. Alteration of NAu-1, represented by the morphological and mineralogical changes, occurred regardless of the extent of microbial Fe(III) reduction in all of our experimental systems, including those that contained heat-killed bacteria and those in which O<sub>2</sub>, rather than Fe(III), was the primary terminal electron acceptor. The solid alteration products observed under transmission electron microscopy included poorly crystalline smectite with diffuse electron diffraction signals, discrete grains of Fe-free amorphous aluminosilicate with increased Al/Si ratio, Fe-rich grains, and amorphous Si globules in the immediate vicinity of bacterial cells and extracellular polymeric substances. In reducing systems, Fe was also found as siderite. The small amount of Fe partitioned to the aqueous phase was primarily in the form of dissolved Fe(III) species even in the systems in which Fe(III) was the primary terminal electron acceptor for microbial respiration. From

these observations, we conclude that microbial respiration of Fe(III) in our laboratory systems proceeded through the following: (1) alteration of NAu-1 and concurrent release of Fe(III) from the octahedral sheets of NAu-1; and (2) subsequent microbial respiration of Fe(III).

DTIC

*Bacteria; Clays; Iron; Microorganisms; Minerals; Respiration*

**20070015363** Naval Research Lab., Stennis Space Center, MS USA

**Roughness Spectra and Acoustic Response from a Diver-Manipulated Sea Floor**

Briggs, Kevin B; Richardson, Michael D; Williams, Kevin L; Lyons, Anthony P; Sep 18, 2006; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464179; NRL/PP/7430-06-3; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464179>

A digital stereo photogrammetric system was designed and implemented to measure seafloor roughness in coastal sands. High-resolution images that achieve more than four pixels/millimeter in either the horizontal or vertical dimension are created by two cameras sealed in watertight housings and actuated simultaneously by a scuba diver. A Digital Elevation Model (DEM) of the photographed sea floor is created from digital autocorrelation of left and right paired images. The DEM is used to estimate a two-dimensional roughness power spectrum from which parameters of the spectral exponent and spectral strength are derived that are used as inputs in high-frequency acoustic scattering models.

DTIC

*Acoustic Scattering; Coasts; Diving (Underwater); Ocean Bottom; Photography; Surface Roughness; Topography*

**20070015408** Washington Univ., Seattle, WA USA

**Remote Sensing Technique for Geoacoustic Characterization of Heterogeneous Marine Sediments**

Ivakin, Anatoliy N; Oct 5, 2006; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-02-G-0460-0035

Report No.(s): AD-A464262; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464262>

The long term goal of this research is to develop an improved physics-based technique for remote quantification of seafloor geoacoustical properties. The specific scientific tasks of this project were: (1) to develop inversion algorithms for estimating the sediment grain size distribution of coarse fractions in sandy sediments based on a recently developed inclusion scattering' model, (2) to test these algorithms using the SAXO4 scattering data, and (3) to provide ground truth for such tests by direct measurements of the grain size distribution in the available SAXO4 sediment samples and cores. The tasks were accomplished. An algorithm for scattering data inversions was developed based on a parameterization of the grain size distribution using power law approximations in given intervals of sizes. The algorithm allows inversions of the level and power exponent of the size distribution in each interval. To provide ground truth for testing the algorithm, 13 sediment samples taken at the SAXO4 site were analyzed. Sand grains and shell particles were separated and their number, weight and shape factor were measured in each size interval. It was demonstrated that the SAXO4 acoustic scattering data inversion based on the developed algorithm provides a qualitative fit to the ground truth data.

DTIC

*Acoustic Scattering; Algorithms; Heterogeneity; Remote Control; Remote Sensing; Sediments*

**20070015939** Army Topographic Engineering Center, Alexandria, VA USA

**The Geology of Somalia: A Selected Bibliography of Somalian Geology, Geography and Earth Science**

Hadden, Robert L; Feb 2007; 431 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464006; No Copyright; Avail.: CASI: [A19](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464006>

This bibliography on the geology, geography, and other earth sciences of Somalia was initiated to fill a request for current information on that war-torn state. The bibliography brings together selected citations from a variety of different cartographic, geographical, geological, agricultural, hydrological, and other earth science resources. Sources include scientific societies, government agencies, nongovernmental organizations, commercial databanks, and major research libraries. Most of the citations have information on where the item can be located and used on site, or borrowed through inter-library loan. In other cases, copies of the items can be purchased from the originating source or through commercial document delivery services. Retrieval information, such as ISSN, ISBN, OCLC, and Library of Congress numbers are provided whenever possible. Very

often, scientific publications in less developed countries are not published in large numbers, and it is very difficult to retrieve reports or maps more than a few years old. This bibliography is intended to be a resource for those scientific citations on Somalia that can still be retrieved. Within these citations are many variations in spelling and place names. Many scientific and cartographic investigations were done in Cushitic and European and Semitic languages, such as Arabic, English, French, Italian, and Somali. Thus, the same name may be spelled differently according to the language(s) used. Mogadisco, Mogadiscio, Mogadishu, Mogadischu, and Muqdisho are all variations on the name of the capital city. The river Juba can be spelled Jubba, Juba, Giuba, etc., according to the language used, as can the port city of Chisimaio, Chisimayo, Kismayo, Kisimayo, Kisymao, etc. So any search for authors, place names, and locations in this bibliography should take into account spelling variations.

DTIC

*Agriculture; Bibliographies; Earth Sciences; Geography; Geology; Hydrology; Somalia; Topography*

**20070016543** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Australian National Airborne Field Experiment 2005: Soil Moisture Remote Sensing at 60 Meter Resolution and Up**

Kim, E. J.; Walker, J. P.; Panciera, R.; Kalma, J. D.; [2006]; 1 pp.; In English; IGARSS, 31 Jul. - 4 Aug. 2006, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

Spatially-distributed soil moisture observations have applications spanning a wide range of spatial resolutions from the very local needs of individual farmers to the progressively larger areas of interest to weather forecasters, water resource managers, and global climate modelers. To date, the most promising approach for space-based remote sensing of soil moisture makes use of passive microwave emission radiometers at L-band frequencies (1-2 GHz). Several soil moisture-sensing satellites have been proposed in recent years, with the European Space Agency's Soil Moisture Ocean Salinity (SMOS) mission scheduled to be launched first in a couple years. While such a microwave-based approach has the advantage of essentially allweather operation, satellite size limits spatial resolution to 10's of km. Whether used at this native resolution or in conjunction with some type of downscaling technique to generate soil moisture estimates on a finer-scale grid, the effects of subpixel spatial variability play a critical role. The soil moisture variability is typically affected by factors such as vegetation, topography, surface roughness, and soil texture. Understanding and these factors is the key to achieving accurate soil moisture retrievals at any scale. Indeed, the ability to compensate for these factors ultimately limits the achievable spatial resolution and/or accuracy of the retrieval. Over the last 20 years, a series of airborne campaigns in the USA have supported the development of algorithms for spaceborne soil moisture retrieval. The most important observations involved imagery from passive microwave radiometers. The early campaigns proved that the retrieval worked for larger and larger footprints, up to satellite-scale footprints. These provided the solid basis for proposing the satellite missions. More recent campaigns have explored other aspects such as retrieval performance through greater amounts of vegetation. All of these campaigns featured extensive ground truth collection over a range of grid spacings, to provide a basis for examining the effects of subpixel variability. However, the native footprint size of the airborne L-band radiometers was always a few hundred meters. During the recently completed (November, 2005) National Airborne Field Experiment (NAFE) campaign in Australia, a compact L-band radiometer was deployed on a small aircraft. This new combination permitted routine observations at native resolutions as high as 60 meters, substantially finer than in previous airborne soil moisture campaigns, as well as satellite footprint areal coverage. The radiometer, the Polarimetric L-band Microwave Radiometer (PLMR) performed extremely well and operations included extensive calibration-related observations. Thus, along with the extensive fine-scale ground truth, the NAFE dataset includes all the ingredients for the first scaling studies involving very-high-native resolution soil moisture observations and the effects of vegetation, roughness, etc. A brief overview of the NAFE will be presented, then examples of the airborne observations with resolutions from 60 m to 1 km will be shown, and early results from scaling studies will be discussed.

Author

*Airborne Equipment; Australia; Remote Sensing; Soil Moisture*

**20070016557** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Atmospheric Radiative Transfer for Satellite Remote Sensing: Validation and Uncertainty**

Marshak, Alexander; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

My presentation will begin with the discussion of the Intercomparison of three-dimensional (3D) Radiative Codes (I3RC) project that has been started in 1997. I will highlight the question of how well the atmospheric science community can solve the 3D radiative transfer equation. Initially I3RC was focused only on algorithm intercomparison; now it has acquired a broader identity providing new insights and creating new community resources for 3D radiative transfer calculations. Then I will switch to satellite remote sensing. Almost all radiative transfer calculations for satellite remote sensing are

one-dimensional (1D) assuming (i) no variability inside a satellite pixel and (ii) no radiative interactions between pixels. The assumptions behind the 1D approach will be checked using cloud and aerosol data measured by the MODerate Resolution Imaging Spectroradiometer (MODIS) on board of two NASA satellites TERRA and AQUA. In the discussion, I will use both analysis technique: statistical analysis over large areas and time intervals, and single scene analysis to validate how well the 1D radiative transfer equation describes radiative regime in cloudy atmospheres.

Author

*Radiative Transfer; Remote Sensing; Algorithms; MODIS (Radiometry)*

**20070016594** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**MODIS Aerosol Observations used to Constrain Dust Distributions and Lifecycle in the NASA GEOS-5 Model**

Colarco, P.; Nowottnick, E.; daSilva, A.; [2007]; 1 pp.; In English; AMS Meeting, 17 Jan. 2007, San Antonio, TX, USA; No Copyright; Avail.: Other Sources; Abstract Only

Approximately 240 Tg of mineral dust aerosol are transported annually from Saharan Africa to the Atlantic Ocean. Dust affects the Earth radiation budget, and plays direct (through scattering and absorption of radiation) and indirect (through modification of cloud properties and environment) roles in climate. Deposition of dust to the surface provides an important nutrient source to terrestrial and oceanic ecosystems. Dust is additionally a contributor to adverse air quality. Among the tools toward understanding the lifecycle and impacts of mineral dust aerosols are numerical models. Important constraints on these models come from quantitative satellite observations, like those from the space-based Moderate Resolution Imaging Spectroradiometer (MODIS). In particular, Kauhan et al. [2005] used MODIS aerosol observations to infer transport and deposition fluxes of Saharan dust over the Atlantic, Caribbean, and Amazonian basins. Those observations are used here to constrain the transport of dust and its interannual variability simulated in the NASA GEOS-5 general circulation model and data assimilation system. Significant uncertainty exists in the MODIS-derived fluxes, however, due to uncertainty in the wind fields provided by meteorological analyses in this region. That same uncertainty in the wind fields is manifest in our GEOS-5 simulations of dust distributions. Here we use MODIS observations to investigate the seasonality and location of the Saharan dust plume and explore through sensitivity analysis of our model the meteorological controls on the dust distribution, including dust direct radiative effects and sub-gridscale source and sink processes.

Author

*Aerosols; Dust; MODIS (Radiometry); NASA Programs; GEOS Satellites (ESA); Atmospheric General Circulation Models*

**20070016596** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**March 2003 EOS Aqua AMSR-E Arctic Sea Ice Field Campaign**

Cavalieri, Donald J.; Markus, Thorsten; Maslanik, James A.; Sturm, Matthew; Lobl, Elena; IEEE Transactions on Geoscience and Remote Sensing; [2006]; Volume 44, No. 11, pp. 2999-3001; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

An overview of the March 2003 coordinated sea ice field campaign in the Alaskan Arctic is presented with reference to the papers in this special section. This campaign is part of the program to validate the Aqua Advanced Microwave Scanning Radiometer for Earth Observing System (AMSR-E) sea ice products. Standard AMSR-E sea ice products include sea ice concentration, sea ice temperature, and snow depth on sea ice. The validation program consists of three elements, namely: 1) satellite data comparisons; 2) coordinated satellite/aircraft surface measurements; and 3) modeling and sensitivity analyses. Landsat-7 and RADARSAT observations were used in comparative studies with the retrieved AMSR-E sea ice concentrations. The aircraft sensors provided high-resolution microwave imagery of the surface, atmospheric profiles of temperature and humidity, and digital records of sea ice conditions. When combined with in situ measurements, aircraft data were used to validate the AMSR-E sea ice temperature and snow-depth products. The modeling studies helped interpret the field-data comparisons, provided insight on the limitations of the AMSR-E sea ice algorithms, and suggested potential improvements to the AMSR-E retrieval algorithms.

Author

*Aqua Spacecraft; Arctic Regions; Earth Observing System (EOS); Sea Ice; Remote Sensing; Microwave Radiometers*

**20070016597** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Online Analysis Enhances Use of NASA Earth Science Data**

Acker, James G.; Leptoukh, Gregory; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

Giovanni, the Goddard Earth Sciences Data and Information Services Center (GES DISC) Interactive Online Visualization and Analysis Infrastructure, has provided researchers with advanced capabilities to perform data exploration and

analysis with observational data from NASA Earth observation satellites. In the past 5-10 years, examining geophysical events and processes with remote-sensing data required a multistep process of data discovery, data acquisition, data management, and ultimately data analysis. Giovanni accelerates this process by enabling basic visualization and analysis directly on the World Wide Web. In the last two years, Giovanni has added new data acquisition functions and expanded analysis options to increase its usefulness to the Earth science research community.

Author

*Earth Sciences; Remote Sensing; On-Line Systems; Data Acquisition; Geophysics*

**20070016604** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Establishment and Implementation of a Close Approach Evaluation and Avoidance Process for Earth Observing System Missions**

Newman, Lauri; Duncan, Matthew; [2006]; 1 pp.; In English; AAS/AIAA Astrodynamics Specialist Conference, 21-24 Jun. 2006, Keystone, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

In the fall of 2004, the Earth Science Mission Operations Project tasked the Goddard Space Flight Center (GSPC) Flight Dynamics Analysis Branch with establishment of a process to protect the high-value Earth Observing System (EOS) missions (Terra, Aqua, and Aura) from close approaches with space debris and other orbiting objects. An agreement between GSFC and the USA Strategic Command was put in place so that close approach predictions would be routinely generated. This paper describes the ESMO conjunction assessment process for the EOS satellites. Process details, including tools and algorithms developed, are discussed. Particular details for a predicted close approach between Terra and a piece of space debris that resulted in the execution of a debris avoidance maneuver are included. This close approach example is described in detail from the first screening identification through execution of the mitigation maneuver to illustrate both the process and lessons learned from its implementation.

Author

*Earth Observing System (EOS); Earth Sciences; Space Debris; Collision Avoidance; Approach*

**20070016610** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Applying Advanced and Existing Sensors in Dealing with Potential Natural Disasters**

Habib, Shahid; [2006]; 1 pp.; In English; European Symposium on Remote Sensing, 11-14 Sep. 2006, Stockholm, Sweden Report No.(s): Paper no. 6366-13; No Copyright; Avail.: Other Sources; Abstract Only

As an integrated observing strategy, the concept of sensorweb for Earth observations is appealing in many aspects. For instance, by increasing the spatial and temporal coverage of observations from space and other vantage points, one can eventually aid in increasing the accuracy of the atmospheric models which are precursor to hurricane track prediction, volcanic eruption forecast, and trajectory path of transcontinental transport of dust, harmful nuclear and chemical plumes. In reality, there is little analysis available in terms of benefits, costs and optimized set of sensors needed to make these necessary observations. This is a complex problem that must be carefully studied and balanced over many boundaries such as science, defense, early warning, security, and surveillance. Simplistically, the sensorweb concept from the technological point of view alone has a great appeal in the defense, early warning and security applications. In fact, it can be relatively less expensive in per unit cost as opposed to building and deploying it for the scientific use. However, overall observing approach should not be singled out and aligned somewhat orthogonally to serve a particular need. On the other hand, the sensorweb should be designed and deployed to serve multiple subject areas and customers simultaneously; and can behave as directed measuring systems for both science and operational entities. Sensorweb can be designed to act as expert systems, and/or also provide a dedicated integrated surveillance network. Today, there is no system in the world that is fully integrated in terms of reporting timely multiple hazards warnings, computing the loss of life and property damage estimates, and is also designed to cater to everyone's needs. It is not an easier problem to undertake and more so is not practically solvable. At this time due to some recent events in the world, the scientific community, social scientists, and operational agencies are more cognizant and getting together to address such colossal problems. Increasing our knowledge of the home planet, via amplified set of observations, is certainly a right step in a right direction. Furthermore, this is a prerequisite in understanding multiple hazard phenomena's. This paper examines various sensorweb options and observing architectures that can be useful specifically in addressing some of these complex issues. The ultimate goal is to serve the society by providing potential natural hazards information to the decision makers in the most expeditious manner so they can prepare themselves to mitigate potential risks to human life, livestock and property.

Author

*Disasters; Sensors; Remote Sensing; Expert Systems*

**20070016615** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A Unique Perspective from Space on our Planet: Science, Technologies and Applications**

Habib, Shaid; [2006]; 1 pp.; In English; International Conference on Advance Space Technologies (ICAST) 2006, 2-3 Sep. 2006, Islamabad, Pakistan; No Copyright; Avail.: Other Sources; Abstract Only

The study of Planet earth is a very complex problem. It has many non-linear and chaotic systems operating in parallel and have interdependencies. In reality, these systems/phenomena s are not well understood or mathematically modeled because of our lack of knowledge of such intricate processes. However, in order to further the subject of Earth as an integrated system, space provides excellent vantage points to look at these processes in multidimensional framework. For example, we can make strives to understand the global water cycle, carbon cycle, atmospheric chemistry, biomass changes, oceans and solid Earth variations by making multitude of global measurements such as soil moisture, precipitation, tropospheric and stratospheric gases, aerosols, tropospheric winds, ocean salinity, ocean color, vegetation cover, crustal dynamics and many more. Such suites of measurements derive the coupled models so we may predict the changes due to natural and anthropogenic forcing. NASA along with other international space agencies have made tremendous investments in recent years in developing and flying remote sensing space borne sensors to enable these measurements. These science measurements and products are further used to address pressing issues such as coastal zone erosion, air quality, severe weather, water availability and quality, public health, fires, earthquakes, land slides and others for societal benefits. This presentation provides a comprehensive overview of NASA s science investigations, related technologies and satellites/sensors and applications.

Author

*Atmospheric Chemistry; Earth (Planet); Earth Crust; Remote Sensing; Tectonics; Soil Moisture; Geodynamics; Earthquakes*

**20070016619** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Global Aerosol Optical Models and Lookup Tables for the New MODIS Aerosol Retrieval over Land**

Levy, Robert C.; Remer, Loraine A.; Dubovik, Oleg; [2007]; 34 pp.; In English; Copyright; Avail.: CASI: [A03](#), Hardcopy

Since 2000, MODIS has been deriving aerosol properties over land from MODIS observed spectral reflectance, by matching the observed reflectance with that simulated for selected aerosol optical models, aerosol loadings, wavelengths and geometrical conditions (that are contained in a lookup table or 'LUT'). Validation exercises have showed that MODIS tends to under-predict aerosol optical depth ( $\tau$ ) in cases of large  $\tau$  ( $\tau$  greater than 1.0), signaling errors in the assumed aerosol optical properties. Using the climatology of almucantur retrievals from the hundreds of global AERONET sunphotometer sites, we found that three spherical-derived models (describing fine-sized dominated aerosol), and one spheroid-derived model (describing coarse-sized dominated aerosol, presumably dust) generally described the range of observed global aerosol properties. The fine dominated models were separated mainly by their single scattering albedo ( $\omega_0$ ), ranging from non-absorbing aerosol ( $\omega_0$  approx. 0.95) in developed urban/industrial regions, to neutrally absorbing aerosol ( $\omega_0$  approx. 0.90) in forest fire burning and developing industrial regions, to absorbing aerosol ( $\omega_0$  approx. 0.85) in regions of savanna/grassland burning. We determined the dominant model type in each region and season, to create a 1 deg. x 1 deg. grid of assumed aerosol type. We used vector radiative transfer code to create a new LUT, simulating the four aerosol models, in four MODIS channels. Independent AERONET observations of spectral  $\tau$  agree with the new models, indicating that the new models are suitable for use by the MODIS aerosol retrieval.

Author

*Aerosols; Grasslands; MODIS (Radiometry); Optical Properties; Atmospheric Models; Climatology*

**20070016675** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**13 Years of TOPEX/POSEIDON Precision Orbit Determination and the 10-fold Improvement in Expected Orbit Accuracy**

Lemoine, F. G.; Zelensky, N. P.; Luthcke, S. B.; Rowlands, D. D.; Beckley, B. D.; Klosko, S. M.; 21-24 Aug. 2006; 4 pp.; In English; AIAA/AAS Astrodynamics Conference, 21-24 Aug. 2006, Keystone, CO, USA; Copyright; Avail.: CASI: [A01](#), Hardcopy

Launched in the summer of 1992, TOPEX/POSEIDON (T/P) was a joint mission between NASA and the Centre National d Etudes Spatiales (CNES), the French Space Agency, to make precise radar altimeter measurements of the ocean surface. After the remarkably successful 13-years of mapping the ocean surface T/P lost its ability to maneuver and was de-commissioned January 2006. T/P revolutionized the study of the Earth s oceans by vastly exceeding pre-launch estimates of surface height accuracy recoverable from radar altimeter measurements. The precision orbit lies at the heart of the altimeter measurement providing the reference frame from which the radar altimeter measurements are made. The expected quality of orbit knowledge had limited the measurement accuracy expectations of past altimeter missions, and still remains a major component in the error budget of all altimeter missions. This paper describes critical improvements made to the T/P orbit time

series over the 13-years of precise orbit determination (POD) provided by the GSFC Space Geodesy Laboratory. The POD improvements from the pre-launch T/P expectation of radial orbit accuracy and Mission requirement of 13-cm to an expected accuracy of about 1.5-cm with today's latest orbits will be discussed. The latest orbits with 1.5 cm RMS radial accuracy represent a significant improvement to the 2.0-cm accuracy orbits currently available on the T/P Geophysical Data Record (GDR) altimeter product.

Author

*Radio Altimeters; Ocean Surface; Time Series Analysis; Accuracy; Poseidon Satellite; Coordinates; Orbit Determination*

#### 44

### ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

**20070015694** Department of the Navy, Washington, DC USA

#### **Device for Measurement of Electrical Properties in Materials**

Rivera, David F, Inventor; Feb 12, 2007; 35 pp.; In English

Report No.(s): AD-D020282; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADD020282>

The present invention relates to a device used for measuring the permittivity of insulating materials over a broad range of frequencies. The electrical property of an insulator is an important piece of information that gives the designer the ability to choose the most appropriate material for a given application. Of the numerous electric characteristics that describe a given insulator, the relative permittivity (Symbol:  $\epsilon_r$ ) receives attention because the relative permittivity describes an insulator's ability to store and/or dissipate electric field energy. This is symbolized by writing  $\epsilon_r$ , explicitly as the complex quantity.

DTIC

*Electrical Measurement; Electrical Properties; Insulation; Inventions; Measurement; Patent Applications; Permittivity*

**20070015812** Fujitsu Ltd., Atsugi, Japan

#### **Single-Photon Generator for Optical Telecommunication Wavelength**

Usuki, T; Sakuma, Y; Hirose, S; Takemoto, K; Yokoyama, N; Miyazawa, T; Takatsu, M; Arakawa, Y; Jan 2006; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464525; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report on the generation of single-photon pulses from a single InAs/InP quantum dot in telecommunication bands (1.3-1.55 micrometers: higher transmittance through an optical fiber). First we prepared InAs quantum dots on InP (0 0 1) substrates in a low-pressure MOCVD by using a so-called InP double-cap procedure. The quantum dots have well-controlled photo emission wavelength in the telecommunication bands. We also developed a single-photon emitter in which quantum dots were embedded. Numerical simulation designed the emitter to realize efficient injection of the emitted photons into a single-mode optical fiber. Using a Hanbury-Brown and Twiss technique has proved that the photons through the fiber were single photons.

DTIC

*Optical Communication; Photons; Telecommunication*

**20070015919** White and Case, LLP, New York, NY, USA

#### **Solar Cell Mechanical Interconnection Using Direct Wafer Bonding**

Aiken, Daniel, Inventor; July 28, 2005; 6 pp.; In English

Contract(s)/Grant(s): NAS3-02201

Patent Info.: Filed 27 Jan. 2004; US-Patent-Appl-SN-10-765532

Report No.(s): PB2007-102836; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070015919>

A multi-junction solar cell includes a plurality of monolithic cells joined together by direct wafer bonds. Each monolithic cell has at least one junction. The direct wafer bonds include no intervening material between joined monolithic cells. The



direct wafer bonds are achieved by bonding forces between dipoles at the surfaces of adjoining monolithic cells.

Author

*Bonding; Integrated Circuits; Microelectronics; Solar Cells; Wafers*

**20070015982** Foley and Lardner, LLP, Madison, WI, USA, Chicago Univ., Chicago, IL USA

**Novel Redox Shuttles for Overcharge Protection of Lithium Batteries**

Amine, K.; Chen, Z.; Wang, Q.; 1 Mar 06; 18 pp.; In English

Contract(s)/Grant(s): W31-109-ENG-38

Patent Info.: Filed 1 Mar 06; US-Patent-Appl-SN-11-366 891

Report No.(s): PB2007-101717; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The present invention is generally related to electrolytes containing novel redox shuttles for overcharge protection of lithium-ion batteries. The redox shuttles are capable of thousands hours of overcharge tolerance and have a redox potential at about 3-5.5 V vs. Li and particularly about 4.4-4.8 V vs. Li. Accordingly, in one aspect the invention provides electrolytes comprising an alkali metal salt; a polar aprotic solvent; and a redox shuttle additive that is an aromatic compound having at least one aromatic ring with four or more electronegative substituents, two or more oxygen atoms bonded to the aromatic ring, and no hydrogen atoms bonded to the aromatic ring; and wherein the electrolyte solution is substantially non-aqueous. Further there are provided electrochemical devices employing the electrolyte and methods of making the electrolyte.

NTIS

*Electric Batteries; Lithium Batteries; Oxidation-Reduction Reactions; Patent Applications; Protection*

## 45

### ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

**20070014801** Brookhaven National Lab., Upton, NY USA

**Madison Square Garden Dispersion Study (MSG05) Meteorological Data Description**

Reynolds, R. M.; Oct. 2006; 46 pp.; In English

Report No.(s): DE2006-896728; No Copyright; Avail.: National Technical Information Service (NTIS)

MSG05 was a study of atmospheric transport and dispersion in the deep urban canyons of Midtown New York City, in the area of Madison Square Garden. This downtown area is considered to be a prime target for terrorist activities, and has one of the largest commuter populations in the world. Little is known about air flow and hazardous gas dispersion in such scenarios, since previous urban field experiments have focused on small to medium sized cities with much smaller street canyons. On March 10 and 14, 2005, a series of Perfluorocarbon Tracer (PFT) tracers were released and tracked with about 30 sampling stations at radial distances of about 0.2 and 0.4 km, with vertical profiles near a 250 m tall building (One Penn Plaza). Meteorological stations collected wind data in the MSG vicinity, at street level and rooftop level. MSG05 is expected to provide useful information on rapid vertical dispersion will assist in planning for more extensive studies. This data release is being made available to a restricted group of key scientists who have worked on the project. Part of the QA program involves feedback from scientists and modelers who are working on this study. This document describes the meteorological component of the project. The file organization and metadata are detailed so that a researcher can work with the data sets.

NTIS

*Emergencies; Environmental Transport; Meteorological Parameters; New York City (NY); Terrorism; Wind (Meteorology)*

**20070014819** Stockholm Univ., Sweden

**Revisiting the 'Ozone Deficit Problem' in the Middle Atmosphere: An Investigation of Uncertainties in Photochemical Modelling**

Jonsson, A. I.; Mar. 2006; 82 pp.; In English

Report No.(s): PB2007-103379; No Copyright; Avail.: National Technical Information Service (NTIS)

The scientific understanding of processes related to ozone depletion and climate change in the upper stratosphere and lower mesosphere is compromised by the fact that models tend to underestimate the observed levels of ozone in this region—a problem commonly referred to as the ozone deficit problem. Recently the use of updated photochemical models and improved ozone measurements has led to large reductions in this discrepancy in the 40 km region. This paper investigates the ozone deficit problem in the upper stratosphere and also examines the ozone budget in the mesosphere. In order to focus on the photochemical aspects of the problem, a comprehensive photochemical box model was constrained by HALOE solar sunset

occultation measurements of temperature and several chemical species, such that the key background source gases CH<sub>4</sub> and H<sub>2</sub>O, and the chemical families NO<sub>y</sub> and Cly in the model are consistent with the observed atmosphere. It is shown that the modeled ozone values can be kept to within 10% of the HALOE observations at 40-55 km.

NTIS

*Air Pollution; Atmospheric Chemistry; Ozone; Photochemical Reactions*

**20070014824** National Inst. for Occupational Safety and Health, Washington, DC, USA  
**NIOSH Health Hazard Evaluation Report: HETA No. 2003-0175-3033, COL-FIN Specialty Steel, Fallston, Pennsylvania, March 2007**

Achutan, C.; Nemhauser, J.; Mar. 2007; 27 pp.; In English

Report No.(s): PB2007-104910; HETA-2003-0175-3033; No Copyright; Avail.: CASI: [A03](#), Hardcopy

On February 27, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the United Steelworkers of America Local 9305 for a health hazard evaluation (HHE) at COL-FIN Specialty Steel (COL-FIN) in Fallston, Pennsylvania. The union was concerned about inadequate ventilation in the pickling and annealing areas and other potential health hazards throughout the whole plant. On November 11, 2003, NIOSH investigators made an initial visit to the facility to meet with union and management representatives, tour the facility to understand the manufacturing process, and observe work practices. Between March 8 and March 12, 2004, NIOSH investigators returned to COL-FIN to conduct environmental sampling and medical interviews with employees. Area and personal breathing zone (PBZ) air samples for respirable particulates and acids (sulfuric and hydrochloric) were collected during the annealing, pickling, and hot etching of steel coils. Area and PBZ air samples for respirable particulates from soap powder and metal working fluids (MWFs) were collected when employees were drawing, straightening, and grinding the steel coils. Respirable particulate samples were also analyzed for crystalline silica. Spot measurements for carbon monoxide (CO) were taken in the annealing area. In addition, personal noise measurements were made on employees during the annealing, drawing, straightening, and grinding processes. Material handlers, who transport steel coils on gas-powered forklifts throughout the production area were assessed for exposure to noise, respirable particulates, silica, CO, and acids.

NTIS

*Fins; Gaps (Geology); Hazards; Health; Safety; Steels*

**20070014825** National Inst. for Occupational Safety and Health, Washington, DC, USA  
**NIOSH Health Hazard Evaluation Report: HETA No. 2006-0006-3039, Environmental Protection Agency, Inc., Wheeling, West Virginia, March 2007**

Rodriguez, M.; Adebayo, A.; Mar. 2007; 25 pp.; In English

Report No.(s): PB2007-107662; HETA-2006-0006-3039; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The National Institute for Occupational Safety and Health (NIOSH) received a confidential employee request for a health hazard evaluation (HHE) at Environmental Protection Services (EPS), Inc. Wheeling, West Virginia. The request asked NIOSH to evaluate exposures to dust, smoke, and fumes generated while recycling transformers, some of which contained polychlorinated biphenyls (PCBs). During an initial site visit to the EPS facility on February 15-16, 2006, we observed the transformer recycling processes, looked at potential worker exposures, and randomly selected eight persons for confidential interviews to discuss their concerns about work exposures and adverse health outcomes. On July 10-13, 2006, we took personal breathing-zone (PBZ) and area air samples for PCBs and metals, collected surface wipe samples and bulk samples of transformer oil for PCB analysis, and ash from incinerated materials for PCB and metal analysis.

NTIS

*Environment Protection; Hazards; Health; Polychlorinated Biphenyls; Recycling; Safety; Transformers*

**20070014826** National Inst. for Occupational Safety and Health, Washington, DC, USA  
**NIOSH Health Hazard Evaluation Report: HETA No. 2003-0205-3032, Interfaith Medical Center, Brooklyn, New York, March 2007**

Achutan, C.; Mortimer, V.; Mar. 2007; 20 pp.; In English

Report No.(s): PB2007-104911; HETA-2003-0205-3032; No Copyright; Avail.: CASI: [A03](#), Hardcopy

On March 24, 2003, the National Institute for Occupational Safety and Health (NIOSH) received a request from the New York State Nurses Association (NYSNA) to conduct a health hazard evaluation (HHE) at Interfaith Medical Center (IMC) in Brooklyn, New York. The survey was conducted July 30 -August 1, 2003. Air monitoring was conducted in the endoscopy unit for glutaraldehyde and indoor environmental quality (IEQ), and ventilation measurements were taken in the operating

room, intensive care unit (ICU), and emergency department at the main facility. IEQ measurements were also taken at the methadone clinic, which is at a separate location. Confidential interviews were conducted with twelve employees in the ICU at the main IMC facility, and an informal interview was conducted with three employees at the methadone clinic. OSHA logs were reviewed as well. Glutaraldehyde levels in air were well below applicable occupational exposure limits. However, approximately half the rooms at the main IMC facility lacked adequate ventilation and there was no mechanical ventilation system in place at the methadone clinic. Some employees were concerned about inadequate ventilation in their workplace. Another mentioned that there was a delay in learning whether a patient had a communicable disease. Employees also expressed satisfaction with management's timely response to their complaints. OSHA logs showed that there were 80 cases of workplace violence over a 2-year period. The NIOSH evaluation identified areas in the main IMC facility with inadequate ventilation. Ventilation at the methadone clinic was nonexistent, leading to complaints of heat exhaustion among employees. NIOSH investigators recommend consultation with ventilation engineers who are familiar with hospital facilities to improve ventilation. NIOSH investigators recommend addressing workplace violence, improving communication between management at the main IMC facility and management at the methadone clinic, as well as between employees and management at the methadone clinic.

NTIS

*Hazards; Health; Medical Personnel; Safety*

**20070014834** RTI International, Research Triangle Park, NC, USA, ETS, Inc., Roanoke, VA, USA  
**Environmental Technology Verification Report. Baghouse Filtration Products. Southern Filter Media, LLC., PE-16/M-SPES Filter Sample**

Feb. 2007; 22 pp.; In English

Report No.(s): PB2007-107825; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

NTIS

*Air Pollution; Evaluation; Filtration; Particulates; Performance Tests; Pollution Control*

**20070014838** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA  
**In-Depth Survey of Dust Control Technology for Asphalt Milling at Northeast Asphalt, Inc., US Route 22 and SR 64 Projects, Wisconsin**

Echt, A.; Garcia, A.; Shulman, S.; Colinet, J.; Cecala, A.; Jan. 2007; 36 pp.; In English

Report No.(s): PB2007-107223; EPHB-282-12A; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A study was performed to evaluate the effectiveness of water spray controls for a cold-milling machine. The objective of this study was to quantify the exposure reduction that could be achieved through the use of higher water flow rates during pavement milling. The effectiveness of the dust controls examined in this study was evaluated by measuring the reduction in the respirable dust and respirable quartz exposures in personal and area samples collected during a typical milling job. Increasing the water flow to the cutter drum spray bars from about 5 gpm to about 9 gpm and from approximately 2 gpm to around 3 gpm at the conveyor sprays resulted in an overall reduction in respirable dust emissions of about 50%, and nearly as great a reduction in respirable quartz emissions. Those results varied by location, with the greatest reduction occurring at the conveyor sampling location.

NTIS

*Air Pollution; Asphalt; Dust; Dust Collectors; Pavements; Pollution Control; Routes; Surveys*

**20070014847** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA  
**Air Filter Materials and Building Related Symptoms in the BASE Study**

Buchanan, I. S.; Apte, M. G.; Jun. 2006; 7 pp.; In English

Report No.(s): DE2007-895526; LBNL-59663; No Copyright; Avail.: Department of Energy Information Bridge

Mechanical ventilation of buildings is a risk factor for building related symptoms (BRS). This analysis examines air filters within mechanical ventilation systems to determine their effect on BRS. We hypothesize that certain ventilation filter materials

will contribute more than others to the burden of building related headaches, mucous membrane (MM) and lower respiratory (LR) BRS within a building. This hypothesis was tested using the USEPA Building Assessment, Survey and Evaluation (BASE) study. Logistic regression models constructed to control for personal, workplace, and environmental factors revealed statistically significant ( $p < 0.05$ ) associations between the increased prevalence of building related headaches, certain MM and LR BRS and polyester or synthetic containing air filters in a ventilation system, relative to fiberglass or cotton air filters.

NTIS

*Air Filters; Buildings; Indoor Air Pollution; Risk; Headache; Materials Selection; Construction Materials*

**20070014914** Pacific Northwest National Lab., Richland, WA, USA

**Mechanisms and Dynamics of Abiotic and Biotic Interactions at Environmental Interfaces. Annual Report 2006**

Rosso, K. M.; Jun. 01, 2006; 5 pp.; In English

Report No.(s): DE2006-895931; ERSD-1024942-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

The Stanford Environmental Molecular Sciences Institute (SEMSI) was established in 2004 through joint funding by the National Science Foundation and the OBER-ERSD. It encompasses a number of universities and national laboratories. The PNNL component of the SEMSI is funded by ERSD and is the focus of this report. This component has the objective of providing theory support to the SEMSI by bringing computational capabilities and expertise to bear on important electron transfer problems at mineral/water and mineral/microbe interfaces. PNNL staff member Dr. Kevin Rosso, who is also 'matrixed' into the Environmental Molecular Sciences Laboratory (EMSL) at PNNL, is a co-PI on the SEMSI project and the PNNL lead. The EMSL computational facilities being applied to the SEMSI project include the 11.8 teraflop massively-parallel supercomputer. Science goals of this EMSL/SEMSI partnership include advancing our understanding of: (1) The kinetics of U(VI) and Cr(VI) reduction by aqueous and solid-phase Fe(II), (2) The structure of mineral surfaces in equilibrium with solution, and (3) Mechanisms of bacterial electron transfer to iron oxide surfaces via outer-membrane cytochromes.

NTIS

*Cytochromes; Electron Transfer; Organic Compounds*

**20070014915** Notre Dame Univ., IN, USA

**Design and Evaluation of Ionic Liquids as Novel CO<sub>2</sub> Absorbents. Quarterly Technical Report for July 1, 2006 to September 30, 2006**

Magine, E. J.; Oct. 31, 2006; 12 pp.; In English

Contract(s)/Grant(s): DE-FG26-04NT42122

Report No.(s): DE2006-895858; No Copyright; Avail.: National Technical Information Service (NTIS)

Progress from the third quarter 2006 activity on the project Design and Evaluation of Ionic Liquids as Novel CO<sub>2</sub> Absorbents is provided. Major activities in two areas are reported: property measurement and molecular modeling. We have measured CO<sub>2</sub> solubility in an ammonium lactate ionic liquid. Previous work has shown that the lactate anion enables chemical complexation to occur. We hypothesized that the lactate anion would not be as effective in complexing when paired with an ammonium cation as compared to when it is paired with an imidazolium cation. The results confirm this. We also measured CO<sub>2</sub> solubility in a functionalized ionic liquid containing an amine group. These so-called task specific ionic liquids (TSILs) are expected to have dramatically higher CO<sub>2</sub> solubility than physical absorbents. We report isotherms as well as entropies and enthalpies of absorption for CO<sub>2</sub> in one TSIL. CO<sub>2</sub> solubilities are higher in this compound than in any previous IL we have observed. Finally, we also developed a new simulation method that will enable us to compute full isotherms of gases in ionic liquids. So far, we have tested the method against model systems and found it to be highly effective.

NTIS

*Adsorbents; Air Pollution; Pollution Control; Carbon Dioxide Removal*

**20070014916** Research Triangle Inst., Research Triangle Park, NC USA

**Carbon Dioxide Capture from Flue Gas Using Dry, Regenerable Sorbents. Quarterly Technical Progress Report for July 1, 2006 to September 30, 2006**

Green, D. A.; Nelson, T. O.; Turk, B. S.; Box, P. D.; Gupta, R. P.; Oct. 2006; 15 pp.; In English

Contract(s)/Grant(s): DE-FG2626-00NT40923

Report No.(s): DE2006-895860; No Copyright; Avail.: National Technical Information Service (NTIS)

This report describes research conducted between July 1, 2006 and September 30, 2006 on the use of dry regenerable sorbents for removal of carbon dioxide (CO<sub>2</sub>) from coal combustion flue gas. Modifications to the integrated absorber/ sorbent

regenerator/ sorbent cooler system were made to improve sorbent flow consistency and measurement reliability. Operation of the screw conveyor regenerator to achieve a sorbent temperature of at least 120DGC at the regenerator outlet is necessary for satisfactory carbon dioxide capture efficiencies in succeeding absorption cycles. Carbon dioxide capture economics in new power plants can be improved by incorporating increased capacity boilers, efficient flue gas desulfurization systems and provisions for withdrawal of sorbent regeneration steam in the design.

NTIS

*Drying; Flue Gases; Sorbents; Carbon Dioxide Removal*

**20070014955** Ohio Univ., Athens, OH, USA, Texas A&I Univ., Kingsville, TX, USA, National Energy Technology Lab., Pittsburgh, PA USA

**Database and Analytical Tool Development for the Management of Data Derived from US DOE (NETL) Funded Fine Particulate (PM<sub>2.5</sub>) Research Semi-Annual Technical Progress Report**

Khosah, R. P.; Crawford, C. G.; Aug. 2006; 38 pp.; In English

Contract(s)/Grant(s): DE-FC26-02NT41476

Report No.(s): DE2006-894910; No Copyright; Avail.: National Technical Information Service (NTIS)

Advanced Technology Systems, Inc. (ATS) was contracted by the U. S. Department of Energys National Energy Technology Laboratory (DOE-NETL) to develop a state-of-the- art, scalable and robust web-accessible database application to manage the extensive data sets resulting from the DOE-NETL-sponsored ambient air monitoring programs in the upper Ohio River valley region. The data management system was designed to include a web-based user interface that will allow easy access to the data by the scientific community, policy- and decision-makers, and other interested stakeholders, while providing detailed information on sampling, analytical and quality control parameters. In addition, the system will provide graphical analytical tools for displaying, analyzing and interpreting the air quality data. The system will also provide multiple report generation capabilities and easy-to-understand visualization formats that can be utilized by the media and public outreach/educational institutions. The project is being conducted in two phases. Phase One includes the following tasks: (1) data inventory/benchmarking, including the establishment of an external stakeholder group; (2) development of a data management system; (3) population of the database; (4) development of a web-based data retrieval system, and (5) establishment of an internal quality assurance/quality control system on data management. Phase Two, which is currently underway, involves the development of a platform for on-line data analysis. Phase Two includes the following tasks: (1) development of a sponsor and stakeholder/user website with extensive online analytical tools; (2) development of a public website; (3) incorporation of an extensive online help system into each website; and (4) incorporation of a graphical representation (mapping) system into each website. The project is now into its forty-second month of development activities.

NTIS

*Air Quality; Ambience; Data Bases; Energy Technology; Particulates*

**20070014957** Southern Research Inst., Birmingham, AL USA

**Evaluation and Mitigation of Visible Acidic Aerosol Plumes from Coal Fired Power Boilers**

Walsh, P. M.; McCain, J. D.; Cushing, K. M.; Nov. 2006; 103 pp.; In English

Report No.(s): PB2007-107823; No Copyright; Avail.: National Technical Information Service (NTIS)

The formation of sulfur trioxide (SO<sub>3</sub>) during the combustion of sulfur-containing fuels, particularly coal, can increase significantly following the installation and operation of selective catalytic reduction (SCR) systems for reduction of nitrogen oxides (NO<sub>x</sub>). The increased SO<sub>3</sub> formation can in turn lead to adverse environmental impacts, including visible near-stack plumes and increased fine PM emissions, primarily in the form of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>) aerosols. The potential extent of the problem in the electric utility sector is estimated based on the population of coal-fired utility boilers, the sulfur content of coal burned by each unit, and the likelihood that units will install SCR and flue gas desulfurization (FGD) systems. Of the 363 large (= 250 MWe) generating plants in the eastern U.S., there is a significant potential that as many as 65 could experience visible H<sub>2</sub>SO<sub>4</sub> aerosol plumes or more serious problems after installation of SCR and FGD systems, based on the sulfur content of the coal historically used at those plants. As use of FGD systems increases, it is also likely that utilities will turn to higher sulfur coal, which can exacerbate this problem. This report describes the mechanisms of SO<sub>3</sub> and acid aerosol formation and removal across boiler convection sections, air preheaters, and wet FGD systems, and presents information from an exploratory study of the absorption of SO<sub>3</sub> onto coal fly ash. A model of SO<sub>3</sub> formation and emissions based on these mechanisms is shown to accurately predict the stack concentration of SO<sub>3</sub> for a 1300 MWe pulverized coal-fired boiler, indicating that the mechanisms described have captured the fundamental behavior of SO<sub>3</sub> in utility combustion and flue gas treatment systems.

This information can provide the basis for developing mitigation approaches to reduce the impacts of SO<sub>3</sub> formation across SCRs and the subsequent formation and emission of acid aerosols.

NTIS

*Acidity; Aerosols; Boilers; Fuels; Particulates; Plumes; Sulfur; Sulfuric Acid*

**20070015044** Utah Univ., Salt Lake City, UT, USA, Reaction Engineering International, Salt Lake City, UT USA, Connecticut Univ., Storrs, CT, USA

**Fundamentals of Mercury Oxidation in Flue Gas. Technical Annual Report. Reporting Period: August 1, 2005 through July 31, 2006**

Lighty, J. S.; Silcox, G.; Senior, C.; Helble, J.; Aug. 01, 2006; 16 pp.; In English

Contract(s)/Grant(s): DE-FG26-03NT41797

Report No.(s): DE2006-896137; No Copyright; Avail.: Department of Energy Information Bridge

The objective of this project is to understand the importance of and the contribution of gas-phase and solid-phase coal constituents in the mercury oxidation reactions. The project involves both experimental and modeling efforts. The team is comprised of the University of Utah, Reaction Engineering International, and the University of Connecticut. The objective is to determine the experimental parameters of importance in the homogeneous and heterogeneous oxidation reactions; validate models; and, improve existing models. Parameters to be studied include HC1, NO<sub>x</sub>, and SO<sub>2</sub> concentrations, ash constituents, and temperature. This report summarizes Year 3 results for the experimental and modeling tasks. Experiments have been completed on the effects of chlorine. However, the experiments with sulfur dioxide and NO, in the presence of water, suggest that the wet-chemistry analysis system, namely the impingers, is possibly giving erroneous results. Future work will investigate this further and determine the role of reactions in the impingers on the oxidation results. The solid-phase experiments have not been completed and it is anticipated that only preliminary work will be accomplished during this study.

NTIS

*Flue Gases; Oxidation; Mercury (Metal)*

**20070015047** National Renewable Energy Lab., Golden, CO USA

**Burbank Transportation Management Organization: Impact Analysis**

Brown, E.; Aabakken, J.; Nov. 01, 2006; 18 pp.; In English

Contract(s)/Grant(s): DE-AC36-99-GO10337

Report No.(s): DE2006-896150; NREL/TP-640-40507; No Copyright; Avail.: National Technical Information Service (NTIS)

The Burbank Transportation Management Organization (BTMO), a private, membership-based, nonprofit organization dedicated to traffic reduction and air quality improvement, contracted with the National Renewable Energy Laboratory (NREL), a U.S. Department of Energy-owned, contractor-operated national laboratory, to analyze its member programs and their benefits and effects. This report uses trip data collected by the BTMO, and defines and implements a methodology for quantifying non-traffic benefits such as gasoline savings, productivity, and pollution reduction.

NTIS

*Transportation; Quality Control; Contract Management*

**20070015065** Energy Information Administration, Washington, DC, USA, Science Applications International Corp., Washington, DC, USA

**Emissions of Greenhouse Gases in the USA 2005**

Conti, J.; Nov. 2006; 130 pp.; In English

Report No.(s): PB2007-107796; DOE/EIA-0573-2005; No Copyright; Avail.: CASI: [A07](#), Hardcopy

This report, in accordance with Section 1605(a) of the Energy Policy Act of 1992, provides estimates of U.S. emissions of greenhouse gases for 2005. It is the fourteenth annual report and presents the Energy Information Administration's latest estimates of emissions for carbon dioxide, methane, nitrous oxide, and other greenhouse gases. Most of these estimates are based on activity data and applied emissions factors and not on measured or metered emissions. A limited number of emissions estimates, such as for methane from coal mine ventilation, are obtained through direct measurement.

NTIS

*Greenhouse Effect; United States; Emission*

**20070015098** Environmental Protection Agency, Reston, VA, USA

**Strategic Plan for the Analysis of the National Human Exposure Assessment Survey (NHEXAS) Pilot Study Data**

Nov. 2000; 147 pp.; In English

Report No.(s): PB2007-106201; EPA/600/R-00/049; No Copyright; Avail.: CASI: [A07](#), Hardcopy

The Office of Research and Development (ORD) of the U.S. Environmental Protection Agency (EPA) initiated the National Human Exposure Assessment Survey (NHEXAS) in the early 1990's. It was a population-based pilot study of the exposure of over 500 people in three areas of the U.S. to metals, pesticides, volatile organic compounds, and other toxic chemicals. Measurements were made of the air people breathed, the foods and beverages they consumed, and the soil and dust in/near their home. Chemicals in their blood and urine were measured. The participants also completed questionnaires to help identify possible sources of exposures and to characterize activities that might contribute to exposure. To this date, NHEXAS remains the largest multimedia, multipathway, multichemical study of its kind. Key goals included evaluating the feasibility of conducting such a large study, documenting the population distribution of exposure to the chemicals examined, understanding the factors that contribute to high exposures, and improving the accuracy of exposure models. Such a study produces a multitude of data that must be thoughtfully analyzed to realize its full potential. EPA's Science Advisory Board (SAB) recommended that EPA develop a strategy to analyze the data to ensure the optimal use of the data. Therefore, ORD developed this Strategic Plan. ORD began with a workshop at which about 70 scientific and policy experts from ORD, EPA program offices, EPA regions, other federal agencies, state health agencies, academia, and private institutions offered their suggestions on the most useful analyses of the NHEXAS pilot data. ORD used their thoughtful contributions as the basis to begin development of the Strategic Plan. The draft Plan was reviewed by the SAB, and made available to all EPA program offices and the public. This document has been revised based upon those recommendations.

NTIS

*Exposure; Surveys; Environmental Monitoring*

**20070015100** Statewide Air Pollution Research Center, Riverside, CA USA

**Identification and Atmospheric Reactions of Polar Products of Selected Aromatic Hydrocarbons. Final Report for Period March 1, 2004 to July 31, 2006**

Atkinson, R.; Arey, J.; Jul. 2006; 67 pp.; In English

Report No.(s): PB2007-107817; No Copyright; Avail.: CASI: [A04](#), Hardcopy

During this experimental program, we have used the facilities and expertise available at the Air Pollution Research Center, University of California, Riverside, to investigate the atmospheric chemistry of selected aromatic hydrocarbons found in California's atmosphere. Experiments were carried out in large volume (5800 to approx. 7500 liter) chambers with analysis of reactants and products by gas chromatography (with flame ionization and mass spectrometric detection) and in situ Fourier transform infrared spectroscopy.

NTIS

*Air Pollution; Hydrocarbons*

**20070015141** Statewide Air Pollution Research Center, Riverside, CA USA

**Identification and Atmospheric Reactions of Polar Products of Selected Aromatic Hydrocarbons**

Jul. 2006; 74 pp.; In English

Contract(s)/Grant(s): CARB-03-319

Report No.(s): PB2007-107305; No Copyright; Avail.: CASI: [A04](#), Hardcopy

During this experimental program, we have used the facilities and expertise available at the Air Pollution Research Center, University of California, Riverside, to investigate the atmospheric chemistry of selected aromatic hydrocarbons found in California's atmosphere. Experiments were carried out in large volume (5800 to approx. 7500 liter) chambers with analysis of reactants and products by gas chromatography (with flame ionization and mass spectrometric detection) and in situ Fourier transform infrared spectroscopy. The gas chromatographic analyses included the use of Solid Phase MicroExtraction (SPME) fibers coated with derivatizing agent for on-fiber derivatization of carbonyl-containing compounds, with subsequent gas chromatographic (GC) analyses of the carbonyl-containing compounds as their oximes. This technique was especially useful for the identification and quantification of 1,2-dicarbonyls and unsaturated 1,4-dicarbonyls, some of which are not commercially available and most of which do not elute from gas chromatographic columns without prior derivatization.

NTIS

*Atmospheric Chemistry; Carbonyl Compounds; Hydrocarbons; Air Pollution; Aromatic Compounds; Photochemical Reactions; Atmospheric Composition*

**20070015169** Clarkson Univ., Potsdam, NY, USA

**Analyses of PM-Related Measurements for the Impacts of Ships**

Hopke, P. K.; Hwang, I.; Kim, E.; Lee, J. H.; Sep. 2006; 210 pp.; In English

Report No.(s): PB2007-107818; No Copyright; Avail.: National Technical Information Service (NTIS)

The objective of this project is to resolve the sources of PM<sub>2.5</sub> along the western coast of the USA with a particular emphasis on the impacts of ship emissions on the mass concentrations observed. Ship engines burn low cost, residual oil similar to that used in oil-fired power plants. The ability of these analyses to separately apportion the impacts of ships, spark and compression-ignition vehicle emissions as well as the formation of secondary particles will be important to permit the assessment of the effects of ship emissions on air quality along this coast.

NTIS

*Coasts; Particulates; Ships; United States*

**20070015430** Pacific Northwest National Lab., Richland, WA, USA

**Climate Change Mitigation: An Analysis of Advanced Technology Scenarios**

Clarke, L. E.; Wise, M.; Placet, M.; Izaurrealde, R. C.; Lurz, J. P.; Sep. 2006; 129 pp.; In English

Contract(s)/Grant(s): DE-AC05-76RL01830

Report No.(s): DE2006-895757; PNNL-16078; No Copyright; Avail.: National Technical Information Service (NTIS)

This report documents a scenario analysis that explores three advanced technology pathways toward climate stabilization using the MiniCAM model.

NTIS

*Climate Change; Technology Utilization*

**20070015717** 75 CEV/CEG, Hill ABF, UT USA

**Validation of the Digital Opacity Compliance System Under Regulatory Enforcement Conditions--Postprint**

McFarland, Michael J; Rasmussen, Steve L; Stone, Daniel A; Palmer, Glenn R; Wander, Joseph D; Sep 2006; 10 pp.; In English

Contract(s)/Grant(s): F42650-03-D-0007; Proj-6905

Report No.(s): AD-A464373; No Copyright; Avail.: CASI: [A02](#), Hardcopy

U.S. Environmental Protection Agency (EPA) Emission Measurement Center (EMC), in conjunction with EPA Regions VI and VIII, the State of Utah and the US Department of Defense, have conducted a series of long-term pilot and field tests to determine the accuracy and reliability of a visible opacity monitoring system consisting of a conventional digital camera and a separate computer software application for plume opacity determination. This technology, known as the Digital Opacity Compliance System (DOCS), has been successfully demonstrated at EPA-sponsored Method-9 'smoke schools' as well as at a number of government and commercially operated industrial facilities. Results from the current DOCS regulatory pilot study demonstrate that, under regulatory enforcement conditions, the average difference in opacity measurement between the DOCS technology and EPA Reference Method 9 (Method 9) is 1.12%. This opacity difference, which was computed from the evaluation of 241 regulated air sources, was found to be statistically significant at the 99% confidence level. In evaluating only those sources for which a nonzero visible opacity level was recorded, the average difference in opacity measurement between the DOCS technology and EPA Reference Method 9 (Method 9) was 1.20%. However, in this case, the opacity difference was found to be not significant at the 99% confidence level, a finding that suggests that the two opacity measurement methods are statistically equivalent when measuring nonzero visible opacity emissions. Given the costs and technical limitations associated with use of Method 9, there is a recognized need to develop accurate, reproducible, and scientifically defensible alternatives to the use of human observers. The use of digital imaging/processing brings current technology to bear on this important regulatory issue.

DTIC

*Air Pollution; Digital Systems; Emission Spectra; Opacity*

**20070015836** Washington Univ., Seattle, WA USA

**Ocean Inherent Optical Property Estimation from Irradiances**

Leathers, Robert A; McCormick, Norman J; Nov 20, 1997; 15 pp.; In English

Report No.(s): AD-A464572; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A method is evaluated for estimating the absorption coefficient  $a$  and the backscattering coefficient  $\beta_{\text{sub } \beta}$  from measurements of the upward and downward irradiances  $E_{\text{sub } \mu}(z)$  and  $E_{\text{sub } d}(z)$ . With this method, the



reflectance ratio  $R(z)$  and the downward diffuse attenuation coefficient  $K_{d(z)}$  obtained from  $E_{\mu(z)}$  and  $E_{d(z)}$  are used to estimate the inherent optical properties  $R(\infty)$  and  $K_d(\infty)$  that are the asymptotic values of  $R(\text{sub infinity})$  and  $K_{\text{appa}}(\text{sub infinity})$ , respectively. For an assumed scattering phase function  $Beta$ , there are unique correlations between the values of  $R(\text{sub infinity})$  and  $K_{\text{appa}}(\text{sub infinity})$  and those of  $\alpha$  and  $\beta(\text{sub beta})$  that can be derived from the radiative transfer equation. Good estimates of  $\alpha$  and the Gordon parameter  $G = \beta(\text{sub beta})/(\alpha + \beta(\text{sub beta}))$  can be obtained from  $R(\text{sub infinity})$  and  $K_{\text{appa}}(\text{sub infinity})$  if the true scattering phase function is not greatly different from the assumed function. The method works best in deep, homogeneous waters, but can be applied to some cases of stratified waters. To improve performance in shallow waters where bottom effects are important, the deep- and shallow-measurement reflectance models also are developed.

DTIC

*Irradiance; Irradiation; Oceans; Optical Properties*

### 20070015985

#### **Survey of the Use of Ozone-generating Air Cleaners by the California Public**

Piazza, T.; Lee, R. H.; Hayes, J.; January 2005; 104 pp.; In English

Report No.(s): PB2007-107819; No Copyright; Avail.: CASI: [A06](#), Hardcopy

A representative telephone survey of 2,019 California adults was conducted to determine the extent to which Californians purchased and used indoor air cleaners, specifically models that produce ozone either intentionally or as a by-product, as well as the reasons for their purchase, the frequency and duration of their use, and to determine other factors that may impact public health. Fourteen percent of California households own an air cleaner. Ten percent of California households own an air cleaner that produces ozone intentionally or as a by-product: two percent (2%) of California households own an air cleaner that intentionally emits ozone, while eight percent (8%) own one that may emit ozone as a by-product. Although these are small percentages of the total California households, this equates to about 282,000 households and 828,000 Californians who are exposed to ozone emitted intentionally from air cleaners, and many more who may be exposed to lower levels from by-product devices. Californians purchase air cleaners primarily for health reasons, and most use their air cleaners continuously every day.

NTIS

*Air Filters; Air Purification; Ozone*

### 20070016545 NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **When Will the Antarctic Ozone Hole Recover?**

Newman, Paul A.; [2006]; 1 pp.; In English; University of New Hampshire Environment Science Seminar Series, 8-11 Nov. 2006, Durham, NH, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Antarctic ozone hole develops each year and culminates by early spring (late September - early October). Antarctic ozone values have been monitored since 1979 using satellite observations from the TOMS instrument. The severity of the hole has been assessed from TOMS using the minimum total ozone value from the October monthly mean (depth of the hole) and by calculating the average area coverage during this September-October period. Ozone is mainly destroyed by halogen (chlorine and bromine) catalytic cycles, and these losses are modulated by temperature variations in the collar of the polar lower stratospheric vortex. In this talk, I will show the relationships of halogens and temperature to both the size and depth of the hole. Because atmospheric halogen levels are responding to international agreements that limit or phase out production, the amount of halogens in the stratosphere should decrease over the next few decades. Using projections of halogen levels combined with age-of-air estimates, we find that the ozone hole is recovering at an extremely slow rate and that large ozone holes will regularly recur over the next 2 decades. The ozone hole will begin to show first signs of recovery in about 2023, and the hole will fully recover to pre-1980 levels in approximately 2070. This 2070 recovery is 20 years later than recent projections. I will also discuss current assessments of mid-latitude ozone recovery.

Author

*Antarctic Regions; Ozone Depletion; Air Pollution; Satellite Observation*

## GEOPHYSICS

Includes Earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology*; and *93 Space Radiation*.

**20070015265** Naval Research Lab., Stennis Space Center, MS USA

**Shallow Seabed Methane Gas Could Pose Coastal Hazard**

Best, Angus I; Richardson, Michael D; Boudreau, Bernard P; Judd, Alan G; Leifer, Ira; Lyons, Anthony P; Martens, Christopher S; Orange, Danial L; Wheeler, Simon J; May 30, 2006; 3 pp.; In English; Original contains color illustrations  
Contract(s)/Grant(s): N00014-05-1-0175; N00014-03-1-142

Report No.(s): AD-A464004; NRL/JA/7430-05-09; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464004>

Abnormally high levels of methane gas in seafloor sediments could pose a major hazard to coastal populations within the next 100 years through their impact on climate change and sea level rise. Marine scientists have known for many years that biogenic methane (CH<sub>4</sub>) is generated in shallow seabed sediments on continental margins, especially in rapidly deposited muddy sediments with high organic matter content. Grassy sediments are found in river deltas, estuaries, and harbors, but also in deeper waters on continental shelves and slopes. Human activities can accelerate natural sea-floor gas generation by increasing the supply of sediments and organic matter from rivers through deforestation and intensive farming, and also by the disposal of human waste at sea. When this extra organic matter becomes buried to about one meter beneath the seabed, biogeochemical processes start to convert it to CH<sub>4</sub>. The impact of this extra CH<sub>4</sub> could be felt within the next 100 years, assuming a one-centimeter-per-year sediment accumulation.

DTIC

*Coasts; Gases; Greenhouse Effect; Hazards; Methane; Ocean Bottom; Sediments; Soils*

**20070015821** Oslo Univ., Norway

**Polar Cap Dynamics and Formation of High-Latitude Ionospheric Irregularities**

Moen, Joran; Egeland, Alv; May 24, 2002; 27 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F61775-01-W-E051

Report No.(s): AD-A464538; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This report results from a contract tasking University of Oslo as follows: The contractor will investigate disturbances in the polar ionosphere caused by fluctuating solar winds. In particular, he will attempt to accurately locate the boundary between open and closed magnetic field lines and then determine which processes occur on each of the field lines. These measurements will be made during quiet and disturbed conditions. The final report will contain an analysis of these measurements.

DTIC

*Ionospheres; Ionospheric Disturbances; Polar Caps; Polar Regions*

**20070016602** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The International Heliophysical Year**

Thompson, Barbara J.; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

In 1957 a program of international research, inspired by the International Polar Years of 1882 and 1932, was organized as the International Geophysical Year (IGY) to study global phenomena of the Earth and geospace. Fifty years later, the world's space science community will again come together for international programs of scientific collaboration: the International Heliophysical Year (IHY), the Electronic Geophysical Year (eGY), and the International Polar Year (IPY) 2007. This time, research will extend out into the Heliosphere to focus on solar-terrestrial-planetary interactions. The ambitious plans for the IHY, eGY and IPY incorporate the activities of scientists in 191 nations, as well as the IGY Gold Historical Preservation initiative, plus a series of coordinated campaigns involving more than 100 instruments and models, education and public outreach programs, a developing nations instrument development program, and opportunities for supported research worldwide. The presentation will focus on the efforts and operations which will make these activities possible.

Author

*Heliosphere; International Geophysical Year; Earth Surface; Aerospace Sciences*

**20070016605** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Geodesy at Mercury with MESSENGER**

Smith, David E.; Zuber, Maria t.; Peale, Stanley J.; Phillips, Roger J.; Solomon, Sean C.; [2006]; 9 pp.; In English; AOGS 2006, 9-12 Jul. 2006, Singapore; Copyright; Avail.: Other Sources; Abstract Only

In 2011 the MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) spacecraft will enter Mercury orbit and begin the mapping phase of the mission. As part of its science objectives the MESSENGER mission will determine the shape and gravity field of Mercury. These observations will enable the topography and the crustal thickness to be derived for the planet and will determine the small libration of the planet about its axis, the latter critical to constraining the state of the core. These measurements require very precise positioning of the MESSENGER spacecraft in its eccentric orbit, which has a periapsis altitude as low as 200 km, an apoapsis altitude near 15,000 km, and a closest approach to the surface varying from latitude 60 to about 70 N. The X-band tracking of MESSENGER and the laser altimetry are the primary data that will be used to measure the planetary shape and gravity field. The laser altimeter, which has an expected range of 1000 to 1200 km, is expected to provide significant data only over the northern hemisphere because of MESSENGER's eccentric orbit. For the southern hemisphere, radio occultation measurements obtained as the spacecraft passes behind the planet as seen from Earth and images obtained with the imaging system will be used to provide the long-wavelength shape of the planet. Gravity, derived from the tracking data, will also have greater resolution in the northern hemisphere, but full global models for both topography and gravity will be obtained at low harmonic order and degree. The limiting factor for both gravity and topography is expected to be knowledge of the spacecraft location. Present estimations are that in a combined tracking, altimetry, and occultation solution the spacecraft position uncertainty is likely to be of order 10 m. This accuracy should be adequate for establishing an initial geodetic coordinate system for Mercury that will enable positioning of imaged features on the surface, determination of the planet's obliquity, and detection of the librational motion of the planet about its axis.

Author

*Geodesy; Mercury Surface; Messenger (Spacecraft); Mercury (Planet); Aerospace Environments; Geochemistry; Ranging*

**20070016663** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Progress and Plans in Support of the Polar Community**

Olsen, Lola M.; Meaux, Melanie F.; June 7, 2006; 1 pp.; In English; Scientific Committee on Antarctic Research (SCAR)/Council of Managers of National Antarctic Programmes (COMNAP), 7-15 Jun. 2006, Tasmania, Australia  
Contract(s)/Grant(s): NAS5-00220; No Copyright; Avail.: Other Sources; Abstract Only

Feedback provided by the Antarctic community has proven instrumental in positively influencing the direction of the GCMD's development. For example, in response to requests for a stand alone metadata authoring tool, a new shareable software package called docBUILDER solo will be released to the public in March 2006. This tool permits researchers to document their data during experiments and observational periods in the field. The international polar community has also played a key role in encouraging support for the foreign language character set in the metadata display and tools (10% of the records in the AMD hold foreign characters). In the upcoming release, the full ISO character set, which also includes mathematical symbols, will be supported. Additional upgrades include the ability for users to search for data sets based on pre-selected temporal and spatial resolution ranges. Data providers are strongly encouraged to populate the resolution fields for their data sets, although these fields are not currently required. In prior versions, browser incompatibilities often resulted in unreliable performance for users attempting to initiate a spatial search using a map based on Java applet technology. The GCMD will offer an integrated Google map and date search, replacing the applet technology and enhancing the geospatial and temporal searches. It is estimated that 30% of the records in the AMD have direct access to data. A growing number of these records can be accessed through data service links. Related data services are therefore becoming valuable assets in facilitating the use and visualization of data. Users will gain the ability to refine services using the same options as those available for data set searches. Data providers are encouraged to describe available data-related services through the directory. Future plans include offering web services through a SOAP interface and extending semantic queries for the polar regions through the use of ontologies. The Open Archives Initiative's (OAI) Protocol for Metadata Harvesting (PMH) has been successfully tested with several organizations and appears to be a prime candidate for sharing metadata within the community. The GCMD anticipates contributing to the design of the data management system for the International Polar Year and to the ongoing efforts in the years to come. Further enhancements will be discussed at the meeting.

Author

*Antarctic Regions; Polar Regions; Metadata; Geophysics*

**20070016665** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Constraining Numerical Geodynamo Modeling with Surface Observations**

Kuang, Weijia; Tangborn, Andrew; May 3, 2006; 1 pp.; In English; First SWARM International Science Meeting, 3-5 May 2006, Nates, France; No Copyright; Avail.: Other Sources; Abstract Only

Numerical dynamo solutions have traditionally been generated entirely by a set of self-consistent differential equations that govern the spatial-temporal variation of the magnetic field, velocity field and other fields related to dynamo processes. In particular, those solutions are obtained with parameters very different from those appropriate for the Earth's core. Geophysical application of the numerical results therefore depends on correct understanding of the differences (errors) between the model outputs and the true states (truth) in the outer core. Part of the truth can be observed at the surface in the form of poloidal magnetic field. To understand these differences, or errors, we generate new initial model state (analysis) by assimilating sequentially the model outputs with the surface geomagnetic observations using an optimal interpolation scheme. The time evolution of the core state is then controlled by our MoSST core dynamics model. The final outputs (forecasts) are then compared with the surface observations as a means to test the success of the assimilation. We use the surface geomagnetic data back to year 1900 for our studies, with 5-year forecast and 20-year analysis periods. We intend to use the result; to understand time variation of the errors with the assimilation sequences, and the impact of the assimilation on other unobservable quantities, such as the toroidal field and the fluid velocity in the core.

Author

*Geophysics; Mathematical Models; Dynamo Theory; Surface Geometry*

## 47

### METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

**20070014820** Texas A&M Univ., College Station, TX USA

#### **Concepts for Managing Freeway Operations During Weather Events**

Balke, K.; Songchitruksa, P.; Liu, H.; Brydia, R.; Jasek, D.; Feb. 2007; 182 pp.; In English

Report No.(s): PB2007-107269; REPT-0-5278-1; No Copyright; Avail.: National Technical Information Service (NTIS)

The goal of this research was to help TxDOT develop a structured, systematic approach for managing traffic during weather events. Our focus in this research project was on common weather events such as fog, high winds, heavy rains, and snow and ice storms that impact traffic operations day-to-day. First, we conducted a survey of selected Texas Department of Transportation (TxDOT) districts to determine what information traffic management center (TMC) operators need to manage traffic operations during weather events. Through a review of the existing literature, we assessed systems and technologies that other states have deployed to manage traffic during weather-related events. We reviewed the current state of weather-related detection and monitoring technologies. Using historical traffic detector and weather information, we assessed the magnitude of the impact of different weather events on traffic operations. Using all this information, we developed concepts of operations for how TMC operators should respond to different types of weather-related events, including limited visibility conditions, ponding and flash flooding, high winds, severe thunderstorms, tornados, and winter storms. We developed a catalog of advisory, control, and treatment strategies (or ACTS) that operators could use to manage traffic operations during weather events. Specific criteria outline when TxDOT TMC operators should implement different types of responses. We proposed messages that TxDOT TMC operators can use on dynamic message signs (DMSs) to achieve different advisory and control strategies for different types of weather events. Finally, we provided a framework TxDOT can use to integrate weather information from the National Weather Service and other private weather providers into its TMC operations software.

NTIS

*Congestion; Highways; Traffic; Weather*

**20070014845** Maryland Univ., Baltimore, MD, USA

#### **Final Report: Closeout of the Award NO. DE-FG02-98ER62618 (M.S. Fox-Rabinovitz, P.I.)**

Fox-Rabinovitz, M. S.; Oct. 23, 2006; 5 pp.; In English

Contract(s)/Grant(s): FG02-98ER62618

Report No.(s): DE2007-893815; DOE/ER/62618-1; No Copyright; Avail.: Department of Energy Information Bridge

The final report describes the study aimed at exploring the variable-resolution stretched-grid (SG) approach to decadal regional climate modeling using advanced numerical techniques. The obtained results have shown that variable-resolution SG-GCMs using stretched grids with fine resolution over the area(s) of interest, is a viable established approach to regional climate modeling. The developed SG-GCMs have been extensively used for regional climate experimentation. The SG-GCM

simulations are aimed at studying the U.S. regional climate variability with an emphasis on studying anomalous summer climate events, the U.S. droughts and floods.

NTIS

*Climate Models; Geology; Geophysics; Grid Generation (Mathematics)*

**20070014900** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Remote Sensing of Spectral Aerosol Properties: A Classroom Experience**

Levy, Robert C.; Pinker, Rachel T.; July 2006; 22 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

Bridging the gap between current research and the classroom is a major challenge to today's instructor, especially in the sciences where progress happens quickly. NASA Goddard Space Flight Center and the University of Maryland teamed up in designing a graduate class project intended to provide a hands-on introduction to the physical basis for the retrieval of aerosol properties from state-of-the-art MODIS observations. Students learned to recognize spectral signatures of atmospheric aerosols and to perform spectral inversions. They became acquainted with the operational MODIS aerosol retrieval algorithm over oceans, and methods for its evaluation, including comparisons with groundbased AERONET sun-photometer data.

Author

*Imaging Spectrometers; MODIS (Radiometry); Spectral Signatures; Photometers; Inversions; Remote Sensing*

**20070014948** Pacific Northwest National Lab., Richland, WA, USA, Wisconsin Univ., Madison, WI, USA

**Principal Component Analysis Noise Filter Value-Added Procedure to Remove Uncorrelated Noise from Atmospheric Emitted Radiance Interferometer (AERI) Observations**

Lo, C.; Turner, D. D.; Knuteson, R. O.; Jan. 01, 2006; 11 pp.; In English

Report No.(s): DE2006-876671; DOE/ARM-TR-071; No Copyright; Avail.: National Technical Information Service (NTIS)

This technical report provides a short description of the application of the principle component analysis techniques to remove uncorrelated random noise from ground-based high spectral resolution infrared radiance observations collected by the atmospheric emitted radiance interferometers (AERIs) deployed by the Atmospheric Radiation Measurement (ARM) Program. A general overview of the technique, the input, and output datastreams of the newly generated value-added product, and the data quality checks used are provided. A more complete discussion of the theory and results is given in Turner et al. (2006).

NTIS

*Principal Components Analysis; Random Noise; Interferometers*

**20070015043** California Univ., Berkeley, CA USA

**Predictor Coupled Ocean-Atmosphere Modes with a Climate Modeling**

Ghil, M.; Robertson, A. W.; Aug. 04, 2006; 6 pp.; In English

Contract(s)/Grant(s): DE-FG03-01ER63260

Report No.(s): DE2006-889817; No Copyright; Avail.: Department of Energy Information Bridge

The goal of the project was to determine midlatitude climate predictability associated with tropical-extratropical interactions on interannual-to-interdecadal time scales. Our strategy was to develop and test a hierarchy of climate models, bringing together large GCM-based climate models with simple fluid-dynamical coupled ocean-ice-atmosphere models, through the use of advanced probabilistic network (PN) models. PN models were used to develop a new diagnostic methodology for analyzing coupled ocean-atmosphere interactions in large climate simulations made with the NCAR Parallel Climate Model (PCM), and to make these tools user-friendly and available to other researchers. We focused on interactions between the tropics and extratropics through atmospheric teleconnections (the Hadley cell, Rossby waves and nonlinear circulation regimes) over both the North Atlantic and North Pacific, and the oceans thermohaline circulation (THC) in the Atlantic. We tested the hypothesis that variations in the strength of the THC alter sea surface temperatures in the tropical Atlantic, and that the latter influence the atmosphere in high latitudes through an atmospheric teleconnection, feeding back onto the THC. The PN model framework was used to mediate between the understanding gained with simplified primitive equations models and multi-century simulations made with the PCM. The project team is interdisciplinary and built on an existing synergy between atmospheric and ocean scientists at UCLA, computer scientists at UCI, and climate researchers at the IRI.

NTIS

*Air Water Interactions; Atmospheric Models; Climate Models; Ocean Models*

**20070015744** Naval Research Lab., Washington, DC USA

**NOGAPS-ALPHA: A Prototype High-Altitude Global NWP Model**

Eckermann, Stephen D; McCormack, John P; Coy, Lawrence; Allen, Douglas; Hogan, Tim; Kim, Young-Joon; Jun 2004; 24 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464412; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Navy Operational Global Atmospheric Prediction System (NOGAPS) is the Department of Defense's (DoD's) high-resolution global numerical weather prediction (NWP) system. Its development and operation is a joint activity of the Naval Research Laboratory (NRL) and the Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC). NOGAPS is a complete operational forecasting system that includes data quality control, tropical cyclone bogusing, operational data assimilation, balanced initialization, and a global forecast model. Operational NOGAPS forecasts currently consist of high-resolution T239L30 six-day forecasts every 6 hours and once-a-day extended ten-day guidance using the FNMOC ensemble (T119L24). These forecasts are distributed to numerous defense and civilian users, and are used as input for numerous DoD environmental and application systems. Examples include: the Navy's Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPSTM); FNMOC's ocean wave, sea ice, ocean thermodynamics, and tropical cyclone models; aircraft and ship-routing programs.

DTIC

*Atmospheric Models; Forecasting; High Altitude; Military Operations; Navy; Prototypes*

**20070015799** Naval Research Lab., Washington, DC USA

**Self-Shading Correction for Upwelling Sea-Surface Radiance Measurements Made With Buoyed Instruments**

Leathers, Robert A G; Downes, T V; Mobley, Curtis D; May 7, 2001; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464502; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Upwelling radiance measurements made with instruments designed to float at the sea surface are shaded both by the instrument housing and by the buoy that holds the instrument. The amount of shading is wavelength dependent and is affected by the local marine and atmospheric conditions. Radiance measurements made with such instruments should be corrected for this self-shading error before being applied to remote sensing calibrations or remote sensing algorithm validation. Here we use Monte Carlo simulations to compute the self-shading error of a commercially available buoyed radiometer so that measurements made with this instrument can be improved. This approach can be easily adapted to the dimensions of other instruments.

DTIC

*Meteorological Instruments; Ocean Surface; Radiance; Upwelling Water*

**20070015861** Naval Research Lab., Washington, DC USA

**Optical Turbulence Model for Laser Propagation and Imaging Applications**

Oh, E S; Ricklin, J C; Gilbreath, G C; Valletero, N, J; Eaton, F D; Jan 2004; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464613; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We evaluate a simple model for predicting and understanding the structural behavior of Cn 2 for a specific location, date, time, and given environmental parameters. This model is compared with Cn 2 data taken at the Chesapeake Bay Detachment of the Naval Research Laboratory in Chesapeake Beach, Maryland. This simplified model predicts and explains the fluctuation in Cn 2 reasonably well, and also shows that Cn 2 is a strong function of solar irradiation.

DTIC

*Imaging Techniques; Laser Applications; Masers; Optical Equipment; Turbulence; Turbulence Models*

**20070015926** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Percentage Contributions from Atmospheric and Surface Features to Computed Brightness Temperatures**

Skofronick Jackson, Gail; Kim, Min-Jeong; Johnson, Benjamin; [2006]; 2 pp.; In English; IGARSS, 31 Jul. - 4 Aug. 2006, Denver, CO, USA; Copyright; Avail.: CASI: [A01](#), Hardcopy

Over the past few years, a few solid precipitation detection and retrieval algorithms have been developed and shown to be applicable for snowing clouds and blizzards. Current precipitating snow retrieval algorithms require the use of millimeter-wave radiometer observations. The millimeter-wave frequencies are especially sensitive to the scattering and emission properties of frozen particles due to the ice particle refractive index. These channels can also be used to discern information about the frozen particles above the melting layer. Passive radiometric channels respond to both the integrated

particle mass throughout the volume and field of view, and to the amount, location, and size distribution of the frozen (and liquid) particles with the sensitivity varying for different frequencies and hydrometeor types. This work will show the percentage of the brightness temperature resulting from the liquid hydrometeor, frozen hydrometeor, relative humidity, and surface contributions. The focus will be on precipitating snow events and millimeter-wave frequencies however, other events and frequencies will be included in the analysis.

Derived from text

*Brightness Temperature; Frequency Distribution; Millimeter Waves; Cloud Physics; Algorithms; Precipitation (Meteorology); Earth Surface*

**20070015927** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Methods of Attenuation Correction for Dual-Wavelength and Dual-Polarization Weather Radar Data**

Meneghini, R.; Liao, L.; [2007]; 2 pp.; In English; IGARSS, 31 Jul. - 4 Aug. 2006, Denver, CO, USA; Copyright; Avail.: CASI: A01, Hardcopy

In writing the integral equations for the median mass diameter and number concentration, or comparable parameters of the raindrop size distribution, it is apparent that the forms of the equations for dual-polarization and dual-wavelength radar data are identical when attenuation effects are included. The differential backscattering and extinction coefficients appear in both sets of equations: for the dual-polarization equations, the differences are taken with respect to polarization at a fixed frequency while for the dual-wavelength equations, the differences are taken with respect to frequency at a fixed polarization. An alternative to the integral equation formulation is that based on the  $k$ - $Z$  (attenuation coefficient-radar reflectivity factor) parameterization. This-technique was originally developed for attenuating single-wavelength radars, a variation of which has been applied to the TRMM Precipitation Radar data (PR). Extensions of this method have also been applied to dual-polarization data. In fact, it is not difficult to show that nearly identical equations are applicable as well to dualwavelength radar data. In this case, the equations for median mass diameter and number concentration take the form of coupled, but non-integral equations. Differences between this and the integral equation formulation are a consequence of the different ways in which attenuation correction is performed under the two formulations. For both techniques, the equations can be solved either forward from the radar outward or backward from the final range gate toward the radar. Although the forward-going solutions tend to be unstable as the attenuation out to the range of interest becomes large in some sense, an independent estimate of path attenuation is not required. This is analogous to the case of an attenuating single-wavelength radar where the forward solution to the Hitschfeld-Bordan equation becomes unstable as the attenuation increases. To circumvent this problem, the equations can be expressed in the form of a final-value problem so that the recursion begins at the far range gate and proceeds inward towards the radar. Solving the problem in this way traditionally requires estimates of path attenuation to the final gate: in the case of orthogonal linear polarizations, the attenuations at horizontal and vertical polarizations (same frequency) are required while in the dual-wavelength case, attenuations at the two frequencies (same polarization) are required.

Derived from text

*Attenuation Coefficients; Meteorological Radar; Radar Data; Correction; Parameterization; Precipitation (Meteorology)*

**20070015991** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Tropospheric Ozone from Assimilation of Aura Data using Different Definitions of the Tropopause**

Stajner, Ivanka; Wargan, K.; Chang, L.-P.; Hayashi, H.; Pawson, S.; Pawson, Steven; Livesey, N.; Bhartia, P. K.; September 15, 2006; 1 pp.; In English; EOS Aura Science and Validation Team meeting, 11-15 Sep. 2006, Boulder, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

Ozone data from Aura OMI and MLS instruments were assimilated into the general circulation model (GCM) constrained by assimilated meteorological fields from the Global Modeling and Assimilation Office at NASA Goddard. Properties of tropospheric ozone and their sensitivity to the definition of the tropopause are investigated. Three definitions of the tropopause are considered: (1) dynamical (using potential vorticity and potential temperature), (2) using temperature lapse rate, and (3) using a fixed ozone value. Comparisons of the tropospheric ozone columns using these tropopause definitions will be presented and evaluated against coincident profiles from ozone sondes. Assimilated ozone profiles are used to identify possible tropopause folding events, which are important for stratosphere-troposphere exchange. Each profile is searched for multiple levels at which ozone attains the value typical of the troposphere-stratosphere transition in order to identify possible tropopause folds. Constrained by the dynamics from a global model and by assimilation of Aura ozone data every 3-hours, this data set provides an opportunity to study ozone evolution in the upper troposphere and lower stratosphere with high temporal resolution.

Author

*Atmospheric General Circulation Models; Ozone; Tropopause; Meteorological Parameters; Atmospheric Circulation*

**20070015993** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Compilation of a Global Emission Inventory from 1980 to 2000 for Global Model Simulations of the Long-term Trend of Tropospheric Aerosols**

Diehl, T. L.; Mian, Chin; Bond, T. C.; Carn, S. A.; Duncan, B. N.; Krotkov, N. A.; Streets, D. G.; [2007]; 1 pp.; In English; Second International Conference on Global Warming and Next Ice Age and the Aerosol Workshop on Climate Prediction Uncertainties; No Copyright; Avail.: Other Sources; Abstract Only

The approach to create a comprehensive emission inventory for the time period 1980 to 2000 is described in this paper. We have recently compiled an emission database, which we will use for a 21 year simulation of tropospheric aerosols with the GOCART model. Particular attention was paid to the time-dependent SO<sub>2</sub>, black carbon and organic carbon aerosol emissions. For the emission of SO<sub>2</sub> from sporadically erupting volcanoes, we assembled emission data from the Global Volcanism Program of the Smithsonian Institution, using the VEI to derive the volcanic cloud height and the SO<sub>2</sub> amount, and amended this dataset by the SO<sub>2</sub> emission data from the TOMS instrument when available. 3-dimensional aircraft emission data was obtained for a number of years from the AEAP project, converted from burned fuel to SO<sub>2</sub> and interpolated to each year, taking the sparsity of the flight patterns into account. Other anthropogenic SO<sub>2</sub> emissions are based on gridded emissions from the EDGAR 2000 database (excluding sources from aircraft, biomass burning and international ship traffic), which were scaled to individual years with country/regional based emission inventories. Gridded SO<sub>2</sub> emissions from international ship traffic for 2000 and the scaling factors for other years are from [Eyring et al., 2005]. We used gridded anthropogenic black and organic carbon emissions for 1996 [Bond et al., 2005], again excluding aircraft, biomass burning and ship sources. These emissions were scaled with regional based emission inventories from 1980 to 2000 to derive gridded emissions for each year. The biomass burning emissions are based on a climatology, which is scaled with regional scaling factors derived from the TOMS aerosol index and the AVHRR/ATSR fire counts to each year [Duncan et al., 2003]. Details on the integration of the information from the various sources will be provided and the distribution patterns and total emissions in the final product will be discussed.

Author

*Aerosols; Troposphere; Emission; Climatology; Simulation; Annual Variations*

**20070015994** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Using Multi-scale Modeling System to Study the Interactions between Clouds, Precipitation, Aerosols, Radiation and Land Surface**

Tao, Wei-Kuo; [2006]; 1 pp.; In English; Physics and Severe Storms, Institute of Atmospheric Physics., 2 Aug. 2006, China; No Copyright; Avail.: Other Sources; Abstract Only

Numerical cloud models, which are based the non-hydrostatic equations of motion, have been extensively applied to cloud-scale and mesoscale processes during the past four decades. Because cloud-scale dynamics are treated explicitly, uncertainties stemming from convection that have to be parameterized in (hydrostatic) large-scale models are obviated, or at least mitigated, in cloud models. Global models will use the non-hydrostatic framework when their horizontal resolution becomes about 10 kilometers, the theoretical limit for the hydrostatic approximation. This juncture will be reached one to two decades from now. Over the past generation, voluminous datasets on atmospheric convection have been accumulated from radar, instrumented aircraft, satellites, and rawinsonde measurements in field campaigns, enabling the detailed evaluation of models. Improved numerical methods have resulted in more accurate and efficient dynamical cores in models. Improvements have been made in the parameterizations of microphysical processes, radiation, boundary-layer effects, and turbulence; however, microphysical parameterizations remain a major source of uncertainty in all classes of atmospheric models. In recent years, exponentially increasing computer power has extended cloud-resolving-model integrations from hours to months, the number of computational grid points from less than a thousand to close to ten million. Three-dimensional models are now more prevalent. Much attention is devoted to precipitating cloud systems where the crucial 1-kilometer scales are resolved in horizontal domains as large as 10,000 kilometers in two-dimensions, and 1,000 x 1,000 square kilometers in three-dimensions. Cloud models now provide statistical information useful for developing more realistic physically based parameterizations for climate models and numerical weather prediction models. It is also expected that NWP and mesoscale model can be run in grid size similar to cloud resolving model through nesting technique. A review of developments, improvements and applications of cloud models (GCE and WRF) at Goddard will be presented in this talk. In particular, a new approach to using multi-scale modeling system to study the interactions between clouds, precipitation, aerosols and land will be presented.

Author

*Aerosols; Clouds (Meteorology); Multiscale Models; Precipitation (Meteorology); Land; Earth Surface; Numerical Analysis; Radiation*



**20070015998** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Living With a Star Geospace Program**

Sibeck, D. G.; [2006]; 1 pp.; In English; Superdam Workshop 2006, 5-9 Jun. 2006, Assateague Island, VA, USA; No Copyright; Avail.: Other Sources; Abstract Only

NASA's Living With a Star program addresses research problems with societal impact. As specified by its mission definition team, the Geospace component of the program addresses two regions which pose the greatest hazards: the Earth's radiation belts and the mid-latitude ionosphere. Two Radiation Belt Storm Probe spacecraft with identical energetic particle, plasma wave, and magnetic field instrumentation will make the observations needed to distinguish spatial from temporal effects and identify the mechanisms governing particle energization, transport, and loss. Two Ionosphere- Thermosphere Storm Probes on inclined low-altitude and midlatitude orbits will make the observations needed to distinguish between special and temporal effects, characterize the response to varying solar EUV radiation and geomagnetic storms, and identify the mechanisms generating mid-latitude ionospheric irregularities. An imager on a mission of opportunity will provide the observations needed to place these in situ measurements in context.

Author

*NASA Programs; Geophysics; Radiation Belts; Midlatitude Atmosphere*

**20070016544** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A Mission to Observe Ice in Clouds from Space**

Ackerman, S.; O'CSarr, D.; Skofronick-Jackson, G.; Evans, F.; Wang, J. R.; Racette, P.; Norris, P.; daSilva, A.; Soden, B.; [2006]; 1 pp.; In English; IGARSS, 31 Jul. - 4 Aug. 2006, Denver, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

To date there have been multiple satellite missions to observe and retrieve cloud top properties and the liquid in, and precipitation from, clouds. There are currently a few missions that attempt to measure cloud ice properties as a byproduct of other observations. However, we do not yet quantitatively understand the processes that control the water budget of the upper troposphere where ice is the predominant phase, and how these processes are linked to precipitation processes and the radiative energy budget. The ice in clouds either melts into rain or is detrained, and persists, as cirrus clouds affecting the hydrological and energy cycle, respectively. Fully modeling the Earth's climate and improving weather and climate forecasts requires accurate satellite measurements of various cloud properties at the temporal and spatial scales of cloud processes. The uncertainty in knowledge of these ice characteristics is reflected in the large discrepancies in model simulations of the upper tropospheric water budget. Model simulations are sensitive to the partition of ice between precipitation and outflow processes, i.e., to the parameterization of ice clouds and ice processes. This presentation will describe the Submillimeter-wave InfraRed Ice Cloud Experiment (SIRICE) concept, a satellite mission designed to acquire global Earth radiance measurements in the infrared and submillimeter-wave region (183-874 GHz). If successful, this mission will bridge the measurement gap between microwave sounders and shorter-wavelength infrared and visible sensors. The brightness temperatures at submillimeter-wave frequencies are especially sensitive to cirrus ice particle sizes (because they are comparable to the wavelength). This allows for more accurate ice water path estimates when multiple channels are used to probe into the cloud layers. Further, submillimeter wavelengths offer simplicity in the retrieval algorithms because they do not probe into the liquid and near surface portions of clouds, thus requiring only one term of the radiative transfer equation (ice scattering) to relate brightness temperatures to ice. Scientific justification and the SIRICE approach to measuring ice water path and particle size that span a range encompassing both the hydrologically active and radiatively active components of cloud systems will be presented.

Author

*Cloud Physics; Ice Clouds; Radiance; Submillimeter Waves; Infrared Radiation*

**20070016546** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Impact of Microphysics on Intensity and Structure of Hurricanes**

Tao, Wei-Kuo; Shi, Jainn; Lang, Steve; Peters-Lidard, Christa; [2006]; 1 pp.; In English; 2006 AGU Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

During the past decade, both research and operational numerical weather prediction models, e.g. Weather Research and Forecast (WRF) model, have started using more complex microphysical schemes originally developed for high-resolution cloud resolving models (CRMs) with a 1-2 km or less horizontal resolutions. WFW is a next-generation mesoscale forecast model and assimilation system that has incorporated modern software framework, advanced dynamics, numeric and data assimilation techniques, a multiple moveable nesting capability, and improved physical packages. WFW model can be used for a wide range of applications, from idealized research to operational forecasting, with an emphasis on horizontal grid sizes in the range of 1-10 km. The current WRF includes several different microphysics options such as Lin et al. (1983), WSM

6-class and Thompson microphysics schemes. We have recently implemented three sophisticated cloud microphysics schemes into WRF. The cloud microphysics schemes have been extensively tested and applied for different mesoscale systems in different geographical locations. The performances of these schemes have been compared to those from other WRF microphysics options. We are performing sensitivity tests in using WW to examine the impact of six different cloud microphysical schemes on hurricane track, intensity and rainfall forecast. We are also performing the inline tracer calculation to comprehend the physical processes (e.g., boundary layer and each quadrant in the boundary layer) related to the development and structure of hurricanes.

Author

*Hurricanes; Mesometeorology; Weather Forecasting; Boundary Layers; Cloud Physics; High Resolution; Numerical Weather Forecasting*

**20070016547** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Investigations of Stratosphere-Troposphere Exchange of Ozone Derived From MLS Observations**

Olsen, Mark A.; Schoeberl, Mark R.; Ziemke, Jerry R.; [2006]; 1 pp.; In English; AGU Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Daily high-resolution maps of stratospheric ozone have been constructed using observations by MLS combined with trajectory information. These fields are used to determine the extratropical stratosphere-troposphere exchange (STE) of ozone for the year 2005 using two diagnostic methods. The resulting two annual estimates compare well with past model- and observational-based estimates. Initial analyses of the seasonal characteristics indicate that significant STE of ozone in the polar regions occurs only during spring and early summer. We also examine evidence that the Antarctic ozone hole is responsible for a rapid decrease in the rate of ozone STE during the SH spring. Subtracting the high-resolution stratospheric ozone from OMI total column measurements creates a high-resolution tropospheric ozone residual (HTOR) product. The HTOR fields are compared to the spatial distribution of the ozone STE. We show that the mean tropospheric ozone maxima tend to occur near locations of significant ozone STE. This suggests that STE may be responsible for a significant fraction of many mean tropospheric ozone anomalies.

Author

*Stratosphere; Ozone Depletion; Atmospheric Circulation; Atmospheric Composition; Troposphere; Polar Regions; Antarctic Regions*

**20070016553** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Tropospheric Wind Lidar Technology Experiment (TWiLiTE): An Airborne Direct Detection Doppler Lidar Instrument Development Program**

Gentry, Bruce; McGill, Matthew; Schwemmer, Geary; Hardesty, Michael; Brewer, Alan; Wilkerson, Thomas; Atlas, Robert; Sirota, Marcos; Lindemann, Scott; [2006]; 1 pp.; In English; 7th International Symposium on Tropospheric Profiling: Needs and Technologies, 11-17 Jun. 2006, Boulder, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

Global measurement of tropospheric winds is a key measurement for understanding atmospheric dynamics and improving numerical weather prediction. Global wind profiles remain a high priority for the operational weather community and also for a variety of research applications including studies of the global hydrologic cycle and transport studies of aerosols and trace species. In addition to space based winds, a high altitude airborne system flown on UAV or other advanced platforms would be of great interest for studying mesoscale dynamics and hurricanes. The Tropospheric Wind Lidar Technology Experiment (TWiLiTE) project was selected in 2005 by the NASA Earth Sun Technology Office as part of the Instrument Incubator Program. TWiLiTE will leverage significant research and development investments in key technologies made in the past several years. The primary focus will be on integrating these sub-systems into a complete molecular direct detection Doppler wind lidar system designed for autonomous operation on a high altitude aircraft, such as the NASA WB57, so that the nadir viewing lidar will be able to profile winds through the full troposphere. TWiLiTE is a collaboration involving scientists and technologists from NASA Goddard, NOAA ESRL, Utah State University Space Dynamics Lab and industry partners Michigan Aerospace Corporation and Sigma Space Corporation. NASA Goddard and its partners have been at the forefront in the development of key lidar technologies (lasers, telescopes, scanning systems, detectors and receivers) required to enable spaceborne global wind lidar measurement. The TWiLiTE integrated airborne Doppler lidar instrument will be the first demonstration of a airborne scanning direct detection Doppler lidar and will serve as a critical milestone on the path to a fixture spaceborne tropospheric wind system. The completed system will have the capability to profile winds in clear air from the aircraft altitude of 18 h to the surface with 250 m vertical resolution and less than 2 meters per second velocity accuracy. The

instrument design, technologies and predicted performance will be presented.

Author

*Troposphere; Wind Measurement; Technology Utilization; Systems Engineering; Optical Radar; Airborne Equipment; Numerical Weather Forecasting*

**20070016554** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Precipitation Measurements from Space: Why Do We Need Them?**

Hou, Arthur Y.; [2006]; 1 pp.; In English; Atmospheric Science Seminar, 17-18 Sep. 2006, Cambridge, MA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Water is fundamental to the life on Earth and its phase transition between the gaseous, liquid, and solid states dominates the behavior of the weather/climate/ecological system. Precipitation, which converts atmospheric water vapor into rain and snow, is central to the global water cycle. It regulates the global energy balance through interactions with clouds and water vapor (the primary greenhouse gas), and also shapes global winds and dynamic transport through latent heat release. Surface precipitation affects soil moisture, ocean salinity, and land hydrology, thus linking fast atmospheric processes to the slower components of the climate system. Precipitation is also the primary source of freshwater in the world, which is facing an emerging freshwater crisis in many regions. Accurate and timely knowledge of global precipitation is essential for understanding the behavior of the global water cycle, improving freshwater management, and advancing predictive capabilities of high-impact weather events such as hurricanes, floods, droughts, and landslides. With limited rainfall networks on land and the impracticality of making extensive rainfall measurements over oceans, a comprehensive description of the space and time variability of global precipitation can only be achieved from the vantage point of space. This presentation will examine current capabilities in space-borne rainfall measurements, highlight scientific and practical benefits derived from these observations to date, and provide an overview of the multi-national Global Precipitation Measurement (GPM) Mission scheduled to be launched in the early next decade.

Author

*Precipitation Measurement; Climatology; Weather; Ecology; Airborne Equipment*

**20070016555** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Comments on the Terminology of ‘Convectively-Coupled Kelvin Waves’**

Chao, Winston C.; [2006]; 7 pp.; In English; No Copyright; Avail.: CASI: A02, Hardcopy  
ONLINE: <http://hdl.handle.net/2060/20070016555>

The terminology ‘convectively-coupled Kelvin waves’ has been used frequently in the literature to refer to the 15 m/s eastward-moving planetary and large-scale waves in the tropics. This note points out that this terminology is not appropriate, since these waves contain Rossby waves and mixed Rossby-gravity waves also. The significance of pointing out this misnomer is that a better understanding of these waves may contribute to the search for their cause.

Author

*Planetary Waves; Convective Flow; Meteorology; Atmospheric Circulation*

**20070016558** Meteorological Coll., Kashiwa, Japan

**Monthly Report of the Meteorological Satellite Center: December 2006**

December 2006; In English; Copyright; Avail.: Other Sources

The CD-ROM concerning the December 2006 Monthly Report of the Meteorological Satellite Center (MSC) contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the Polar Orbital Meteorological Satellites operated by NOAA. The CD-ROM contains the following observation data: Full Disk Earth’s Cloud Image; Cloud Image of Japan and its vicinity; Cloud Amount; Sea Surface Temperature; Cloud Motion Wind; Water Vapor Motion Wind; Equivalent Blackbody Temperature; OLR (Out-going Longwave Radiation), Solar Radiation; Snow and Ice Index; Orbit Data; Attitude Data; VISSR Image Data Catalog (Cartridge Magnetic Tape (CMT), Micro Film); TOVS (TIROS Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water; and TOVS Total Ozone Amount.

Derived from text

*Satellite Observation; Satellite Sounding; Atmospheric Sounding; Meteorological Parameters; Satellite Imagery; Japan*

**20070016580** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Revised Correlation between Odin/OSIRIS PMC Properties and Coincident TIMED/SABER Mesospheric Temperatures**

Feofilov, A. G.; Petelina, S V.; Kutepov, A. A.; Pesnell, W. D.; Goldberg, R. A.; Llewellyn, E. J.; Russell, J. M.; [2006]; 1 pp.; In English; The Polar Summer MLT Plasma Environment as Seen by the Drops Sounding Rockets, 11-15, Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Optical Spectrograph and Infrared Imaging System (OSIRIS) instrument on board the Odin satellite detects Polar Mesospheric Clouds (PMCs) through the enhancement in the limb scattered solar radiance. The Sounding of the Atmosphere using the Broadband Emission Radiometry (SABER) instrument on board the TIMED satellite is a limb scanning infrared radiometer that measures temperature and vertical profiles and energetic parameters for minor constituents in the mesosphere and lower thermosphere. The combination of OSIRIS and SABER data has been previously used to statistically derive thermal conditions for PMC existence [Petelina et al., 2005]. In this work, we employ the simultaneous common volume measurements of PMCs by OSIRIS and temperature profiles measured by SABER for the Northern Hemisphere summers of 2002-2005 and corrected in the polar region by accounting for the vibrational-vibrational energy exchange among the CO<sub>2</sub> isotopes [Kutepov et al., 2006]. For each of 20 coincidences identified within plus or minus 1 degree latitude, plus or minus 2 degrees longitude and less than 1 hour time the frost point temperatures were calculated using the corresponding SABER temperature profile and water vapor densities of 1,3, and 10 ppmv. We found that the PMC presence and brightness correlated only with the temperature threshold that corresponds to the frost point. The absolute value of the temperature below the frost point, however, didn't play a significant role in the intensity of PMC signal for the majority of selected coincidences. The presence of several bright clouds at temperatures above the frost point is obviously related to the limitation of the limb geometry when some near- or far-field PMCs located at higher (and warmer) altitudes appear to be at lower altitudes.

Author

*Infrared Imagery; Mesosphere; Noctilucent Clouds; Spectrographs; Polar Regions; Broadband; Radiometers; Atmospheric Temperature*

**20070016581** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Studying the MLT by a Combined Analysis of SABER/TIMED and Lidar Measurements**

Feofilov, A. G.; Kutepov, A. A.; Pesnell, W. D.; Goldberg, R. A.; Zecha, M.; Gerding, M.; Luebken, F. J.; Fiedler, J.; vonZhan, U.; Russell, J. M., III; [2006]; 1 pp.; In English; 2006 AGU Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The SABER instrument on board the TIMED Satellite is a limb scanning infrared radiometer designed to measure temperature and minor constituent vertical profiles and energetics parameters in the mesosphere and lower thermosphere (MLT). The measurements have been performed continuously since January 25, 2002 to provide excellent coverage for both hemispheres. The Leibniz-Institute of Atmospheric Physics (LAP) at Kuehlungsborn, Germany (54N, 12E) operates two lidar instruments, using three different temperature measurement methods, optimized for three altitude ranges. The total altitude range of the lidar installation lies from 1 to 105 km. Another instrument used for intercomparison is the ALOMAR RMR lidar, located at Andoya, Norway (69N, 16E). We have searched the SABER and lidar datasets for coincidental common volume measurements within plus or minus 1 degree in latitude, plus or minus 2 degrees in longitude and approx. 1 hour in time for the sake of (a) comparison of measured temperatures; (b) validation of the models used in SABER data analysis; and (c) extracting new information about MLT parameters. In this work we applied the non-LTE ALL-ARMS code designed to calculate the nonequilibrium radiance in different viewing geometries to the analysis of measurements which satisfied these search criteria. The results of this analysis (a) support the application of higher value of CO<sub>2</sub>-O quenching rate (6e-12 cubic centimeters per second) by the non-LTE temperature retrievals from the SABER 15 micrometer limb radiance data, and (b) demonstrate the importance of accounting for the vibrational-vibrational energy exchange among the CO<sub>2</sub> isotopes for accurate temperature retrievals. Using temperature profiles obtained in lidar measurements as inputs for the retrieval algorithm we also retrieved the nighttime CO<sub>2</sub> densities from the SABER 15 micrometer limb radiances and compared them with the model and climatology CO<sub>2</sub> data used in the SABER nighttime temperature retrievals.

Author

*Mesosphere; Optical Radar; Thermosphere; Broadband; Ionospheres; Satellite Instruments; Atmospheric Physics; Infrared Radiometers*

**20070016595** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Influences of Local Sea-Surface Temperatures and Large-scale Dynamics on Monthly Precipitation Inferred from Two 10-year GCM-Simulations**

Sud, Y. C.; Walker, G. K.; Zhou, Y.; Lau, W. K.-M.; [2007]; 40 pp.; In English; Original contains black and white illustrations  
Contract(s)/Grant(s): WBS 509496.02.01.01.07; Copyright; Avail.: CASI: A03, Hardcopy

Two parallel sets of 10-year long: January 1, 1982 to December 31, 1991, simulations were made with the finite volume General Circulation Model (fvGCM) in which the model integrations were forced with prescribed sea-surface temperature fields (SSTs) available as two separate SST-datasets. One dataset contained naturally varying monthly SSTs for the chosen period, and the other had the 12-monthly mean SSTs for the same period. Plots of evaporation, precipitation, and atmosphere-column moisture convergence, binned by 1 C SST intervals show that except for the tropics, the precipitation is more strongly constrained by large-scale dynamics as opposed to local SST. Binning data by SST naturally provided an ensemble average of data contributed from disparate locations with same SST; such averages could be expected to mitigate all location related influences. However, the plots revealed: i) evaporation, vertical velocity, and precipitation are very robust and remarkably similar for each of the two simulations and even for the data from 1987-ENSO-year simulation; ii) while the evaporation increased monotonically with SST up to about 27 C, the precipitation did not; iii) precipitation correlated much better with the column vertical velocity as opposed to SST suggesting that the influence of dynamical circulation including non-local SSTs is stronger than local-SSTs. The precipitation fields were doubly binned with respect to SST and boundary-layer mass and/or moisture convergence. The analysis discerned the rate of change of precipitation with local SST as a sum of partial derivative of precipitation with local SST plus partial derivative of precipitation with boundary layer moisture convergence multiplied by the rate of change of boundary-layer moisture convergence with SST (see Eqn. 3 of Section 4.5). This analysis is mathematically rigorous as well as provides a quantitative measure of the influence of local SST on the local precipitation. The results were recast to examine the dependence of local rainfall on local SSTs; it was discernible only in the tropics. Our methodology can be used for computing relationship between any forcing function and its effect(s) on a chosen field.

Author

*Atmospheric General Circulation Models; Sea Surface Temperature; Simulation; Precipitation (Meteorology)*

**20070016598** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Observational Evidence of a Hemispheric-wide Ice-ocean Albedo Feedback Effect on Antarctic Sea-ice Decay**

Nihashi, Sohey; Cavalieri, Donald J.; Journal of Geophysical Research; 2006; Volume 111, pp. C12001; In English; Copyright; Avail.: Other Sources

ONLINE: <http://dx.doi.org/10.1029/2005JC003447>

The effect of ice-ocean albedo feedback (a kind of ice-albedo feedback) on sea-ice decay is demonstrated over the Antarctic sea-ice zone from an analysis of satellite-derived hemispheric sea ice concentration and European Centre for Medium-Range Weather Forecasts (ERA-40) atmospheric data for the period 1979-2001. Sea ice concentration in December (time of most active melt) correlates better with the meridional component of the wind-forced ice drift (MID) in November (beginning of the melt season) than the MID in December. This 1 month lagged correlation is observed in most of the Antarctic sea-ice covered ocean. Daily time series of ice concentration show that the ice concentration anomaly increases toward the time of maximum sea-ice melt. These findings can be explained by the following positive feedback effect: once ice concentration decreases (increases) at the beginning of the melt season, solar heating of the upper ocean through the increased (decreased) open water fraction is enhanced (reduced), leading to (suppressing) a further decrease in ice concentration by the oceanic heat. Results obtained from a simple ice-ocean coupled model also support our interpretation of the observational results. This positive feedback mechanism explains in part the large interannual variability of the sea-ice cover in summer.

Author

*Albedo; Antarctic Ocean; Sea Ice; Feedback; Geophysics; Hemispheres*

**20070016612** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Stratospheric Ozone Variations Caused by Solar Proton Events between 1963 and 2005**

Jackman, Charles H.; Fleming, Eric L.; [2006]; 11 pp.; In English; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016612>

Solar proton fluxes have been measured by satellites for over forty years (1963-2005). Several satellites, including the NASA Interplanetary Monitoring Platforms (1963-1993) and the NOAA Geostationary Operational Environmental Satellites (1994-2005), have been used to compile this long-term dataset. Some solar eruptions lead to solar proton events (SPEs) at the Earth, which typically last a few days. High energy solar protons associated with SPEs precipitate on the Earth's atmosphere

and cause increases in odd hydrogen (HO<sub>x</sub>) and odd nitrogen (NO<sub>y</sub>) in the polar cap regions (greater than 60 degrees geomagnetic). The enhanced HO<sub>x</sub> leads to short-lived ozone depletion (~days) due to the short lifetime of HO<sub>x</sub> constituents. The enhanced NO<sub>y</sub> leads to long-lived ozone changes because of the long lifetime of the NO<sub>y</sub> family in the stratosphere and lower mesosphere. Very large SPEs occurred in 1972, 1989, 2000, 2001, and 2003 and were predicted to cause maximum total ozone depletions of 1-3%, which lasted for several months to years past the events. These long-term ozone changes caused by SPEs are discussed.

Author

*Ozone Depletion; Solar Protons; Stratosphere; Annual Variations; Atmospheric Chemistry*

**20070016637** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Detection of Ice Polar Stratospheric Clouds from Assimilation of Atmospheric Infrared Sounder Data**

Stajner, Ivanka; Benson, Craig; Liu, Hui-Chun; Pawson, Steven; Chang, Ping; Riishojgaard, Lars Peter; [2006]; 1 pp.; In English; AGU Fall Meeting (Session A01: Atmospheric Sciences General Contributions), 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

A novel technique is presented for detection of ice polar stratospheric clouds (PSCs) that form at extremely low temperatures in the lower polar stratosphere during winter. Temperature is a major factor in determining abundance of PSCs, which in turn provide surfaces for heterogeneous chemical reactions leading to ozone loss and radiative cooling. The technique infers the presence of ice PSCs using radiances from the Atmospheric Infrared Sounder (AIRS) in the Goddard Earth Observing System version 5 (GEOS-5) data assimilation system. Brightness temperatures are computed from short-term GEOS-5 forecasts for several hundred AIRS channels, using a radiation transfer module. The differences between collocated AIRS observations and these computed values are the observed-minus-forecast (O-F) residuals in the assimilation system. Because the radiation model assumes clear-sky conditions, we hypothesize that these O-F residuals contain quantitative information about PSCs. This is confirmed using sparse data from the Polar Ozone and Aerosol Measurement (POAM) III occultation instrument. The analysis focuses on O-F residuals for the 6.79 $\mu$ m AIRS moisture channel. At coincident locations, when POAM III detects ice clouds, the AIRS O-F residuals for this channel are lower than -2K. When no ice PSCs are evident in POAM III data, the AIRS O-F residuals are larger. Given this relationship, the high spatial density of AIRS data is used to construct maps of regions where O-F residuals are lower than -2K, as a proxy for ice PSCs. The spatial scales and spatio-temporal variations of these PSCs in the Antarctic and Arctic are discussed on the basis of these maps.

Author

*Ice Clouds; Polar Meteorology; Stratosphere; Temporal Distribution; Chemical Reactions; Earth Observing System (EOS)*

**20070016641** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Hurricane Intensity Forecasts with a Global Mesoscale Model on the NASA Columbia Supercomputer**

Shen, Bo-Wen; Tao, Wei-Kuo; Atlas, Robert; [2006]; 1 pp.; In English; 2006 AGU Fall Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

It is known that General Circulation Models (GCMs) have insufficient resolution to accurately simulate hurricane near-eye structure and intensity. The increasing capabilities of high-end computers (e.g., the NASA Columbia Supercomputer) have changed this. In 2004, the finite-volume General Circulation Model at a 1/4 degree resolution, doubling the resolution used by most of operational NWP center at that time, was implemented and run to obtain promising landfall predictions for major hurricanes (e.g., Charley, Frances, Ivan, and Jeanne). In 2005, we have successfully implemented the 1/8 degree version, and demonstrated its performance on intensity forecasts with hurricane Katrina (2005). It is found that the 1/8 degree model is capable of simulating the radius of maximum wind and near-eye wind structure, and thereby promising intensity forecasts. In this study, we will further evaluate the model's performance on intensity forecasts of hurricanes Ivan, Jeanne, Karl in 2004. Suggestions for further model development will be made in the end.

Author

*Hurricanes; Forecasting; Atmospheric General Circulation Models; Mesoscale Phenomena; Finite Volume Method*

**20070016673** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Role of Aerosols in Cloud Growth, Suppression, and Precipitation: Yoram Kaufman and his Contributions**

King, Michael D.; Dec. 11, 2006; 1 pp.; In English; 2006 Fall AGU Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Aerosol particles are produced in the earth's atmosphere through both natural as well as manmade processes, and contribute profoundly to the (i) formation and characteristics of clouds, (ii) lifetime of clouds, (iii) optical and microphysical

properties of clouds, (iv) human health through effects on air quality and the size of particulates as well as vectors for transport of pathogens, (v) climate response and feedbacks, (vi) precipitation, and (vii) harmful algal blooms. Without aerosol particles in the Earth's atmosphere, there would be no fogs, no clouds, no mists, and probably no rain, as noted as far back as 1880 by Scottish physicist John Aitken. With the modern development of instrumentation, both groundbased, airborne, and satellite-based, much progress has been made in linking phenomena and processes together, and putting regional air quality characteristics and hypothesized cloud response into closer scrutiny and linkages. In his presentation I will summarize the wide ranging contributions that Yoram Kaufman has made in ground-based (AERONET), aircraft field campaigns (such as SCAR-B and TARFOX), and, especially, satellite remote sensing (Landsat, MODIS, POLDER) to shed new light on this broad ranging and interdisciplinary field of cloud-aerosol-precipitation interactions.

Author

*Aerosols; Earth Atmosphere; Particulates; Landsat Satellites; Air Quality*

**20070016674** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Spatial and Temporal Distribution of Tropospheric Clouds and Aerosols Observed by MODIS Onboard the Terra and Aqua Satellites**

King, Michael D.; Platnick, Steven; Menzel, W. Paul; Ackerman, Steven A.; Remer, Lorraine A.; December 11, 2006; 1 pp.; In English; 2006 Fall AGU Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

Remote sensing of cloud and aerosol optical properties is routinely obtained using the Moderate Resolution Imaging Spectroradiometer (MODIS) onboard the Terra and Aqua satellites. Instruments that are being used to enhance our ability to characterize the global distribution of cloud and aerosol properties include well-calibrated multispectral radiometers that measure in the visible, near-infrared, and thermal infrared. The availability of thermal channels to enhance detection of cloud when estimating aerosol properties is an important improvement. In this paper, we describe the radiative properties of clouds as currently determined from satellites (cloud fraction, optical thickness, cloud top pressure, and cloud particle effective radius) and highlight the global/regional cloud microphysical properties currently available for assessing climate variability and forcing. These include the latitudinal distribution of cloud optical and radiative properties of both liquid water and ice clouds, as well as joint histograms of cloud optical thickness and effective particle radius for selected geographical locations around the world. In addition, we will illustrate the radiative and microphysical properties of aerosol particles (in cloud free regions) that are currently available from space-based observations, and show the latitudinal distribution of aerosol optical properties over both land and ocean surfaces.

Author

*Aerosols; Remote Sensing; Optical Properties; Cloud Physics; Imaging Spectrometers; MODIS (Radiometry); Infrared Radiation; Ice Clouds; Calibrating*

## 48

### OCEANOGRAPHY

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

**20070016664** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Serving Fisheries and Ocean Metadata to Communities Around the World**

Meaux, Melanie F.; [2007]; 1 pp.; In English

Contract(s)/Grant(s): NAS5-00220; No Copyright; Avail.: Other Sources; Abstract Only

NASA's Global Change Master Directory (GCMD) assists the oceanographic community in the discovery, access, and sharing of scientific data by serving on-line fisheries and ocean metadata to users around the globe. As of January 2006, the directory holds more than 16,300 Earth Science data descriptions and over 1,300 services descriptions. Of these, nearly 4,000 unique ocean-related metadata records are available to the public, with many having direct links to the data. In 2005, the GCMD averaged over 5 million hits a month, with nearly a half million unique hosts for the year. Through the GCMD portal (<http://gcmd.nasa.gov/>), users can search vast and growing quantities of data and services using controlled keywords, free-text searches, or a combination of both. Users may now refine a search based on topic, location, instrument, platform, project, data center, spatial and temporal coverage, and data resolution for selected datasets. The directory also offers data holders a means to advertise and search their data through customized portals, which are subset views of the directory. The discovery metadata standard used is the Directory Interchange Format (DIF), adopted in 1988. This format has evolved to accommodate other

national and international standards such as FGDC and IS019115. Users can submit metadata through easy-to-use online and offline authoring tools. The directory, which also serves as the International Directory Network (IDN), has been providing its services and sharing its experience and knowledge of metadata at the international, national, regional, and local level for many years. Active partners include the Committee on Earth Observation Satellites (CEOS), federal agencies (such as NASA, NOAA, and USGS), international agencies (such as IOC/IODE, UN, and JAXA) and organizations (such as ESIP, IOOS/DMAC, GOSIC, GLOBEC, OBIS, and GoMODP).

Author

*Fisheries; Metadata; Oceanography; Earth Sciences*

## 51

### LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

**20070014941** Brookhaven National Lab., Upton, NY USA

#### **Microbial Transformation of Tru and Mixed Wastes: Actinide Speciation and Waste Volume Reduction**

Francis, A. J.; Dodge, C. J.; January 2006; 9 pp.; In English

Report No.(s): DE2006-895762; No Copyright; Avail.: National Technical Information Service (NTIS)

The overall goals of this research project are to determine the mechanism of microbial dissolution and stabilization of actinides in Department of Energy's (DOE) TRU wastes, contaminated sludges, soils, and sediments. This includes (1) investigations on the fundamental aspects of microbially catalyzed radionuclide and metal transformations (oxidation/reduction reactions, dissolution, precipitation, chelation); (2) understanding of the microbiological processes that control speciation and alter the chemical forms of complex inorganic/organic contaminant mixtures; and (3) development of new and improved microbially catalyzed processes resulting in immobilization of metals and radionuclides in the waste with concomitant waste volume reduction.

NTIS

*Actinide Series; Microorganisms; Wastes; Microbiology*

**20070015110** Mission Research Corp., Laguna Hills, CA USA

#### **Analytic Simulation of Tissue Damage from Penetrating Wounds to the Heart**

Eisler, Robert D; Chatterjee, Amiya K; Stone, Steven F; El-Raheb, M; Dec 2006; 299 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-C-0084

Report No.(s): AD-A463348; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463348>

ATK Mission Research was sponsored by DARPA's Virtual Soldier program to analytically simulate residual wound tracts and tissue dynamics associated with a survivable wound from an explosively driven fragment penetrating the left ventricular wall of the human heart. The resulting ATK Mission Research wound description was used in the DARPA/University of Michigan Virtual Soldier program as initial conditions for describing blood loss and occurrence of hemorrhagic shock. The DARPA/ATK Mission Research Statement of Work (SOW) is included as Appendix A.

DTIC

*Damage; Heart; Simulation*

**20070015113** Texas Univ., Houston, TX USA

#### **New Imaging Kit for Assessment of Estrogen Receptors with Single Photon Emission Computed Tomography**

Kim, E E; Yang, David J; Azhdarinia, Ali; Sep 2006; 91 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0624

Report No.(s): AD-A463447; No Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463447>

To evaluate the feasibility of using <sup>99m</sup>Tc-glutamate peptide-estradiol (GAP-EDL) in imaging estrogen receptor positive (ER +) diseases. Methods: 3-Aminoethyl estradiol (EDL) was conjugated glutamate peptide (GAP) to yield GAP-EDL. Cellular uptake studies of <sup>99m</sup>Tc-GAP-EDL were conducted in ER (+) cell lines (MCF7 13762 and T47D). To demonstrate



whether GAP-EDL increases MAP kinase activation Western blot analysis of GAP-EDL was performed in 13762 cells. Biodistribution was conducted in 13762 breast tumor-bearing rats at 0.5-4 hrs. Each rat was administered 99mTc-GAP-EDL (10 microCi/rat 10 microg/ml rat iv). Two animal models (Rats and rabbits) were created to ascertain whether cellular or tumor uptake by 99mTc-GAP-EDL was via an ER-mediated process In tumor model breast tumor-bearing rats were pretreated with diethylstilbestrol (DES n=3 10 mg/kg iv) 1 hr prior to receiving 99mTc-GAP-EDL (300 microCi/rat iv). In endometriosis model part of rabbit uterine tissue was dissected and grafted in the peritoneal wall. The rabbit was administered with 99mTc-GAP-EDL (1 mCi/rabbit iv). Results: There was 10-40% decreased uptake in cells treated with DES or tamoxifen compared to untreated 99mTc-GAP-EDL. Western blot analysis showed an ERK1/2 phosphorylation process with GAP-EDL. Biodistribution studies showed that tumor uptake and tumor-to-muscle count density ratio in 99mTc-GAP-EDL groups were significantly higher than in 99mTc-GAP groups at 4 hrs. In 99mTc-GAP-EDL ROI analysis of images showed that tumor-to-muscle ratios were decreased in blocking groups. In endometriosis model the grafted uterine tissue could be visualized by 99mTc-GAP-EDL. Conclusion: A new imaging kit for assessment of estrogen receptors with single photon emission computed tomography (SPECT) was developed. Cellular or tumor uptake of 99mTc-GAP-EDL was via an estrogen receptor-mediated process. 99mTc GAP-EDL is a useful ER (+) imaging agent.

DTIC

*Computer Aided Tomography; Estrogens; Imaging Techniques; Kits; Photons; Tomography*

**20070015118** Society for Medical Simulation, Santa Fe, NM USA

**International Meeting on Simulation in Healthcare 2007**

Gordon, James; Anderson, Beverlee; Mar 1, 2007; 102 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-07-1-0180

Report No.(s): AD-A463523; No Copyright; Avail.: CASI: A06, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463523>

1200 individuals attended the 2007 International Meeting on Simulation in Healthcare and had access to panels, keynotes and workshop sessions to further their knowledge of use of simulation in healthcare to improve patient safety and manage resources. 26 workshops provided both hands-on and interactive learning in the areas of conducting research, outcomes based assessment, case development, disaster training, needs assessment and competency based training. Panels and keynotes addressed education, research, simulations operations, interactive environments, credentialing & assessment, clinical areas, economics of simulation and standardized patients. 72 peer reviewed abstracts were presented and are published in the Society's Journal, Simulation in Healthcare.

DTIC

*Management Systems; Medical Services; Simulation*

**20070015142** California Univ., San Francisco, CA USA

**The Analysis of Cell Population Dynamics in Mammary Gland Development and Tumorigenesis**

Welm, Bryan; Aug 2006; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0498

Report No.(s): AD-A463667; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463667>

The mammary gland is made up of two distinct epithelial layers that are derived from a common progenitor. The experiments in this proposal investigate the processes of mammary epithelial cell differentiation during development and tumorigenesis. Using FACS, mammary epithelial cell (MEC) populations from tumors and wildtype tissue were investigated for their outgrowth potential or tumorigenic capacity. We also developed new mouse models and imaging techniques that can be used to identify viable long-surviving cell populations and characterize these cells in real-time in vivo. We are also interested in studying how genes expressed in different mammary epithelial cell populations affect differentiation and tumorigenesis. For these experiments we have developed techniques for viral transduction and transplantation of primary MECs.

DTIC

*Breast; Cancer; Cells (Biology); Genes; Mammary Glands; Populations*

**20070015143** Minnesota Univ., Minneapolis, MN USA

**Role of Rad23 and Dsk2 in Nucleotide Excision Repair and Spindle Pole Body Duplication**

Diaz-Martinez, Laura; Mar 2006; 17 pp.; In English

Contract(s)/Grant(s): W81XWH-05-1-0310

Report No.(s): AD-A463672; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463672>

The three yeast UBL-UBA proteins, Rad23, Ddi1 and Dsk2 bind both ubiquitin and the proteasome. They are not essential for viability and some redundancy in terms of stabilization of ubiquitinated substrates has been shown, suggesting that they may have overlapping functions. Here we showed that Rad23 is indeed redundant with both Ddi1 and Dsk2 for cell cycle related roles. Surprisingly, Ddi1 and Dsk2 do not show any redundancy but the triple deletion shows a synthetic defect, suggesting that Rad23 has at least two different roles in cell cycle progression during G2/M. In addition, we found that these putative roles do not include a role in SPB duplication, which contradicts a previously reported study (3). We do not know at the time the nature of this discrepancy. In addition, we show that a tetra-ubiquitin chain is able to bind several UBL-UBA proteins at once, which might explain the redundancies observed, as well as suggesting that these multiple interactions might be relevant for efficient but regulated delivery of ubiquitinated substrates to the proteasome.

DTIC

*Genetics; Nucleotides; Proteins; Reproduction (Copying); Spindles*

**20070015166** Health Research, Inc., Buffalo, NY USA

**New Strategy for Prostate Cancer Prevention Based on Selenium Suppression of Androgen Receptor Signaling**

Zhang, Haitao; Oct 2006; 33 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0598

Report No.(s): AD-A463812; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463812>

Androgen plays an important role in prostate carcinogenesis. Testosterone is the major androgen in circulation; it is converted to the more potent dihydrotestosterone in the prostate by the enzyme 5 $\alpha$ -reductase. The Prostate Cancer Prevention Trial (PCPT) demonstrated that treatment with finasteride, an inhibitor of 5 $\alpha$ -reductase, reduced prostate cancer incidence by 25%. Selenium, on the other hand, is shown to reduce prostate cancer risk by 50% by the Nutrition Prevention of Cancer (NPC) trial. In vitro studies have shown that selenium suppresses androgen signaling by downregulating expression of the androgen receptor (AR). This project consists of two specific aims: 1). To evaluate the combined use of selenium and a 5 $\alpha$ -reductase inhibitor in preventing prostate cancer; 2). To investigate the role of FOXO1A in mediating the anticancer effect of selenium. For Aim 1, we originally proposed to use dutasteride, a proprietary drug of GlaxoSmithKlein (GSK), as the 5 $\alpha$ -reductase inhibitor. We submitted a research proposal to GSK to request the compound (not funding) after the grant was recommended for funding. However, after much delay, no agreement was reached between Roswell Park and GSK because the company insisted on full ownership of all intellectual properties and research products, even though the study was designed solely by investigators at Roswell Park with no input from GSK. Our Technology Transfer Office felt that we could not possibly accede to this demand. Finasteride, despite being an older drug, has several advantages over dutasteride. First, its efficacy has been proven by a phase III trial, whereas dutasteride is being tested and the result will not be available for a few years. Second, there are minimal side effects with long-term finasteride treatment. No such information is available with dutasteride. Third, finasteride is available commercially from Steraloids (Newport, RI).

DTIC

*Cancer; Hormones; Males; Prevention; Prostate Gland; Selenium*

**20070015174** George Mason Univ., Fairfax, VA USA

**Novel Therapeutic and Prophylactic Modalities to Protect the USA Armed Forces Against Major Biological Threat Agents**

Popov, Serguei G; Bradburne, Chris; Chung, Myung-Chul; Millis, Bryan; Nazarenko, Svetlana; Popova, Taissia G; Oct 2006; 78 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-C-0122

Report No.(s): AD-A463824; No Copyright; Avail.: CASI: A05, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463824>

Secreted virulence factors in addition to lethal toxin (LT) play an important role in anthrax and have previously been identified by us as candidate targets of post-exposure therapies. However the molecular substrates and specific pathogenic mechanisms of these factors remain largely unknown. During the year 2005 the data generated using epithelial cells in culture

and mice challenged with *B. anthracis* spores allow conclude that acceleration of ectodomain shedding by LT other proteolytic proteins and hemolysis represents a new previously unknown feature of anthrax infection. Secreted pathogenic factors of *B. anthracis* can cause ectodomain shedding likely resulting in protective barriers disruption and tissue penetration by bacilli. In addition proteolysis of the extracellular matrix can play signaling role as a mediator of lethality perturbing different mechanisms of the host defense response including the activation of TLRs. Data on pharmacological inhibition of shedding favor a hypothesis that activities of tested bacterial shedding inducers converge on the stimulation of cytoplasmic tyrosine kinases of the Syk family ultimately leading to activation of cellular sheddase. Both LT and poreforming hemolysin 0 transiently modulate ERK1/2 and p38 MAPK signaling pathways while JNK pathway seems to be irrelevant to accelerate shedding. The concerted acceleration of shedding by several virulence factors could represent a pathogenic mechanism contributing to hemorrhage edema and abdominal cell signaling during anthrax infection.

DTIC

*Armed Forces; Bacillus; Therapy; United States; Warfare*

**20070015175** Texas Univ. Health Science Center, San Antonio, TX USA

**Nuclear Dynamics of BRCA1-Dependent Transcription Regulation**

Sharp, Zelton D; Aug 2006; 25 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0700

Report No.(s): AD-A463827; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463827>

BRCA1 coordinates cellular responses to DNA damage. It functions as a co-repressor of GADD45a and estrogen-responsive transcription through interactions with a DNA-binding protein termed ZBRK1. Our goal is to develop a biosensor system to visualize transcription control by ZBRK1 and BRCA1 in single living and/or fixed cells. The rationale is to use integrated DNA binding sites to obtain real time, multiplex-based data. The reportable outcomes for the period are: 1) UAS and ZRE array-bearing plasmids have been constructed; 2) Transient and stable reporter expression have been demonstrated; 3) Stable cell lines with G20, G40 and Z32 are on line for studies; 4) Construction of fluorescent GAL4-DBD and ZBRK1 fusion protein has been achieved, and BRCA1 derivatives are in progress; 5) Development of a high throughput screening system for estrogen receptor activated transcription complex. When operational, these systems will document real time nuclear dynamics of ZBRK1/BRCA1-dependent chromatin modification systems, as cells mount transcriptional responses to genotoxins and identify BRCA1-associated proteins that mediate its actions.

DTIC

*Genes; Proteins*

**20070015176** Hamilton Health Sciences Corp., Ontario, Canada

**Role of Mitochondria in Prostate Cancer**

Chowdhury, Subir K; Dec 2006; 50 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0090

Report No.(s): AD-A463829; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463829>

Most malignant cells are highly glycolytic and produce high levels of reactive oxygen species (ROS) compared to normal cells. Mitochondrial glycerophosphate dehydrogenase (mGPDH) participates in delivering reducing equivalents from this molecule into the electron transport chain thus sustaining glycolysis. Here we investigate the role of mGPDH in maintaining an increased rate of glycolysis and evaluate glycerophosphate-dependent ROS generation in prostate cancer cell lines (LNCaP DU145 RC3 and CL1). Immunoblot Real Time RT-PCR polarographic and spectrophotometric analysis revealed that mGPDH abundance and activity was significantly elevated in prostate cancer cell lines when compared to normal prostate epithelial cell line PNT1A. Overall these data demonstrate that mGPDH is involved in maintaining a high rate of glycolysis and is an important site of electron leakage leading to ROS production in prostate cancer cells.

DTIC

*Cancer; Mitochondria; Prostate Gland*

**20070015179** Michigan Univ., Ann Arbor, MI USA

**The Mustard Consortium's Elucidation of the Pathophysiology of Sulfur Mustard and Antidote Development**

Ward, Peter A; Smith, Milton G; Crawford, Keith; Stone, William; Das, Salil; Sciuto, Alfred; Anderson, Dana; Sep 2006; 36 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-2-0054

Report No.(s): AD-A463834; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463834>

The Mustards Consortium has utilized both in vivo and in vitro models simultaneously to continue to elucidate mustard gas pathophysiology. In previous work done by the MC it was found that CEES, the mustard analogue, induced oxidative stress and was its primary mechanism of action. Consequently, NAC (N-acetyl cystiene) was found to be protective as a prophylaxis and treatment. A combination of a water and fat soluble antioxidant encapsulated in a liposome (STIMAL) was found to have the best ameliorative effect against CEES. We have initiated development of next generation STIMAL, in order to optimize its ameliorative effect. The mechanism of action of the antioxidants is suspected to be primarily by their effect on redox regulated pathways. In an effort to elucidate the mechanism of action of the antioxidants and the pathophysiology of mustards, profiles are being developed for: gene expression and antioxidant levels, as well as biochemical pathways. The first known histological comparison between CEES and sulfur mustard was carried out. Two new rat lung models were developed for the administration of sulfur mustards in preparation for efficacy testing of STIMAL against sulfur mustards. Pulmonary fibrosis was demonstrated in both guinea pig and rat lung models.

DTIC

*Antidotes; Organizations; Sulfur*

**20070015180** Boston Medical Center Corp., Boston, MA USA

**Novel Targets for the Diagnosis and Treatment of Breast Cancer Identified by Genomic Analysis**

Westbrook, Carol A; Dec 2006; 22 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0416

Report No.(s): AD-A463839; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463839>

Chromosomal rearrangements which result in localized increases of genetic material are frequent in breast cancer and occur consistently in certain genomic regions. The resulting increase in expression of genes contained within these amplifications contributes to the malignant phenotype. Such amplified genes such as Her2-Neu provide targets for diagnosis and for the development of inhibitory drugs. The purpose of this study is to use novel genomic technologies to find new genes in breast cancer that are both highly amplified and are suitable targets by virtue of the fact that they are membrane-associated (receptors membrane antigens secretory proteins). The aims of the study are (1) To specify intervals of genomic amplification (amplicons) in primary breast cancer cell lines using genomic microarrays; (2) To prepare a database of membrane-associated genes selected by differential hybridization of RNA prepared from fractionated microsomes; (3) To use the database to select membrane-associated genes that are located within amplicons and measure their expression in the primary cell line using cDNA arrays in order to select those that are upregulated. These genes will provide new insights and reagents for diagnosis and treatment of breast cancer.

DTIC

*Breast; Cancer; Diagnosis; Genetics; Genome; Mammary Glands; Targets*

**20070015182** Tufts Univ., Boston, MA USA

**Promotion of Epithelial to Mesenchymal Transition by Hyaluronan**

Krause, Silva; Jul 2006; 13 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0467

Report No.(s): AD-A463843; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463843>

The mammary gland is comprised of stromal and epithelial cells that communicate with each other through the extracellular matrix (ECM). Disruption of communication between the epithelium and stroma can both induce and promote breast cancer. Crosstalk between the mammary epithelium and stroma is also crucial for the proper patterning and function of the normal mammary gland. It has been proposed that HA may induce malignant transformation in normal cells through interaction with its receptors. We therefore wanted to elucidate its function during normal mammary gland development. The expression of HA in the stroma increased at week 5 and peaked at week 7, the time of puberty coinciding with ductal growth. We observed a decrease with age when the mammary gland achieves mature virginal development (week 9 and ii). The peak

of HA expression during the time of puberty led us to hypothesize that HA expression may be estrogen-mediated. Preliminary data suggest a role of estrogen as a mediator for HA expression but the analysis is still ongoing.

DTIC

*Breast; Cancer; Mammary Glands*

**20070015185** Rochester Univ., NY USA

**Cytokine Disruption to Prevent Radiation Related Breast Damage**

Okunieff, Paul; Sep 2006; 47 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0732

Report No.(s): AD-A463851; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463851>

Introduction: The complications of radiation dermatitis and fibrosis on breast cancer therapy are well established. To date the only proven approaches to reducing radiation toxicity are to decrease the treatment dose or field-size. Altering these has the potential of reducing treatment efficacy and is therefore not advised. We proposed that drugs aimed at the suppression of cytokines involved in the initiation and perpetuation of radiation-induced inflammation would be beneficial in preventing normal tissue toxicity after radiation therapy. Of particular interest were inhibitors of tumor necrosis factor-alpha plus or minus (TNFalpha plus or minus) interleukin 1 (IL-1) and transforming growth factor-beta (TGFbeta) Body: We examined a number of agents to suppress generally and specifically cytokines be believed affect the severity and progression of radiation fibrosis in women after breast irradiation. Importantly IL-1 related interventions consistently reduced cutaneous fibrosis after irradiation. We tested thin in mice deficient in the IL-1 receptor 1 in mice treated with IL-1 Ra the natural soluble IL-1 receptor blocker and in mice treated with non-specific drugs that reduce IL-1 expression including COX2 inhibitors. All interventions greatly reduced the rate of fibrosis development and the severity of the fibrosis. A manuscript describing the most important experiments has recently been accepted for publication in the Radiation Research Journal and is attached in appendix I. Key Research Accomplishments: We have identified 4 agents that should reduce radiation fibrosis in women treated for breast cancer. One curcumin is in development for national clinical testing. Others including IL-1 Ra are being evaluated as radiation protectors in case of bioterror.

DTIC

*Breast; Cancer; Damage; Dermatitis; Mammary Glands*

**20070015187** Michigan Univ., Ann Arbor, MI USA

**The Influence of Physical Forces on Progenitor Cell Migration, Proliferation and Differentiation in Fracture Repair**

Goldstein, Steven A; Hankerson, Kurt; Kilbourn, Michael; Nov 2006; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0107

Report No.(s): AD-A463855; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463855>

The goal of this program is to investigate the influence of controlled mechanical stimulation on the behavior of progenitor cells in an effort to develop strategies to significantly enhance the rate and quality of fracture repair in long bones. In support of these goals we will test the global hypothesis that the migration proliferation and differentiation of systemically or locally delivered Mesenchymal Stem Cells is temporarily dependent on local mechanical conditions within the regenerate tissues.

DTIC

*Bones; Cells (Biology); Fractures (Materials); Fracturing; Migration; Regeneration (Physiology); Stem Cells*

**20070015189** Texas Univ., Dallas, TX USA

**PSMA-Targeted Nano-Conjugates as Dual-Modality (MRI/PET) Imaging Probes for the Noninvasive Detection of Prostate Cancer**

Sun, Xiankai; Oct 2006; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0592

Report No.(s): AD-A463857; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463857>

The goal of this project is to develop dual modality imaging probes for the detection of prostate cancer by doping radioisotopes to iron oxide nanoparticle, so that the sensitivity and specificity of prostate cancer diagnosis could be significantly improved. In the first year, we successfully developed standard procedures to reproducibly prepare dextran-coated iron oxide nanoparticles with desired particle size (DLS:7.5 - 35 nm) and size distribution (+1-5 nm) among the

reaction condition variables, we found that the iron concentration plays the most important role in the nanoparticle formation. The high stability of the prepared particles was exhibited by a series of DLS measurements showing negligible aggregation or disintegration out to 10 days in water. By slightly modifying the synthetic conditions, we have doped three radioisotopes into the iron oxide core of the dextran-coated nanoparticles at high incorporation rates (95%). The radioisotope-doped nano-platforms will be used for the development of MRI/PET and MRI/SPECT dual modality imaging probes in the following two years.

DTIC

*Cancer; Conjugates; Imaging Techniques; Iron Oxides; Prostate Gland; Radioactive Isotopes*

**20070015200** TRUE Research Foundation, San Antonio, TX USA

**Modulation of T Cell Tolerance in a Murine Model for Immunotherapy of Prostatic Adenocarcinoma**

Hurwitz, Arthur A; Sep 2006; 28 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-01-1-0085

Report No.(s): AD-A463887; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463887>

The goal of this project is to characterize T cell tolerance to prostate tumor antigens and to identify the role of costimulatory receptors in overcoming this tolerance. Identification of these processes will assist in the development of novel therapeutic approaches for treating prostate cancer. We use the TRAMP model a transgenic mouse line that develops primary prostatic tumors due to expression of the SV40 T antigen (TAg) under the transcriptional control of a prostate-specific promoter. In this final summary we report that subsequent to adoptive transfer of naive TAg-specific T cells into TRAMP mice there is rapid expansion and contraction of the tumor-specific T cells followed by accumulation of a population of T cells that persist in the prostate as tolerant and suppressive. Co-transfer of TAg-specific CD4+ T cells partially rescues the tolerant suppressive phenotype of prostate-tumor-specific T cells although over time tolerance of the CD8+ T cells ensues. In contrast transfer of CD4+ T cells does not reverse tolerance of the previously-tolerized CD8+ cells. The suppressive nature of these CD8+ T cells was also studied and we present preliminary data on the characterization of these novel suppressor cells. These data demonstrate the critical balance between T cell activation and tolerance and support a mechanism by which tumor growth may induce tolerance and suppressor activity in T cells previously primed to tumor-specific antigens. A greater understanding of how tolerance of these tumor specific T cells can be reversed will certainly lead to more potent anti-tumor immunotherapies.

DTIC

*Antigens; Cancer; Modulation; Prostate Gland; Rodents*

**20070015207** Vanderbilt Univ., Nashville, TN USA

**Therapy Selection by Gene Profiling**

Hayward, Simon W; Apr 2006; 12 pp.; In English

Contract(s)/Grant(s): DAMD17-03-1-0047

Report No.(s): AD-A463894; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463894>

The long term goal of this work is to develop a new prognostic tool with which to determine the response of a patient to a given therapy, with the view of providing the most appropriate treatments tailored to individual patients. The central hypothesis of this proposal is that a subset of the genes expressed in a prostate tumor can be used to predict response to specific therapeutic regimens. The purpose of this work is to generate predictive methods which will allow patients to be selected for specific treatment protocols. In this year, per our proposed schedule, we have continued to focus on acquisition of tissue samples and their grafting and treatment in SCID mouse hosts. Collection and treatment of tissues is now completed. All samples have been assessed for response to Taxotere. Preparation of RNA is complete and microarrays have been run. 12 microarrays are being repeated to confirm results. A preliminary biostatistical analysis has been performed and a full analysis is underway.

DTIC

*Cancer; Genes; Prostate Gland; Therapy*

**20070015209** International Agency for Research on Cancer, Lyon, France  
**Breast Cancer Risk in Relation to Urinary Estrogen Metabolites and Their Genetic Determinants: A Study Within the Dutch 'DOM' Cohort**

Kaaks, Rudolf J; Sep 2006; 12 pp.; In English

Contract(s)/Grant(s): DAMD17-02-1-0422

Report No.(s): AD-A463897; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463897>

Purpose and scope: we are conducting a large case-control study nested within the Dutch DOM prospective cohort to estimate relative risk of breast cancer in post-menopausal women by levels of urinary estrogens and estrogen metabolites. Progress report: in this year of extension of the project we finalized the setting up of our sensitive NCI GC/MS method for the measurement of estrogen metabolites in urine samples. By using this method we performed these measurements on 145 breast cancer cases and 145 matched controls. Conclusions: On the first set of data concentrations of 2-hydroxy estrone 2-methoxy estrone and the ratio between 2-hydroxy estrone and 16-alpha hydroxy estrone were significantly associated with breast cancer risk in post-menopausal women. We plan to complete the analyses on the samples from the whole nested case-control study by April 2007 (i.e. beyond the extension limits of this grant and using internal IARC funds). A manuscript will then be prepared reporting the relationships of the urinary hormone levels with breast cancer risk.

DTIC

*Breast; Cancer; Epidemiology; Estrogens; Genetics; Mammary Glands; Metabolites; Risk; Urology*

**20070015210** Cincinnati Univ., OH USA

**BAF57 Modulation of Androgen Receptor Action and Prostate Cancer Progression**

Link, Kevin A; Dec 2006; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0098

Report No.(s): AD-A463899; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463899>

Given the requirement of the AR activation pathway for prostate cancer growth and progression, it is necessary to identify alternative means of targeting this pathway for the treatment of prostate cancer. The work herein has examined the role of BAF57 in its ability to activate the androgen receptor (AR). The research carried out under this proposal has fine mapped the AR binding site on BAF57 to the N-terminus (proline-rich region). Furthermore, the DBD and hinge region of AR also appear to play a significant role in the ability of BAF57 to activate AR. Together, this data presents the idea of targeting the interaction between AR and BAF57 at the N-terminus for the possibility of using this as a therapeutic for prostate cancer. Additional studies will determine the actual function of BAF57 as well as the efficacy of targeting this interaction.

DTIC

*Cancer; Hormones; Males; Modulation; Prostate Gland; Proteins*

**20070015211** Dana Farber Cancer Inst., Boston, MA USA

**Chemical Genetics of 14-3-3 Regulation and Role in Tumor Development**

Toby, Garabet G; Silver, Pamela; Nov 2006; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0057

Report No.(s): AD-A463902; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463902>

The 14-3-3 proteins are a family of adaptor proteins that bind to more than 200 protein partners and affect their biological function by altering their stability, catalytic activity and subcellular localization. While the structure or 14-3-3 is well studied and the biology of the 14-3-3 interaction with their partners is understood, the regulation of these proteins remains debatable. Specifically, the mode of export of 14-3-3 proteins from the nucleus is not clear. A number of studies suggest a role for the CRM1 nuclear export receptor while other reports provide different findings. Here we describe a number of small molecules that affect the export of 14-3-3 sigma. One molecule, TK10, was previously shown to affect the transport of the transcription factor FKHR in a ORMI-independent manner. A second molecule, Haloprogin, an approved anti-fungal drug of unknown mechanism, was identified in a high-throughput screen of small molecules inhibitors of 14-3-3 export. Using the Rev-GFP reporter for nuclear export, we find that Haloprogin does not interfere with the CRM1 pathway. Haloprogin activity on different 14-3-3 isoforms is also studied. Therefore we determine that 14-3-3 sigma export from the nucleus is ORMI-independent. The results also suggest a mode of action for the drug Haloprogin.

DTIC

*Cancer; Genetics; Molecules; Prostate Gland; Proteins; Tumors*

**20070015216** Kimmel (Sidney) Cancer Center, San Diego, CA USA

**Identification of Novel Retinoid Targets in Prostate Cancer**

Piedrafita, F J; Nov 2006; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0073

Report No.(s): AD-A463912; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463912>

Retinoids have shown promise for the chemoprevention and treatment of prostate cancer. However except for the efficient treatment of acute promyelocytic leukemia and certain skin disorders most natural and synthetic retinoids have failed in clinical trials because of toxicity and limited activity. Retinoids exert their biological activity mainly upon binding and activation of the nuclear retinoid receptors (RARs and RXRs). Novel synthetic retinoid-related molecules (RRMs) that show selective activity towards RAR $\alpha$  (MX3350-1 CD2325) or function as RAR antagonists (MX781) have been discovered that elicit strong anticancer activity and represent promising leads for the chemoprevention and treatment of prostate cancer. These RRM induce apoptosis independently of RARs; instead they bind to other cellular proteins to elicit profound effects on the cell signaling events that lead to inhibition of cell growth and induction of programmed cell death. The cellular targets that mediate RRM-anticancer activity are unknown and the molecular mechanism of RRM action is currently under extensive investigation. Our goals were to identify genes that mediate RRM anticancer activity upon selection of Genetic Suppressor Elements (OSE) that confer resistance to RRM treatment in prostate cancer cells. OSE expression is expected to inhibit RRM-induced apoptosis by blocking the function of key genes that are critical for the anticancer activity of RRMs. After standardizing the experimental conditions to achieve optimal retrovirus production and infection of RC3 cells we have performed several screenings in the presence of toxic amounts of MX781 and MX3350-i. OSEs have been subsequently rescued from surviving cells by POR amplification using primers specific for the OSE library followed by identification by DNA sequencing. Several genes many of them with biological functions unrelated to apoptosis have been identified as potential candidates of interest for functional validation

DTIC

*Cancer; Prostate Gland; Targets*

**20070015217** Texas Univ., Houston, TX USA

**The Clinical Development of Thalidomide as an Angiogenesis Inhibitor Therapy for Prostate Cancer**

Logothetis, Christopher J; Oct 2006; 18 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-01-1-0069

Report No.(s): AD-A463915; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463915>

Significant progress has been made in the understanding of key factors that regulate the cell-cell interaction in the context of the microenvironment of prostate cancer. This includes technical advances in getting information from small amounts of tissue to forward understanding of the molecular determinants of progression. We have developed tissue micro arrays (TMAs), and stained them for candidate factors implicated in stromal epithelial interaction and have demonstrated that they are expressed in the context of Thalidomide treated patients. This information will be used to compare these results to the expression patterns in similar prostate cancers not exposed to Thalidomide. We are requesting a no-cost extension of 6 months to allow completion of the planned studies. A formal letter will be sent separately.

DTIC

*Angiogenesis; Cancer; Inhibitors; Prostate Gland; Therapy*

**20070015218** Alabama Univ., Birmingham, AL USA

**A Dual-Action Armed Replicating Adenovirus for the Treatment of Osteoblastic Bone Metastases of Prostate Cancer**

Douglas, Joanne T; Mar 1, 2006; 58 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0800

Report No.(s): AD-A463916; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463916>

In this Exploration - Hypothesis Development Award we hypothesize that the efficacy of a replicating adenovirus for the treatment of bone metastases of prostate cancer could be enhanced by arming it with the therapeutic protein sOPG-Fc which will block osteoclastic bone resorption and hence inhibit bone remodeling. Thus the objective of this proposal is to generate a dual-action armed replicating adenovirus which will both directly kill metastatic prostate cancer cells by oncolysis and will also secrete sOPG-Fc into the microenvironment of the bone thereby inhibiting osteoclastic bone resorption. To date we have constructed armed replication-selective adenoviruses expressing sOPG-Fc. We have confirmed that the sOPG-Fc gene is



expressed in a similar temporal manner to the E3B genes which it replaced and that the remaining E3 genes continue to be expressed. We have also confirmed that expression of sOPG-Fc does not impair the selectivity or oncolytic potency of the armed replication-selective adenovirus.

DTIC

*Adenoviruses; Bone Demineralization; Bones; Cancer; Metastasis; Prostate Gland*

**20070015219** Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA

**Smallpox DNA Vaccine Delivered by Novel Skin Electroporation Device Protects Mice Against Intranasal Poxvirus Challenge**

Hooper, Jay W; Golden, Joseph W; Ferro, Anthony M; King, Alan D; Nov 27, 2006; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463918; RPP-05-455; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463918>

Previously, we demonstrated that an experimental smallpox DNA vaccine comprised of four vaccinia virus genes (4pox) administered by gene gun elicited protective immunity in mice challenged with vaccinia virus, and in nonhuman primates challenged with monkeypox virus (Hooper JW, et al. Smallpox DNA vaccine protects nonhuman primates against lethal monkeypox. *J Virol* 2004;78:4433-43). Here, we report that this 4pox DNA vaccine can be efficiently delivered by a novel method involving skin electroporation using plasmid DNA-coated microneedle arrays. Mice vaccinated with the 4pox DNA vaccine mounted robust antibody responses against the four immunogens-of-interest, including neutralizing antibody titers that were greater than those elicited by the traditional live virus vaccine administered by scarification. Moreover, vaccinated mice were completely protected against a lethal (vg10LD(50)) intranasal challenge with vaccinia virus strain IHD-J. To our knowledge, this is the first demonstration of a protective immune response being elicited by microneedle-mediated skin electroporation.

DTIC

*Deoxyribonucleic Acid; Mice; Monkeys; Smallpox; Vaccines; Viruses*

**20070015223** Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA

**The Influences of Glycosylation on the Antigenicity, Immunogenicity, and Protective Efficacy of Ebola Virus GP DNA Vaccines**

Dowling, William; Thompson, Elizabeth; Badger, Catherine; Mellquist, Jenny L; Garrison, Aura R; Smith, Jeffrey M; Paragas, Jason; Hogan, Robert J; Schmaljohn, Connie; Nov 22, 2006; 19 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463922; TR-06-128; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463922>

The Ebola virus (EBOV) envelope glycoprotein (GP) is the primary target of protective immunity. Mature GP consists of two disulfide-linked subunits, GP1 and membrane-bound GP2. GP is highly glycosylated with both N- and O-linked carbohydrates. We measured the influences of GP glycosylation on antigenicity, immunogenicity, and protection by testing DNA vaccines comprised of GP genes with deleted N-linked glycosylation sites or with deletions in the central hypervariable mucin region. We showed that mutation of one of the two N-linked GP2 glycosylation sites was highly detrimental to the antigenicity and immunogenicity of GP. Our data indicate that this is likely due to the inability of GP2 and GP1 to dimerize at the cell surface and suggest that glycosylation at this site is required for achieving the conformational integrity of GP2 and GP1. In contrast, mutation of two N-linked sites on GP1, which flank previously defined protective antibody epitopes on GP, may enhance immunogenicity, possibly by unmasking epitopes. We further showed that although deleting the mucin region apparently had no effect on antigenicity in vitro, it negatively impacted the elicitation of protective immunity in mice. In addition, we confirmed the presence of previously identified B-cell and T-cell epitopes in GP but show that when analyzed individually none of them were neither absolutely required nor sufficient for protective immunity to EBOV. Finally, we identified other potential regions of GP that may contain relevant antibody or T-cell epitopes.

DTIC

*Antigens; Deoxyribonucleic Acid; Glucosides; Lymphocytes; Proteins; Vaccines; Viruses*

**20070015226** Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA

**Purification and Protective Efficacy of Monomeric and Modified Yersinia pestis Capsular F1-V Antigen Fusion Proteins for Vaccination Against Plague**

Goodin, Jeremy L; Nellis, David F; Powell, Bradford S; Vyas, Vinay V; Enama, Jeffrey T; Wang, Lena C; Clark, Patrick K; Giardina, Steven L; Adamovicz, Jeffrey J; Michiel, Dennis F; Dec 31, 2006; 19 pp.; In English  
Report No.(s): AD-A463927; TR-06-113; No Copyright; Avail.: CASI: A03, Hardcopy  
ONLINE: <http://hdl.handle.net/100.2/ADA463927>

The F1-V vaccine antigen, protective against Yersinia pestis, exhibits a strong tendency to multimerize that affects larger-scale manufacture and characterization. In this work, the sole F1-V cysteine was replaced with serine by site-directed mutagenesis to enable characterization of F1-V non-covalent multimer interactions and protective potency without participation by covalent disulfide-linkages. F1-V and F1-VC424S proteins were over-expressed in Escherichia coli, recovered using mechanical lysis/pH-modulation and purified from urea-solubilized soft inclusion bodies, by using successive ion-exchange, ceramic hydroxyapatite, and size-exclusion chromatography. This purification method resulted in up to 2 mg per gram of cell paste of 95% pure, mono-disperse protein having  $\leq 0.5$  endotoxin units per mg by LAL. Both F1-V and F1-VC424S were monomeric at pH 10.0 and progressively self-associated as pH conditions decreased to pH 6.0. Solution additives were screened for their ability to inhibit F1-V self-association at pH 6.5. An L-arginine buffer provided the greatest stabilizing effect. Conversion to  $\approx 500$ -kDa multimers occurred between pH 6.0 and 5.0, with partial precipitation occurring below pH 5.0. Conditions for efficient F1-V adsorption to the cGMP-compatible Alhydrogel adjuvant were optimized. Side-by-side evaluation for protective potency against subcutaneous plague infection in mice was conducted for F1-VC424S monomer; cysteine-capped F1-V monomer; cysteine-capped F1-V multimer; and a F1-V standard reported previously. After a two-dose vaccination with 2 x 20 g of F1-V, respectively, 100, 80, 80, and 70% of injected mice survived a subcutaneous lethal plague challenge with 108 LD<sub>50</sub> Y. pestis CO92. Thus, vaccination with F1-V monomer and multimeric forms resulted in significant, and essentially equivalent, protection.

DTIC

*Antigens; Proteins; Purification*

**20070015228** Thomas Jefferson Univ., Philadelphia, PA USA

**EGFR-Dependent Regulation of Matrix-Independent Epithelial Cell Survival**

Rodeck, Ulrich; Apr 2006; 32 pp.; In English; Original contains color illustrations  
Contract(s)/Grant(s): DAMD17-02-1-0216  
Report No.(s): AD-A463929; No Copyright; Avail.: Defense Technical Information Center (DTIC)  
ONLINE: <http://hdl.handle.net/100.2/ADA463929>

Background: Signaling through the epidermal growth factor (EGFR) has been implicated in both effective wound healing and epithelial neoplasia. We have identified a novel function of the EGFR in support of epithelial cell survival, particularly in conditions of anchorage-independence. Objective/Hypothesis: Define molecular mechanisms and pathways by which EGFR activation supports epithelial cell survival. Two specific aims focus on (1) posttranslational modification of relevant Bcl-2 family members by EGFR activation through MAPK-dependent mechanisms and, (2) STAT3 activation by deregulated EGFR signaling as observed in epithelial cancer. Progress: Significant progress relating to Specific Aim I has included: Publication of results in support of BIM regulation by the EGFR in normal and transformed keratinocytes (Appendices included); Characterization of a role of NF- $\kappa$ B activation in keratinocyte survival in the absence of extracellular matrix interaction; and Pro-apoptotic signals by JNK and p38 activation in the anchorage-independent state are counteracted by NF- $\kappa$ B activity. We have completed the work proposed in Specific Aim 2.

DTIC

*Epithelium; Injuries; Survival*

**20070015229** Pittsburgh Univ., Pittsburgh, PA USA

**Fourth Annual Safar Symposium**

Kochanek, Patrick M; Apr 2007; 11 pp.; In English; Original contains color illustrations  
Contract(s)/Grant(s): W81XWH-06-1-0552  
Report No.(s): AD-A463930; No Copyright; Avail.: CASI: A03, Hardcopy  
ONLINE: <http://hdl.handle.net/100.2/ADA463930>

This grant funded expenses related to the fourth Safar Symposium held at the University of Pittsburgh School of Medicine on June 28, 2006. This symposium is held each year in honor of the late Dr. Peter Safar, pioneer of CPR, resuscitation, critical care, and disaster medicine. The symposium focused on two aspects of medical research of importance to the field of

resuscitation medicine in its broadest scope, namely, a morning session entitled 'Advances in Resuscitation Medicine Mitochondria in Resuscitation' and an afternoon session on 'Advances in Human Simulation Education.' The symposium featured 10 speakers and was well received by approximately 200 attendees, including physicians, scientists, medical residents, fellows, and students, nurses, paramedics, and other allied professionals in the field of resuscitation medicine. The symposium had considerable military relevance specifically in the area of combat casualty resuscitation, head injury, blast injury, shock simulation, and education among other topics.

DTIC

*Conferences; Medical Science; Resuscitation*

**20070015230** Garvan Inst. of Medical Research, Darlinghurst, Australia

**Regulation of Progesterone Receptors in Normal and Breast Cancer Cells through Differential Expression of microRNAs**

McGowan, Eileen; Sep 2006; 9 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0472

Report No.(s): AD-A463931; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463931>

MicroRNAs are small non-coding RNAs that have an important function in post-translational gene regulation and have been shown to modulate the expression of developmentally important transcription factors. Dysregulation of specific microRNAs has been associated with several cancer types. The study of microRNAs and their potential role in breast cancer is an under-explored area of breast cancer research. This project was designed to explore the possible link between microRNAs and hormone receptors in a breast cancer cell model and how dysregulation of specific microRNAs may be important in the etiology of breast cancer development. In this study we have used microRNA arrays to identify differentially expressed microRNAs between PR positive and PR negative cell lines. We have started to develop novel techniques to validate differential regulation of microRNAs. In addition, we have identified unique microRNA sequences, potentially regulating PR expression. From this study we predict that specific microRNAs have an essential role in the development of hormone dependent breast cancers. Identification of these microRNAs could be used in prognosis of subsets of hormone dependent breast cancer and form therapeutic targets for directed cancer treatment.

DTIC

*Breast; Cancer; Females; Hormones; Mammary Glands*

**20070015231** Naval War Coll., Newport, RI USA

**Should Medical Humanitarian and Civic Assistance Activities Focus on Building Public Health Capacity in Africa to Better Influence Theater Security Cooperation Objectives?**

Pruden, Paul W; Ferree, William D; Feb 13, 2006; 22 pp.; In English

Report No.(s): AD-A463935; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463935>

The Department of Defense seeks to form the foundations of a peaceful and prosperous world through security cooperation. EUCOM's Theater Security Cooperation Plan (TSCP) seeks to ensure access, promote stability and security, and strengthen capabilities for self-defense and coalition operations through a number of various programs. The particular program that is the subject of this paper is Humanitarian and Civic Assistance (HCA) and, more specifically, medical or health related HCA activities in Africa. Past and current medical HCA activities have not been focused on long-term public health capacity building despite the strong relationship between population health and security. Building public health capacity of developing African nations will improve their stability, thus improving the security environment. They will be better equipped to handle their own health issues without outside intervention and to assist in humanitarian crises in the region, thus reducing the workload on U.S. resources in the long-term.

DTIC

*Africa; Developing Nations; Medical Services; Public Health; Security*

**20070015232** Dana Farber Cancer Inst., Boston, MA USA

**MUC1 Functions as a Oncogene by Targeting the Nucleus of Human Breast Cancer Cells**

Kufe, Donald; Sep 2006; 28 pp.; In English

Contract(s)/Grant(s): DAMD17-03-1-0672

Report No.(s): AD-A463936; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463936>

The MUC1 oncoprotein is aberrantly overexpressed in 80-90% of human breast carcinomas. Little, however, was known about the role of MUC1 in the development of breast cancer. The Specific Aims of this Idea Award were: 1) To determine if MUC1 overexpression is sufficient to induce transformation; and 2) To assess whether MUC1 localizes to the nucleus and thereby regulates gene expression. Work supported by this Award has demonstrated that MUC1 induces transformation and that the cytoplasmic domain is sufficient for this function by stabilizing Beta-catenin (Task 1). Our results also demonstrate that the MUC1- C subunit is targeted to the nucleus where it interacts with p53, ERalpha and KLF4, and thereby regulates gene transcription in human breast cancer cells (Task 2). These findings have thus provided novel information that MUC1 induces transformation, localizes to the nucleus and regulates gene expression. The findings also indicate that overexpression of MUC1 by human breast tumors is of importance to the malignant phenotype and resistance to therapy.

DTIC

*Breast; Cancer; Mammary Glands; Oncogenes; Therapy*

**20070015238** Nebraska Univ., Omaha, NE USA

#### **Neurotoxin Mitigation**

Hinrichs, Steven H; Vetter, Deborah K; Nov 2006; 38 pp.; In English

Contract(s)/Grant(s): W81XWH-06-1-0102; W911SR-04-C-0019

Report No.(s): AD-A463945; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463945>

Organophosphorus esters (OP) are highly toxic poisons used as chemical nerve agents and as pesticides. It is generally agreed that the toxicity from high dose OP exposure involves inhibition of acetyl cholinesterase. The role of other proteins in the toxicity of OP is unknown. Our hypothesis is that several proteins become modified after exposure to OP and that the biological actions of OP are not explained by inhibition of acetylcholinesterase alone. We are using mass spectrometry to identify proteins modified by exposure to OP. A new motif for OP binding is beginning to emerge from our work. We are seeing a pattern of covalent OP binding to tyrosine where the tyrosine is adjacent to an arginine or lysine. We have identified tyrosine 411 on the surface of human albumin and tyrosine 238 of human transferrin as OP-binding sites. Our results are relevant to diagnosis of OP exposure. The mass spectrometry methods we have developed are rapid and simple, but expensive. The new information from our mass spectrometry results can be used to develop antibody based dipstick assays to diagnose OP exposure.

DTIC

*Albumins; Detection; Mass Spectroscopy; Organic Phosphorus Compounds; Plasmas (Physics)*

**20070015241** Naval Health Research Center, San Diego, CA USA

#### **US Department of Defense Surveillance for Neoplasms of Infancy**

Ryan, Margaret A; May 2006; 13 pp.; In English

Contract(s)/Grant(s): MIPR; 1GCE471100

Report No.(s): AD-A463951; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463951>

The DoD Birth and Infant Health Registry at the DoD Center for Deployment Health Research, Naval Health Research Center, San Diego, has now completed six years of surveillance-related data extraction for neoplasms diagnosed in the first year of life among children born to military parents. Between 1998 and 2003, a total of 577,241 infants were born to military families; 12,425 of these infants were diagnosed with at least one neoplasm of any type. A total of 1229 infants received a diagnosis of malignant neoplasm in the first year of life. Preliminary analyses indicate incidence rates for neoplasms appear consistent with civilian reference rates. Malignant neoplasms, however, have required extra validation efforts to confirm electronic-record coding before rates can be confirmed. Data collection and analyses continue, with an emphasis on confirmation of the most concerning diagnoses and potential associated factors.

DTIC

*Defense Program; Neoplasms; Surveillance*

**20070015246** Alabama Univ., Birmingham, AL USA

#### **Dietary Genistein and Prostate Cancer Chemoprevention**

Lamartiniere, Coral A; Apr 2006; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0662

Report No.(s): AD-A463968; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463968>

The goal of our research was to determine if there is a developmental window for suppressing prostate cancer with the phytoestrogen genistein and its mechanism (s) of chemoprevention. Life-time (starting at birth) exposure to genistein was more effective in suppressing chemically-induced prostate cancer in rats than neonatally prepubertal or adult only exposures to genistein. Neonatally prepubertal genistein exposure did not alter prostate bud development. Dietary genistein during the neonatally prepubertal period as well as during adulthood resulted in decreased androgen receptor but not estrogen receptors alpha and beta in dorsolateral prostates of 70 day old rats suggesting that early exposure to genistein can have a programming effect on androgen receptor expression. However genistein at each period of postnatal development did not alter androgen receptor mRNA in the prostate data that argues against genistein causing gene silencing via DNA methylation mechanism in the prostate of rats. On the other hand genistein in the diet resulted in increased apoptosis in the prostate. Phospho-Akt and Bcl-2 protein levels were decreased and Bax was increased in prostates of rats fed genistein in the diet protein regulation consistent with increased apoptosis a cellular mechanism that can suppress prostate cancer development.

DTIC

*Cancer; Chemotherapy; Diets; Drugs; Prostate Gland*

**20070015248** Oregon Health Sciences Univ., Portland, OR USA

**Enhanced Androgen Signaling With Androgen Receptor Overexpression in the Osteoblast Lineage Controls Skeletal Turnover, Matrix Quality and Bone Architecture**

Wiren, Kristine M; Jepsen, Karl; Dec 2006; 68 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0086

Report No.(s): AD-A463969; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463969>

Androgens have been shown to be important mediators of bone growth and remodeling independent of estrogen. We genetically engineered transgenic mice in which androgen receptor (AR) overexpression is skeletally targeted in two separate models to better understand the role of androgen signaling directly in bone. The central hypothesis of this proposal is that AR transactivation in the osteoblast lineage provides key regulatory signals that influence the progression of osteoblast differentiation and osteogenesis, control the resorption of calcified bone, and modulate lineage determination in the marrow, to influence skeletal architecture and matrix quality. In the second year, we have completed the initial analysis of the second line of AR-transgenic mice created using the col2.3 promoter to drive AR expression. AR overexpression in mature osteoblasts results in reduced turnover and inhibition of bone formation at the endosteal surface, resulting in thinner cortical bones with poor biomechanical properties, including a reduction in maximum load, strength and work to failure (Specific Aim 1). Ongoing analysis in both models of AR2.3- and AR3.6-transgenic animals suggests that AR transactivation in mature osteoblasts is primarily responsible for mediating the effects of androgen on matrix quality and/or mineralization (inhibitory), while immature cells mediate effects of androgen on the periosteum and body composition (anabolic). In both AR overexpression models, enhanced androgen signaling during growth produces a low turnover state and may be detrimental to skeletal quality with more damageability. After a sustained hypogonadal period, both males and females demonstrate improved bone mineral, but only males show improvements in body composition including increased lean and reduced fat mass. Thus, results to date indicate androgen is not anabolic in mineralizing bone cells, and raise concerns regarding androgen administration in young adults.

DTIC

*Bones; Hormones; Males; Musculoskeletal System; Osteoblasts*

**20070015249** Michigan Univ., Ann Arbor, MI USA

**Nitric Oxide Generating Polymeric Coatings for Subcutaneous Glucose Sensors**

Meyerhoff, Mark E; Oct 2006; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0602

Report No.(s): AD-A463970; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463970>

Heretofore, efforts to develop implantable chemical sensors for real-time clinical monitoring of glucose subcutaneously (SQ) in diabetic patients have been stymied by the unreliable analytical results owing largely to biocompatibility problems induced by sensor implantation (e.g., inflammatory/foreign body response). The goal of this research program is to explore and optimize the chemistries required to fabricate implantable amperometric glucose sensors with outer polymeric coatings that slowly generate low levels of nitric oxide (NO). The local generation of NO has been shown to enhance the biocompatibility of the implanted sensors by decreasing the inflammatory response. The focus of this research has been to develop new polymeric coatings (biomedical hydrogels and polyurethanes) that possess immobilized copper ion sites that will

serve as catalytic surfaces for in situ conversion of endogenous nitrosothiol species (RSNO) (e.g., nitrosoglutathione, nitrosocysteine, etc.) to NO, thereby providing a local sustained generation of NO species at the surface of the implanted sensors. Preliminary experiments indicate RSNO levels within the SQ fluid of rats are sufficiently generate local NO to reduce the inflammatory response at the implantation site, using test devices coated with polymers containing immobilized copper ion sites. Finally, functional needle type SQ glucose sensors were prepared to demonstrate appropriate analytical performance for glucose measurements. These sensors will provide the basis of assessing if NO generation chemistries are compatible with glucose sensing chemistry?

DTIC

*Detectors; Glucose; Nitric Oxide; Plastic Coatings; Polymeric Films*

**20070015250** Washington Univ., Saint Louis, MO USA

**Chromatin Structure and Breast Cancer Radiosensitivity**

Pandita, Tej K; Oct 2005; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0356

Report No.(s): AD-A463971; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463971>

The hMOF protein is a chromatin-modifying factor. Chromatin structure plays a critical role in gene expression. Since hMOF has a chromodomain region as well as acetyl transferase activity its inactivation can influence modification of chromatin during DNA metabolism. The proposed experiments of this grant proposal will determine functions of hMOF gene. This will be achieved by generating isogenic cells with and without hMOF function. Both in vivo and in vitro experiments will be performed to determine the function of hMOF in context with radio responsiveness and oncogenic transformation. If hMOF proves to be involved in the radio responsiveness and neoplastic transformation then the clinical implications of this proposal are highly significant. It may in the future be prudent to screen each breast cancer patient prior to any final therapeutic decision. This will be accomplished through the use of quantitative RT-PCR and the test results can be obtained within a day. There are several benefits of identifying an individual's normal tissue with loss of hMOF gene expression. First it will allow us to prospectively identify the sensitive subset of patients. Second the radiosensitive patients will be taken for an alternative therapy if exist and would be spared a great deal of suffering. Third it will be possible that once we identify a subset of patients that show a genetic basis of radiation sensitivity the radiation dose to the remaining breast patients could be increased to be more effective for local tumor control. Fourth it will provide health professionals a molecular diagnostic approach to predict the suitability of an individual for radiotherapy.

DTIC

*Breast; Cancer; Chromatin; Mammary Glands; Proteins; Radiation Tolerance*

**20070015251** Rice Univ., Houston, TX USA

**Developing a Brief Method for the Simultaneous Assessment of Anaerobic and Aerobic Fitness**

Weyand, Peter; Oct 2006; 13 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-2-0053

Report No.(s): AD-A463972; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463972>

The objective of the proposed effort is to develop a brief and accurate method for the simultaneous assessment of anaerobic and aerobic fitness that is practical for both field and laboratory use. We anticipate that a method requiring an assessment period of only a few minutes or less, and two brief, minimally fatiguing efforts is possible. Each subject will undergo established tests to assess their maximal aerobic power and anaerobic power, respectively. Subjects will also complete a series of all-out efforts to establish their performance capabilities for efforts of different durations. Our analysis will focus primarily on two questions. First, we will determine if the relationship between the metabolic power available and all-out performance capabilities is common or dependent upon the fitness level of the individual. Second, we will determine whether the relationship between metabolic power and performance varies with the type of physical activity in which soldiers are engaged. We hypothesize that a single relationship will generalize to: 1) different individuals regardless of fitness level, and 2) to different types of physical activity. The development of a simple, practical and accurate method for assessing metabolic fitness and performance capabilities will provide a number of benefits.

DTIC

*Activity (Biology); Aerobes; Anaerobes; Physical Fitness*

**20070015252** Beth Israel Deaconess Medical Center, Boston, MA USA

**The Role of c-FLIP(L) in Regulating Apoptotic Pathways in Prostate Cancer**

Olumi, Aria F; Dec 2006; 103 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0080

Report No.(s): AD-A463973; No Copyright; Avail.: CASI: A06, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463973>

Abnormalities in programmed cell death (apoptosis) machinery play a crucial role in initiation progression and metastasis of prostate cancer. Therefore molecules that initiate pro-apoptotic pathways are excellent therapeutic agents in prostate cancer. However some prostate cancer cells develop resistance to pro-apoptotic agents. In this proposal we are examining the regulatory mechanisms of c-FLIP(L) which is an important modular of apoptosis in prostate cancer.

DTIC

*Apoptosis; Cancer; Prostate Gland*

**20070015253** Michigan Univ., Ann Arbor, MI USA

**Decreased Expression of the Early Mitotic Gene CHFR Contributes to the Acquisition of Breast Cancer Phenotypes**

Privette, Lisa M; Mar 2007; 37 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0332

Report No.(s): AD-A463974; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463974>

The purpose of this study was to determine if CHFR was biologically relevant to breast cancer characteristics and progression. Here we studied both breast cancer cell lines and primary samples from breast cancer patients to investigate CHFR as a relevant tumor suppressor in breast cancer and to associate CHFR expression with clinical and pathological variables. A large percentage of samples demonstrated negative or weak CHFR protein expression or staining. In addition lack of CHFR detection correlated with increased tumor size in patients and was weakly associated with ER-negative primary tumors. To study the effects of low CHFR expression in vitro we decreased CHFR gene expression in mammary epithelial cells. Notably this resulted in the acquisition of many phenotypes associated with malignant progression including higher growth rates increased mitotic index enhanced cellular invasion and motility morphological changes and aneuploidy. Considering the association between CHFR expression and breast cancer tumor size the in vitro data presented here and its previously published correlation with cellular response to chemotherapeutics such as Taxol this study provides substantial evidence to identify CHFR as an important tumor suppressor in breast cancer and possibly a biomarker for tumor response to microtubule-targeting drugs like Taxol.

DTIC

*Breast; Cancer; Genes; Mammary Glands; Mitosis*

**20070015254** Pennsylvania Univ., Philadelphia, PA USA

**Hot Flashes among Prostate Cancer Patients Undergoing Androgen Deprivation Therapy: Psychosocial and Quality of Life Issues**

Coyne, James; Vaughn, David J; Dinges, David; Malkowicz, S B; Gooneratne, Nalaka S; Dec 2006; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0125

Report No.(s): AD-A463975; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463975>

Androgen deprivation therapy (ADT) is increasingly prescribed to patients with prostate cancer and brings with it an array of adverse effects. Hot flashes are a common side effect of ADT and are believed to be qualitatively similar to hot flashes among women receiving treatment for breast cancer. Currently no assessment protocols exist for objective assessments of hot flashes in prostate cancer patients, making it difficult to evaluate outcomes in clinical trials, educate clinicians and patients, or develop management and treatment strategies. This project will provide basic clinical epidemiological data concerning the nature, prevalence, and correlates of hot flashes among prostate patients receiving ADT, document the negative effects of hot flashes on sleep, fatigue, and quality of life, and compare the accuracy of alternative means of assessing hot flashes. The overarching goal is to not only understand the nature and importance of hot flashes, but to develop methodological standards for the assessment of hot flashes suitable to diverse applications. Results will have implications for the education of oncologists with respect to quality of life issues in prostate cancer, set standards for future research and clinical endeavors,

and suggest directions for patient-oriented research to improve the wellbeing of prostate cancer patients.

DTIC

*Cancer; Deprivation; Patients; Prostate Gland*

**20070015257** Wake Forest Univ., Winston-Salem, NC USA

**Inhibition of Fatty Acid Synthase in Prostate Cancer by Orlistat, a Novel Therapeutic**

Kridel, Steven J; Nov 2006; 56 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0065

Report No.(s): AD-A463983; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463983>

The overall goal of this project is to understand the anti-tumor effects of FAS inhibitors. We have followed up on our previous findings by further evaluating the role of ER stress in tumor cells treated with FAS inhibitors. Our results suggest that ER stress may initiate the cell death program when FAS is inhibited in prostate tumor cell lines. Moreover, the data also suggest that the ER may sense fatty acid levels in tumor cells. A further connection to ER stress was discovered by showing that other ER stressing agents like Velcade induce fatty acid synthase activity and sensitize cells to the effects of FAS inhibitors. We have also made the novel observation that FAS expression is regulated by the src oncogene and that FAS inhibitors can block src driven matrigel invasion. Combined these data provide insight into how disruption of the FAS axis can be further exploited to inhibit prostate tumor growth and metastases. We have also extended our previous crystallography studies by solving the crystal structure of FAS bound to a cleaved orlistat. These data will provide valuable insight into future drug discovery and design within the FAS pathway. In total, we have made great strides toward understanding the anti-tumor effects of orlistat and other FAS inhibitors in prostate cancer through a multi-disciplinary approach combining cell biology, biochemistry and crystallography.

DTIC

*Cancer; Fatty Acids; Prostate Gland; Therapy*

**20070015258** California Univ., San Francisco, CA USA

**Preventing Health Damaging Behaviors and Negative Health Outcomes in Army and Marine Corps Personnel During the First Tour of Duty**

Boyer, Cherrie B; Shafer, Mary-Ann; Jan 2006; 40 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0159

Report No.(s): AD-A463992; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463992>

Health damaging behaviors of young military personnel are reflections of health problems facing all young people in the U.S. Military life presents opportunities and challenges that may both protect and place young troops at risk for health damaging behaviors. Challenges for maintaining a healthy armed force include high rates of sexually transmitted infections (STIs), unintended pregnancies (UIPs), misuse of alcohol/substances, and personal sexual violence defined as violence within one's personal (dating or marital) relationships. The common thread through these negative health outcomes is volitional behavior. Such behaviors do not only result in illness or injury, but also negatively impact performance of military duties and threaten military readiness. Despite military leadership in setting standards and policies regarding professional behavior and universal health care for preventing and eliminating such negative health outcomes, many health problems remain. Building on our previous military research, we plan to develop and evaluate a cognitive-behavioral, skills-building intervention to prevent and reduce young troops' risk for STIs, UIPs, alcohol/substance misuse, and personal sexual violence. This research also seeks to establish the best training practices for educating young troops about health issues that impact military performance and readiness. Finally, it will have direct implications for health promotion and disease prevention education strategies designed to reach military men and women early in their careers.

DTIC

*Damage; Education; Health; Military Personnel*

**20070015259** Texas Univ., Houston, TX USA

**The Role of Cyclin E and Its Lower Molecular Forms in the Oncogenesis of Ovarian Cancer and Its Predictive Value in Patients with Early Stage Ovarian Tumor**

Keyomarsi, Khandan; Apr 2006; 9 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0259

Report No.(s): AD-A463993; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463993>



The deregulation of cell cycle checkpoints, with loss of regulation at the G1/S transition, has been shown to play an important role in the transformation to a malignant phenotype. Our studies have focused on cyclin E, which appears in late G1 and flanks the restriction point. We hypothesize that alterations of cyclin E in ovarian cancer cells contributes to the oncogenesis of ovarian tumors and negatively impacts outcome in patients with Stage I-III cancer. In this proposal we will i) develop a comprehensive ovarian cell line model for characterization of the role of cyclin E in ovarian cancer, ii) delineate the role of cyclin E and its tumor specific LMW forms in the development of malignant phenotype in vitro and in nude mice. iii) establish the prognostic value of the hyperactive forms of cyclin E in patients with Stage I-III ovarian cancer and iv) examine the biochemical significance of the LMW forms of cyclin E in tumor specimens. The results from our studies will provide much needed information about the molecular biology of ovarian carcinoma and may open new avenues for the development of targeted therapies.

DTIC

*Cancer; Ovaries; Patients; Predictions; Tumors*

**20070015260** Chicago Univ., Chicago, IL USA

**ProCEED Pilot Study (Prostate Cancer Study of Ethnicity, Exercise and Diet)**

Wallace, Katrine L; Furner, Sylvia E; Freeman, Vicent L; Dec 2006; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0180

Report No.(s): AD-A463997; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463997>

As the first year of the grant was dedicated to study start-up activities, no results from the main study are yet available. A descriptive epidemiology study comparing racial trends in prostate cancer incidence rates in Illinois and the USA was undertaken. The objective of this study was to examine trends in Illinois and US prostate cancer rates to ascertain whether trends were similar by race. Incidence rates were obtained from Illinois State Cancer Registry and SEER. Rate ratios were estimated for three periods: 1986-1990 ('pre-PSA'), 1991-1995 ('PSA-uptake'), and 1996-2000 ('PSA-widespread use'). Incidence rates peaked in the mid-1990s. Rate differences between the two regions narrowed in 1994 and 1995. African-Americans had higher incidence rates than Caucasians throughout. The post-1996 incidence pattern in Illinois, however, was unique with the incidence rates in African-Americans declining and the racial disparities narrowing. This suggests more effective prostate cancer screening is taking place in Illinois African-American populations than US African-American populations, although differential risk profiles may also be operating.

DTIC

*Cancer; Diets; Ethnic Factors; Physical Exercise; Prostate Gland*

**20070015261** Kentucky Univ., Lexington, KY USA

**Neurotrophic Response to CNS Degeneration or Injury: Effects of Aging**

Yurek, David M; Seroogy, Kim B; Oct 2005; 40 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-01-1-0766

Report No.(s): AD-A463998; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463998>

The etiology of Parkinson's disease is not known and may be related to several factors which include inheritable mutations (genetic), exposure to environmental toxins, and/or traumatic head injury. Our current research examines age-related changes in neurotrophic factor expression in Brown Norway (Fischer 344 F1 hybrid (F344BNFI) rats, and we have preliminary evidence that the young and aged nigrostriatal system responds differently to neurotoxic insult or mechanical injury, i.e., young rats show a tendency to increase neurotrophic factor expression while aged rats do not. This is an important finding in the sense that the success of new therapies utilizing embryonic neurons or stem cells may be dependent on how well the implanted cells interact with the host neurotrophic environment. The studies proposed in this research project will further characterize the temporal expression of neurotrophic markers before and after neurotoxic insult or mechanical injury to the nigrostriatal system in young, middle-age, and old F344BNFI rats. The second part of this project will demonstrate that age differences in compensatory neurotrophic mechanisms that occur in the nigrostriatal system have a direct impact on the success of embryonic neurons implanted into the injured or denervated striatum.

DTIC

*Central Nervous System; Degeneration*

**20070015264** Emory Univ., Atlanta, GA USA

**Early Detection of Breast Cancer Using Molecular Beacons**

Yang, Lily; Sep 2006; 59 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0665

Report No.(s): AD-A464003; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464003>

The objectives of our research during that last funding year (2005-2006) are: 1) identification of new tumor markers for early stage breast cancer (ductal carcinoma in situ, DCIS); 2) optimization of methods and molecular beacon design for the detection of the levels of tumor marker gene expression, and 3) development of multiplex quantum dot (QD) technology for detection of the level of protein expression in single cell level. The ultimate goal is to develop a multiplex fluorescence cellular imaging approach for simultaneous examination of the levels of gene and protein expression in a single cell level. From our study, we found that in addition to Her-2/neu, survivin and cyclin D1, three more tumor markers are highly expressed in human DCIS tissues, including HIF-1alpha, epidermal growth factor receptor, and urokinase plasminogen activator receptor (uPAR). We have developed antibodies or targeting peptide-conjugated QDs to detect the expression of those tumor markers in human breast cancer cells. At present, we are in the process of starting the feasibility phase of the clinical trial to determine whether we are able to detect breast cancer cells in fine needle biopsy and ductal lavage samples from breast cancer patients.

DTIC

*Beacons; Breast; Cancer; Detection; Mammary Glands; Molecular Properties*

**20070015266** California Univ., Los Angeles, CA USA

**Understanding the Apoptotic Functions of IGFBP-3 in Prostate Cancer**

Cobb, Laura; Cohen, Pinchas; Nov 2006; 33 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0072

Report No.(s): AD-A464008; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464008>

The IGF axis is known to play an important role in the epidemiology of many tumors. IGFBP-3 promotes apoptosis in cancer cells by both IGF-dependent and -independent mechanisms. We have previously shown that IGF3P-3 is rapidly internalized and localized to the nucleus where its interactions with the nuclear receptor RXRo are important in apoptosis induction. We demonstrate that phosphorylation of IGFBP-3 (S156) by DNA-PK enhances its nuclear accumulation and is essential for its ability to interact with RXR and induce apoptosis in cultured prostate cancer cells. Indeed IGFBP-3-Si 56A is completely unable to induce apoptosis in 22RV1 prostate cancer cells. Using specific chemical inhibitors we investigated the contribution of other protein kinases to the regulation of IGFBP-3-induced apoptosis. Preventing the activation of CK2 enhanced the apoptotic potential of IGFBP-3. We mapped two potential CK2 phosphorylation sites in IGFBP-3: S167 and S175. These sites were mutated to Ala and the resulting constructs were transfected in to LAPC4 and 22RV1 prostate cancer cells. WtIGFBP-3 and IGFBP-3-S175A induced apoptosis to a comparable extent; however IGFBP-3-S167A was far more potently apoptosis-inducing. Together these data reveal two key regulatory phosphorylation sites in the central region of IGFBP-3. Phosphorylation of 5156 by DNA-PK promotes apoptosis whilst phosphorylation of 5167 by CK2 limits the ability of IGFBP-3 to induce apoptosis. These studies reveal multi-site phosphorylation of IGFBP-3 that both positively and negatively regulate its apoptotic potential. Understanding such intrinsic regulation of IGF3P-3 action may enhance the development of potential cancer therapies.

DTIC

*Apoptosis; Cancer; Prostate Gland*

**20070015267** Indian Inst. of Science, Bangalore, India

**Role of Notch Signaling in Human Breast Cancer Pathogenesis**

Rangarajan, Annapoorni; Nov 2006; 9 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0392

Report No.(s): AD-A464009; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464009>

Notch proteins are activated upon binding to ligands of the Delta/Serrate family. In previous experiments I had found that activated allele of Notch 1 cooperates with low levels of oncogenic Ras expressing HMLE cells (termed HMLER). Further investigations revealed that Notch-IC confers protection to HMLER cells against anoikis, a form of apoptosis triggered upon anchorage-independent growth. Eventhough Notch-IC cooperates with oncogenic Ras HMLER cells to initiate tumors in vivo, they form well encapsulated, non-metastatic tumors. Inhibition of Notch signaling, however, reverts the EMT phenotype of

Sum1315 breast cancer cell line, as detected by increase in epithelial E-cadherin and loss of fibroblastic marker, vimentin. In order to assess whether the observed Notch-Ras cooperation in transformation of HMLE cells in vitro also holds true in vivo innaturally arising breast tumors, immunohistochemical analysis was undertaken. While in normal breast tissue activated Notch, its downstream target Hes5, or phospho forms of Erk1/2 were not detected, abundant amounts of all these proteins were detected in the same areas within breast cancer tissue. This suggests that the Notch-Ras cooperation might indeed be involved in initiating breast carcinogenesis as it occurs in vivo.

DTIC

*Breast; Cancer; Mammary Glands; Notches; Pathogenesis*

**20070015271** Dorn Research Inst., Inc., Columbia, SC USA

**Sage Gene Expression Profiles Characterizing Cure**

Hrushesky, William; Bulkhaults, Phillip; You, Shaojin; Oct 2005; 51 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0856

Report No.(s): AD-A464015; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464015>

The menstrual cycle phase of breast cancer resection affects the frequency of cancer metastatic spread. Tumor metastases are 2-3 fold more frequent when the resection is performed during diestrus as compared to estrus. Tumor angiogenesis is essential for both cancer growth and lethal metastatic cancer spread. The balance between vascular endothelial growth factor (VEGF) and basic fibroblast growth factor (bFGF) modulates new blood vessel formation and blood vessel permeability. In a nonbreast tumor, methylcholantrene(meth). The changes in breast cancer capillary permeability, VEGF and bFGF that occur during each fertility cycle, in breast tissue and breast cancer, putatively in response to cyclical changes in sex hormones, may contribute, at least in part, to both the modulation of cancer growth and post-resection breast cancer spread by the fertility cycle. We hypothesize that there are characteristic patterns of tumor cell gene expression that change throughout the menstrual (estrous) cycle, and that a subset of these cycling genes are in part associated with, and responsible for the changes in curability of resected breast cancers. We investigated the influence of the estrous cycle on breast tumor surgical cure and metastatic spread to the lungs, using a primary, transplantable, mammary carcinoma, resected for surgical cure from young, sexually mature cycling C3HeB/FeJ female mice at each of 4 fertility cycle stages.

DTIC

*Breast; Cancer; Gene Expression; Genes; Mammary Glands; Menstruation*

**20070015272** Michigan Univ., Ann Arbor, MI USA

**Herceptin-Resistance and Overexpression of Anti-Apoptotic Molecule Bcl-XL: a Potential Strategy for Overcoming Resistance to Herceptin**

Xu, Liang; Jul 2005; 12 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0616

Report No.(s): AD-A464017; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464017>

The major goal of this Concept Award project is to investigate whether a small molecule inhibitor of Bcl-xL will be able to overcome the Herceptin-resistance of Her-2/neu(+) breast cancer. Our hypothesis is that anti-apoptotic molecule Bcl-xL may play a role in Herceptin resistance, and a potent and specific Bcl-xL inhibitor might be able to block or even reverse this resistance, thus improving efficacy of Herceptin therapy. This is based on our basic hypothesis that Bcl-xL is the primary molecular target that mediate the anticancer activity of the small molecule Bcl-xL inhibitor, (-)-gossypol, in human breast cancer cells. Our ultimate goal is to develop (-)-gossypol as a novel molecular targeted therapy for the treatment of breast cancer with Bcl-xL overexpression. In this project, we investigated anti-tumor activity and the mechanism of action of (-)-gossypol in human breast cancer with Bcl-xL overexpression, and investigate the potential synergistic effects of gossypol in combination with Herceptin therapy.

DTIC

*Apoptosis; Breast; Cancer; Inhibitors; Mammary Glands*

**20070015274** Naval Research Lab., Bay Saint Louis, MS USA

**Hypoxia Hotspots in the Mississippi Bight**

Brunner, Charlotte A; Beall, Jennifer M; Bentley, Samuel J; Furukawa, Yoko; Apr 2006; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464019; NRL/JA/7430-04-1-14; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464019>

Foraminiferal proxies of hypoxia indicate apparent low oxygen to hypoxic conditions in several hotspots in the Mississippi Bight. The foraminiferal hypoxia proxies, the Ammonia to Ephidium (A/E) index and the Pseudonionion-Epistominella- Bullimella (PEB) index were tabulated from three sets of core tops collected in 1951-1956. Additionally, the oxygenation history of a site near the Balize delta was evaluated over the past one hundred years based on ArE and PEB indices and size distributions of pyrite framboids in a gravity core dated by 210Pb geochronology.

DTIC

*Bays (Topographic Features); Hypoxia*

**20070015282** Rochester Univ., NY USA

**Knockout AR in Prostate**

Chang, Chawnshang; Oct 2006; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-04-1-0199

Report No.(s): AD-A464034; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464034>

Prostate cancer progresses from androgen-dependent to androgen-independent state. The androgen receptor (AR) is expressed throughout progression. We would like to understand the AR role in this progression. Using lox-Ore methodology we have generated mice in which AR function is abolished in the entire animal (ARKO) or tissue specific manner and generated mice with ARKO in prostate only or in different stages to be used to study prostate cancer (PCa) progresses. We aim to generate mice lacking AR in prostate epithelium. generate inducible ARKO mice to determine potential effects of androgen in AR absence on prostate growth/maintenance determine AR role in PCA development/progression by crossing ARKO mice with TRAMP mice to examine AR role in TRAMP induced PCa and permit determination of stages in PCA requiring AR function determine AR role in tumorigenicity of androgen- dependent/androgen-independent ARKO PCa cell lines. The effect of AR loss in these cells will be examined for ability to generate/promote tumors in mice. This year we generated mice with ARKO in the prostate epithelium and will be able to continue the other aims in the proposal in the coming years.

DTIC

*Cancer; Prostate Gland*

**20070015283** Brigham and Women's Hospital, Boston, MA USA

**Molecular and Clinical Predictors of Aggressive Prostate Cancer**

Mucci, Lorelei A; Sep 2006; 9 pp.; In English

Contract(s)/Grant(s): W81XWH-05-1-0562

Report No.(s): AD-A464035; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464035>

The current project seeks to study molecular and clinical predictors of aggressive prostate cancer in two large US cohorts of prostate cancer cases from the Physicians' Health Study (PHS) and the Health Professionals' Follow-up Study (HPFS). We have almost completed review of medical records for the more than 6,000 prostate cancer cases in the cohort, to abstract clinical data, and are assembling a clinical datafile. Among the 900 cases on whom tumor tissue are contained on 8 tissue microarrays, we have undertaken immunohistochemistry to assess protein expression for five genes as part of a recently identified molecular signature associated with lethal prostate cancer. Intensity and percent staining for these five markers has been evaluated by the pathologist for the PHS cases, and statistical analyses are underway to assess the association of the molecular signature to predict poor prostate cancer survival. The statistical team has discussed model building strategies for both sets of markers.

DTIC

*Cancer; Predictions; Prostate Gland*

**20070015284** McLaughlin Research Inst., Great Falls, MT USA

**Early Host Responses to Prion Infection and Development of an In Vitro Bioassay**

Carison, George A; Sep 2006; 13 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0584

Report No.(s): AD-A464036; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464036>

The goal of this project is to identify pathways and networks of genes and proteins perturbed by prion replication. The

unusual nature of prion disease prompted a systems approach to identify networks specifically perturbed by prion infections and to determine which perturbations are essential for various aspects of the disease. We previously tracked changes in gene expression in brain and spleen for two different prion strains and five different lines of mice over their entire incubation periods. We have successfully infected ONS stem cell containing neurosphere cultures with the Rocky Mountain Laboratory (RML) prion strain. Neurosphere lines have been produced from the same mouse strains used for our in vivo studies. Differential gene and protein expression in these cells will aid in identifying genes directly involved in prion replication and lead to the identification of markers for prion infected individuals. We also are developing neurosphere cultures as a sensitive, rapid bioassay for mouse, bovine, and human prions.

DTIC

*Bioassay; In Vitro Methods and Tests; Infectious Diseases*

**20070015285** L-3 Communications., San Antonio, TX USA

**Nonsurgical Brain Activity Recovery From a Cap Containing Multiple Electroencephalogram Recording Sites**

Cohon, David; Sep 2006; 217 pp.; In English

Contract(s)/Grant(s): F41624-03-D-6002-0008; Proj-7184

Report No.(s): AD-A464037; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464037>

The goal of this project is to invert electroencephalogram data to brain activity using a novel and accurate algorithm. This algorithm can be used for research and development of brain-machine interfaces, potentially to include prosthetic control, surveillance and lie detection. This report details the mathematical and physical theory behind the algorithm developed during this effort. The algorithm is novel in that it does not use the quasistatic approximation throughout the space, instead using it only at the boundaries between material media. The output of the algorithm consists of three-dimensional currents at dipoles located at pre-specified locations. The number of such dipoles is limited to one third of the number of electroencephalogram electrodes, so they are best regarded as neuronal aggregates instead of individual neurons. The algorithm has been executed on up to five seconds of 128-electrode electroencephalogram data sampled at 2048 Hertz. Numerical results are provided in graphical format.

DTIC

*Algorithms; Brain; Electrodes; Electroencephalography; Prosthetic Devices; Spherical Harmonics*

**20070015286** Cincinnati Univ., OH USA

**NASA Extreme Environments Mission Operations 10 - Evaluation of Robotic and Sensor Technologies for Surgery in Extreme Environments**

Broderick, Timothy J; Nov 2006; 108 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0084

Report No.(s): AD-A464038; No Copyright; Avail.: CASI: A06, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464038>

This final report covers the activities conducted by Dr. Timothy Broderick during his participation in planning and execution of the NASA Extreme Environment Mission Operation (NEEMO) 9 mission. The mission, held in collaboration with NASA, was conducted from April 3 - 20, 2006. Dr. Broderick served as an aquanaut aboard the Aquarius habitat, which is submerged off the coast of Key Largo, FL. During this mission, Dr. Broderick participated in research led by Dr. Mehran Anvari and McMaster University as well as NASA activities. The principal focus of the McMaster University research was telemedicine and telesurgery.

DTIC

*NASA Programs; Robotics; Surgery; Telecommunication; Telemedicine*

**20070015309** Tulane Univ., New Orleans, LA USA

**ErbB4 Overexpression as an Antagonist of ErbB2/HER2/Neu Induced Human Breast Cancer Cell Proliferation**

Long, Weiwen; Duplessis, Tamika; Aug 2006; 24 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0418

Report No.(s): AD-A464063; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464063>

To test the hypothesis that ERBB4 signaling suppresses ERBB2-mediated cell proliferation in breast cancer, we introduced ERBB4 into SKBR-3 and MCF-7 breast cancer cell lines, which overexpress and express normal levels of ErbB2,

respectively. We found that ERBB4 induces apoptosis in over 40% of both SKBR-3 and MCF-7 cells. Significantly, the normal human mammary epithelial cell line hTERT-HME was resistant to ERBB4 induced apoptosis. Although ERBB4 apoptotic function requires kinase activity, neither MAPK nor PI3-K signaling is involved in ERBB4 induced apoptosis. Further studies indicate that ERBB4 couples to the intrinsic apoptotic pathway through the mitochondrial proapoptotic protein Bak. A search for proapoptotic domains in ERBB4 revealed a putative BH3 domain within ERBB4 intracellular domain (410D). We found that 4ICD exhibits equivalent level of apoptotic activity as holoreceptor of ERBB4 and, in contrast, does not require the kinase activity. These findings suggest that ERBB4 kinase activity contributes to apoptosis by generating 4ICD from the cell membrane upon proteolytic cleavage. Mutation of the BH3 domain of 4ICD significantly decreases 4ICD-induced apoptosis. Taken together, our data indicate that ERBB4 functions as a proapoptotic BH3-only protein. The specificity of ERBB4 cell-killing for malignant cells further supports a tumor suppressor function for ERBB4.

DTIC

*Breast; Cancer; Cells (Biology); Mammary Glands; Regeneration (Physiology)*

**20070015310** Yale Univ., New Haven, CT USA

**Mechanisms of Graft-vs.-Leukemia against a Novel Murine Model of Chronic Myelogenous Leukemia**

Shlomchik, Warren D; Jul 2006; 10 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0311

Report No.(s): AD-A464064; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464064>

Our objective is to understand the immunobiology underlying the differential sensitivity of chronic phase and blast crisis CML. Our data thus far support the hypothesis that GVL against mCP-CML can be mediated by redundant processes and that impairment of an individual pathway is insufficient to prevent GVL. We hypothesize that GVL against BC-CML is less forgiving than that against CP-CML, and that multiple effector pathways must act in concert for effective GVL. In the last year we have: 1) determined that cognate interactions are required for 0D4 and 0D8-mediated GVL; 2) determined that host antigen presenting cells are required for both 0D4 and 0D8-mediated GVL; 3) determined that killing by either FasL or TNF- $\alpha$  is not required for 0D4 or 0D8-mediated GVL; 4) created B7H14- mBC-CML; 5) determined that B7Hi expressed on mBC-CML does not impede 0D8-mediated GVL; 6) created TGF-p4- mBC-CML; and 7) determined that effector memory 0D4 cells can mediate GVL against mBC-CML.

DTIC

*Leukemias; Neoplasms; Rodents*

**20070015311** Maryland Univ. Baltimore County, Catonsville, MD USA

**A Novel Therapeutic Vaccine for Metastatic Mammary Carcinoma: Focusing MHC/Peptide Complexes to Lipid Rafts**

Dolan, Brian P; Nov 2006; 90 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0334

Report No.(s): AD-A464065; No Copyright; Avail.: CASI: A05, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464065>

Genetic engineering of tumor cells to express MHC class II and subsequent use of said cells for treatment of established and metastatic tumors has yielded promising results in animal models for treatment of breast cancer. It is widely believed that the vaccine efficacy is due to the ability of such tumor cells to present tumor-specific antigens to CD4+ T helper cells which activate the immune system to eradicate tumors. Next generation cell-based vaccines will have enhanced antigen presentation capabilities to further stimulate the anti-tumor immune response. It has recently been proposed that MHC class II molecules physically localize to cell-surface microdomains termed lipid rafts to enhance antigen presentation. Further more a correlation has been observed where cell-based tumor vaccines that have high levels of MHC class II in such rafts have higher efficacy than those with diminished or abolished levels of MHC class II in rafts. We propose to further target MHC class II molecules to lipid rafts to enhance the antigen presentation capabilities of tumor cell-based vaccines and than to use these modified vaccine cells for the treatment of established metastatic disease in mouse models of breast cancer.

DTIC

*Cancer; Lipids; Mammary Glands; Metastasis; Peptides; Rafts; Therapy; Vaccines*

**20070015312** California Univ., Berkeley, CA USA

**Role of PI3 Kinase Signaling Pathways in Polarity Development of Human Mammary Epithelial Cells Grown in Three-Dimensional Extracellular Matrix**

Mroue, Rana; Sep 2006; 32 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0099

Report No.(s): AD-A464066; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464066>

Establishment and maintenance of tissue polarity is a functional property of epithelial cells and loss of this property is a hallmark of the breast cancer phenotype. We have used a 3-dimensional culture assay in which malignant human breast cells can be phenotypically reverted to a non-malignant phenotype when PI3 kinase (PI3K) activity is inhibited. We show here that Akt and Rac1 act as downstream effectors of PI3K and function as control points of cellular proliferation and tissue polarity respectively. Signaling through these two effectors is sufficient to prevent restoration of a normal phenotype. We reveal key events downstream of PI3K that act synergistically to maintain tissue polarity and when disrupted result in malignant phenotype. We also find that activation of Akt1 can prevent invasive behavior in vitro. Activated Akt1 in human breast cancer cells affects cell motility and invasiveness by targeting the tumor suppressor tuberous sclerosis complex 2 (TSC2) for degradation leading to reduced Rho-GTPase activity. TSC2 thus acts as a downstream target of Akt1 to regulate breast cancer cell motility and invasion suggesting the need for caution in designing therapies targeting the function of individual genes in epithelial tissues.

DTIC

*Mammary Glands; Polarity*

**20070015369** University of Southern Mississippi, Hattiesburg, MS USA

**Coatings and Biodegradable and Bioabsorbable Films**

Thames, Shelby F; Rawlins, James W; Dec 28, 2006; 59 pp.; In English

Contract(s)/Grant(s): N00014-04-1-0703

Report No.(s): AD-A464188; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464188>

Research and development activities focused on environmentally friendly monomer, polymer and composite materials for Navy coating and packaging needs. Specifically focusing on the plasticizing effects of vegetable oil macromonomers as incorporated into emulsion polymers for efficient almost zero VOC film formation and the additional benefit of auto-oxidative polymerization after application. The resulting formulated coatings met or exceeded each of the specified Military specifications and are currently being evaluated for larger surface area application ease in combination with monomer and polymer scale up and commercialization. Polyesters and polyester-urethane block copolymers were evaluated for potential as biodegradable food packaging and pallet stretch wrap. The screening studies have resulted in materials with similar toughness as conventional materials and cursory data suggest acceptable biodegradability. Further evaluations will be performed in conjunction with the Natick Soldier Center. High throughput screening methods were evaluated as a precursor for ASTM 6691-01 testing and proved valuable by reducing the screening time 30 days to 48 hours. Several areas of optimization, such as the types of bacterial organism, were investigated where fluorescence was a most convenient method for microtiter plate detection. Excellent progress was made developing new nanocomposites and salt water triggered dissolution and degradation of polyester composites.

DTIC

*Biodegradability; Biodegradation; Coatings; Composite Materials; Microorganisms; Polyesters; Polymers*

**20070015380** Burnham Inst., La Jolla, CA USA

**Identification of New EGR1 Target Genes That Regulate Radiation Responses in Prostate Cancer Cells**

Arora, Shilpi; Jul 2006; 12 pp.; In English

Contract(s)/Grant(s): W81XWH-04-1-0029

Report No.(s): AD-A464215; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464215>

I have studied the induction of early stress response gene, Egr1, under various stress conditions in prostate cancer cells. I chose the induction of these cells by UV treatment for identifying target genes of Egr1 under this stress condition. I used ChIP on Chip (using promoter arrays) to identify these target genes. I helped in preparation of these promoter arrays which have +12,000 promoter sequences on them and then went ahead to standardize all the protocols to achieve minimum false positive results. These experiments helped me to identify various known and unknown targets of Egr1 such as IGF1,

MAP2K1, CDKN1B, CCNB2, ADAR and PAX3. We identified 177 target genes after the statistical analysis and verified that at least 68% of them contained Egr1 binding consensus sites in their promoters. Ten of these genes were validated by conventional Chip and by Q-RT-PCR analysis. The major pathways involved were Tissue Development/Cellular Movement/Gene Expression, Cell Death, Cell Cycle, Cell Signaling, Cellular Development, Cancer/Cell-To-Cell Signaling and Interaction. The results show that Egr1 induction upon UV irradiation leads to a cascade of events in prostate cancer cells. Further studies on these target genes are underway to study the effect of these genes after irradiation of cells.

DTIC

*Cancer; Chips; Chromatin; Genes; Irradiation; Prostate Gland; Proteins; Targets; Ultraviolet Radiation*

**20070015382** City Univ. of New York, NY USA

**Time-Resolved and Spectroscopic Three-Dimensional Optical Breast Tomography**

Alfano, Robert R; Apr 2006; 43 pp.; In English

Contract(s)/Grant(s): W81XWH-04-1-0461

Report No.(s): AD-A464218; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464218>

The research carried out during the current reporting period included: (a) Setting up of the near-infrared optical imaging experimental arrangements, (b) Development of an approach for optical tomographic imaging using independent component analysis (OPTICA), (c) Development of a tomographic image reconstruction approach using the 'round-trip matrix' approach, and, (d) Target detection and localization using the combined experimental and theoretical approaches. OPTICA is applicable for detection and localization of scattering, absorptive, and fluorescent targets and was demonstrated to provide locations of targets in model media, breast phantoms, and model breasts assembled using ex vivo human breast tissues with millimeter accuracy. The round-trip matrix approach could locate 6 targets embedded in a turbid medium that is 50 transport mean free path thick in simulation. These results have potential applications in obtaining accurate location of tumors within breast, as well as, in lumpectomy.

DTIC

*Breast; Cancer; Detection; Images; Imaging Techniques; Mammary Glands; Position (Location); Spectroscopy; Targets; Tomography*

**20070015388** Wayne State Univ., Detroit, MI USA

**Eicosanoid Regulation of Prostate Cancer Progression: Disruption of Hemidesmosomes and Collaboration in Tumor Invasive Growth**

Honn, Kenneth V; Nei, Daotai; Tang, Keqin; Lamberti, Mario; Mar 2005; 10 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0102

Report No.(s): AD-A464233; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464233>

A significant achievement in the current reporting period is our ability to immunostain both the 12-LOX protein and 4 integrin in paraffin-embedded prostate tumor tissues circumventing the problems described in the previous report. With the new protocol we have stained about 20 cases so far and the remaining cases are in progress. We have generated several stable transfectants of PC-3 cells expressing mutant forms of the 4 integrin and studied their interaction with 12-LOX. During this study, we have identified that the peptide spanning between amino acids 1126 and 1315 of the cytoplasmic tail of the 4 integrin shows strong interaction with 12-LOX. An important observation is that the full-length cytoplasmic tail of 4 integrin, when expressed ectopically, disrupts the interaction with 12-LOX with 4 integrin in a dominant negative manner. This interaction also resulted in a decrease in the biosynthesis of the enzymatic product, 12-HETE, as well as reduction in the tumor growth rate from subcutaneously injected PC-3 cells in athymic nu/nu mice.

DTIC

*Cancer; Cytoplasm; Prostate Gland; Tumors*

**20070015423** Johns Hopkins Univ., Baltimore, MD USA

**Mechanisms of Neuronal Apoptosis In Vivo**

Martin, Lee J; Feb 2004; 462 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-99-1-9553

Report No.(s): AD-A464285; No Copyright; Avail.: CASI: [A20](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464285>



Neuronal cell death in the central nervous system (CNS) has broad significance for military personnel in combat and veteran status and civilians. Neuronal cell death in the form of apoptosis or necrosis occurs after exposure to neurotoxins, chemical warfare agents, radiation, viruses, and after seizures, trauma, limb amputation, and hypoxic-ischemia caused by cardiac arrest, stroke, asphyxiation, and increased intracranial pressure. Secondary brain damage can result from hemorrhagic and hypovolemic shock. The goal of this project was to identify mechanisms of neuronal cell death. We discovered that injury-induced neuronal apoptosis in the adult CNS requires the Bax gene and involves an upregulation of Bax and its translocation to mitochondria. The Bax upregulation requires a functional p53 gene. The early events of target deprivation/axotomy-induced neuronal apoptosis involves oxidative stress, DNA damage, p53 phosphorylation, and subcellular redistribution of death proteins. The process of neuronal apoptosis involves a perinuclear accumulation of mitochondria and cytochrome C release from mitochondria and caspase-3 activation. Upstream signals for neuronal apoptosis within the CNS involve the accumulation of specific forms of DNA lesions, including single-strand breaks, that trigger p53 activation and downstream cell death. The DNA damage that occurs early during neuronal apoptosis has a reactive oxygen species fingerprint.

DTIC

*Apoptosis; Cells (Biology); Central Nervous System; Convulsions; Death; In Vivo Methods and Tests; Nervous System; Neurophysiology*

**20070015464** Arizona State Univ., Tempe, AZ USA

**Ion Channel Conductance Measurements on a Silicon-Based Platform**

Wilk, S J; Aboud, S; Petrossian, L; Goyll, M; Tang, J M; Eisenberg, R S; Saraniti, M; Goodnick, S M; Thornton, T J; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464359; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464359>

Conductance measurements of the transmembrane porin protein OmpF as a function of pH and bath concentration have been made with both a microfabricated silicon substrate device and a commercially available polystyrene aperture. Ion transport through the channel was simulated in atomic detail: the measured current was compared with theoretically calculated current, using a Brownian Dynamics kernel coupled to the Poisson equation by a P3M force field. The explicit protein structure and fixed charge distribution in the protein are calculated using the molecular dynamics code, GROMACS. Reasonable agreement is obtained in the simulated versus measured conductance over the range of experimental concentrations studied.

DTIC

*Measurement; Molecular Dynamics; Poisson Equation; Proteins; Silicon*

**20070015722** General Accounting Office, Washington, DC USA

**DOD and VA Health Care: Challenges Encountered by Injured Servicemembers during Their Recovery Process**

Bascetta, Cynthia A; Mar 8, 2007; 16 pp.; In English

Report No.(s): AD-A464382; GAO-07-606T; No Copyright; Avail.: CASI: [A03](#), Hardcopy

As of March 1, 2007, over 24,000 service members have been wounded in action since the onset of Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF), according to the Department of Defense (DoD). GAO work has shown that service members injured in combat face an array of significant medical and financial challenges as they begin their recovery process in the health care systems of DoD and the Department of Veterans Affairs (VA). GAO was asked to discuss concerns regarding DoD and VA efforts to provide medical care and rehabilitative services for service members who have been injured during OEF and OIF. This testimony addresses the following: (1) the transition of care for seriously injured service members who are transferred between DoD and VA medical facilities, (2) DoD's and VA's efforts to provide early intervention for rehabilitation for seriously injured service members, (3) DoD's efforts to screen service members at risk for post-traumatic stress disorder (PTSD) and whether VA can meet the demand for PTSD services, and (4) the impact of problems related to military pay on injured service members and their families. This testimony is based on GAO work issued from 2004 through 2006 on the conditions facing OEF/OIF service members at the time the audit work was completed.

DTIC

*Defense Program; Disorders; Health; Injuries; Medical Services; Mental Health; Military Personnel*

**20070015739** Daemen Coll., Amherst, NY USA

**Identification of Biomarkers Associated with the Healing of Chronic Wounds**

Edsberg, Laura E; Jul 2006; 24 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-05-1-0401

Report No.(s): AD-A464404; No Copyright; Avail.: CASI: [A03](#), Hardcopy

It is the objective of this study to identify the biomarkers associated with the earliest stages of healing in chronic wounds. The findings of this study are intended to facilitate the development a diagnostic tool which would evaluate the healing process. Samples have been collected from interior and peripheral wound sites over 6 weeks from 17 subjects thus far and analyzed using 2-D page. 161 spots/proteins have been identified that change over time in chronic wounds. The peripheral and interior sites sampled have different proteins present. Some proteins were present only in interior samples and not peripheral samples and vice versa. A series of shadow spots have been identified and linked with healing in chronic wounds. A number of experimental protocols have been developed during this first year including two data analysis methods. The identification of a series of shadow proteins which appear in wounds healing and disappear during non-healing periods, is the first important step in the identification of biomarkers associated with healing chronic wounds.

DTIC

*Biomarkers; Healing; Injuries*

**20070015749** Cincinnati Univ., OH USA

**Challenges and Opportunities for Biophotonic Devices in the Liquid State and the Solid State**

Steckl, A J; Hagen, J A; Yu, Z; Jones, R A; Li, W; Han, D; Kim, D Y; Spaeth, H; Grote, J G; Hopkins, F K; Jul 2006; 4 pp.;

In English; Original contains color illustrations

Report No.(s): AD-A464417; No Copyright; Avail.: CASI: [A01](#), Hardcopy

In this paper we discuss the unique challenges and opportunities present in using biomaterials in photonics applications. We describe biophotonic materials and devices fabricated and operated in the solid state (fluorescent nanometer thin films, light emitting diodes) and in the liquid state (electrofluidic fluorescent biosensor, microfluidic switches).

DTIC

*Biochemistry; Photonics; Solid State*

**20070015831** Naval War Coll., Newport, RI USA

**Red Cross Under Fire: The future of the Geneva Convention's Distinctive Emblem on the Future Combat System - Medical Variant Vehicle**

Bagwell, Randall J; Feb 14, 2005; 26 pp.; In English

Report No.(s): AD-A464550; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Future Combat System-Medical Variant (FCS-MV) vehicle offers self defense, sensor, communication, and medical capabilities that will make it the safest and most advanced medical evacuation vehicle in history. Unfortunately, much of these capabilities will have to be eliminated or severely limited under current Army policy which requires Army medical vehicles to display the red cross. The Army should reexamine its policy on marking medical vehicles in light of the advanced protection capabilities of the FCS-MV and the realities of fourth generation warfare. When the protections provided by the Geneva Convention if the red cross is displayed are compared to the protections a fully capable FCS-MV would have if it does not display the red cross, the answer is clear, the FCS-MV should be unmarked.

DTIC

*Ambulances; Combat; Conventions; Evacuating (Transportation); Medical Services*

**20070015976** Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA

**Powered Air-Purifying Respirator (PAPR) Canister Particulate Efficiency Benchmark Testing**

Gardner, Paul D; Eshbaugh, Jonathan P; Nov 2006; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464118; ECBC-TR-490; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464118>

This investigation performed particulate efficiency testing of commercial chemical, biological, radiological, and nuclear powered air-purifying respirator (PAPR) canister filters to provide benchmark data to the National Institute for Occupational Safety and Health (NIOSH). The data was provided to assist NIOSH in establishing appropriate test parameters and performance criteria for certifying the particulate efficiency of these filters. Two separate evaluations were performed under constant and cyclic flow conditions: an initial penetration test and an aerosol loading test. The initial penetration test assessed

the particulate filtration efficiency of a poly-alpha olefin aerosol at two cyclic flow conditions (85 and 135 L/min) and one of three constant flow conditions (85, 270, or 360 L/min). The aerosol loading test assessed the effect of dioctyl phthalate (DOP) oil aerosol loading on particulate filtration efficiency at high cyclic (135 L/min) and constant (270 L/min) flow conditions. In both evaluations, the test airflow rates were reduced in direct proportion to the number of filters used in the PAPR model. The effect of increased airflow and DOP aerosol loading on particulate filtration efficiency was negligible, as all PAPR filters tested exceeded the 99.97% high efficiency particulate air efficiency criterion level.

DTIC

*Air Filters; Cans; Particulates; Respirators; Safety*

**20070015995** Kentucky Univ., Lexington, KY USA

**Neuregulins, Neuroprotection and Parkinson's Disease**

Yurek, David M; Seroogy, Kim B; Sep 2006; 37 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0174

Report No.(s): AD-A463818; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463818>

The main hypothesis being tested in this research project is that neuregulins, primarily focusing on glial growth factor-2 (GGF2), is neuroprotective and/or neurorestorative for the damaged dopaminergic nigrostriatal system. Other hypotheses to be tested are that GGF2 augments functional indices of the dopaminergic nigrostriatal system and that one of the intracellular signaling mechanisms mediating the protective effects of neuregulins for dopamine neurons involves the PI3-kinase pathway. These studies are being conducted in normal rats, in a 6-OHDA rat model of Parkinson's disease, in primary neuronal cultures of midbrain dopamine cells, and in a dopaminergic cell line. Overall, results from these studies may form the basis for the therapeutic application of neuregulins to the treatment of neurotoxin-induced neurodegenerative disorders such as Parkinson's disease.

DTIC

*Diseases; Cells (Biology); Parkinson Disease*

## 52

### AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments, see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

**20070015294** NTI, Inc., Dayton, OH USA

**Daytime Sleep Aids and Nighttime Cognitive Performance**

Eddy, Douglas; Barton, Emily; Cardenas, Rebecca; French, Jonathan; Gibbons, John; Hickey, Patrick; Miller, James; Ramsey, Carol; Storm, William; Nov 2005; 41 pp.; In English

Contract(s)/Grant(s): FA1624-97-D-6004

Report No.(s): AD-A464047; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464047>

Air and ground crews are often given rest opportunities at atypical times, outside of a normal entrained circadian sleep period. Due to normal human biology, this practice often leads to delayed, thus shortened, sleep as well as restless sleep. In such cases, a sleep promoting or 'No-Go' medication may be prescribed to promote a more restorative crew rest. This study compared two doses of the hypnotic zolpidem, two doses of melatonin and placebo for their effects on daytime sleep, on nighttime cognitive performance and on mood in an operationally and militarily relevant paradigm. The participants worked all night. Subsequently, an Early Group slept from 0800-1600 and a Late Group slept from 1400-2200. The participants worked all night again. Measures included polysomnography, simple and complex cognitive task performance, vigilance, subjective reports, salivary melatonin, and vital signs. Neither zolpidem nor melatonin was successful in improving daytime sleep compared to placebo. Participants slept longer under the medicated treatments, but it was not statistically significant. Sleep inertia was deepened by the use of zolpidem and may prolong degraded performance, sleepiness and fatigue. In this study, there were no advantages for morning or afternoon sleepers for nighttime alertness, mood or performance. The Foret & Lantin (1972) findings of 34 hours of sleep during the day do not appear to hold for sleep-deprived people sleeping under ideal conditions. For two consecutive work nights, ideal daytime sleeping conditions appear to provide nearly as much sleep

as a sleep aid and without any risk to nighttime performance or side effects.

DTIC

*Cognition; Daytime; Hormones; Melatonin; Mental Performance; Night; Sleep*

**20070015295** Air Force Research Lab., Brooks AFB, TX USA

**The Fatigue Equivalent of Job Experience and Performance in Sustained Operations**

Harville, Donald; Harrison, Richard; Scott, Chaiken; May 2006; 25 pp.; In English

Contract(s)/Grant(s): Proj-7757

Report No.(s): AD-A464048; AFRL-HE-BR-TR-2006-0042; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464048>

Individual cognitive performance data taken under a 36-hour fatigue protocol, are assessed for predictability using self-reports of previous fatigue experience. The performance data are from three-person teams of Air Battle Management students, from Tyndall AFB, FL, participating in a larger study. Variables related to age at first remembered sustained wakefulness and frequency of sustained wakefulness were significantly related to individual cognitive performance. Applications for the current research and suggestions for future research are given.

DTIC

*Cognition; Experience; Human Performance; Sleep; Wakefulness*

**20070016002** NASA Johnson Space Center, Houston, TX, USA

**Relative Bioavailability of Scopolamine Dosage Forms and Interaction with Dextroamphetamine**

Boyd, Jason L.; Du, Brian; Vaksman, Zalman; Locke, James P.; Putcha, Lakshmi; [2007]; 1 pp.; In English; International Society of Gravitational Physiology, 8-13 Apr. 2007, San Antonio, TX, USA; Copyright; Avail.: Other Sources; Abstract Only

The NASA Reduced Gravity Office (RGO) uses scopolamine (SCOP) and in combination with dextroamphetamine (DEX) to manage motion sickness symptoms during parabolic flights. The medications are dispensed as custom dosage forms as gelatin capsules. Anecdotal evidence of efficacy suggests that these formulations are unreliable and less efficacious for the treatment of motion sickness. We estimated bioavailability of four different oral formulations used by NASA for the treatment of motion sickness. Twelve healthy, non-smoking subjects between 21 and 48 years of age received four treatments on separate days in a randomized fashion; the treatments were 0.8 mg SCOP alone as tablet, 0.8 mg SCOP alone in gel cap, 0.8 mg SCOP and 10 mg DEX as tablets, and 0.8 mg SCOP and 10 mg DEX in gel cap. After each treatment, blood, saliva, and urine samples were collected at scheduled time intervals for 24 h after dosing. Bioavailability and pharmacokinetic parameters were calculated and compared using ANOVA. After administration of SCOP tablets alone, maximum concentration ( $C_{sub\ max}$ ) and time for maximum concentration ( $t_{sub\ max}$ ) were 0.26 plus or minus 0.04 ng/mL and 0.71 plus or minus 0.02 h, respectively; volume of distribution, and clearance were 47.6 plus or minus 4.72 L/kg and 23.0 plus or minus 4.58 L/h/kg, respectively. SCOP  $t_{sub\ max}$  after administration as gelcaps was significantly longer than that with tablets (1.04 h,  $p$  less than 0.05), but no significant differences in other pharmacokinetic parameters of SCOP were observed between the two dosage forms. When coadministered with DEX, the area underneath the concentration versus time curve (AUC) of SCOP was significantly reduced to 0.61 plus or minus 0.09 and 0.64 plus or minus 0.11 ng (raised dot) h/mL after administration as a tablet or gelcap formulation, respectively; SCOP  $C_{sub\ max}$  was lower after coadministration with DEX, this difference, however, was not statistically significant. Delayed absorption with gelcaps coupled with reduced bioavailability with DEX coadministration may have resulted in the observed treatment failure with some of these formulations. This could result from failure to reach minimum effective concentrations after treatment with gelcap formulations before parabolic flights. A new nomogram for dosing is proposed for treatment with SCOP gelcaps or SCOP-DEX combination.

Author

*Drugs; Amphetamines; Dosage; Bioavailability; Aerospace Medicine*

**20070016013** Oxford Univ., Oxford, UK

**Sleep Deprivation in Humans And Transient Immunodepression**

Castell, Linda; Jul 21, 2003; 27 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F61775-02-W-E005

Report No.(s): AD-A464616; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report results from a contract tasking University of Oxford as follows: The contractor will investigate the effects of

limited sleep loss on the depression of immune function as well as the use of glutamine supplementation to restore or enhance immune function.

DTIC

*Sleep Deprivation; Sleep*

**20070016626** NASA Johnson Space Center, Houston, TX, USA

**Space Nutrition: Lessons from the International Space Station and Implications for Future Exploration**

Smith, Scott M.; Zwart, Sara R.; 25 May 2007; 1 pp.; In English; International Space Development Conference, 25 May 2007, Dallas, TX, USA; Copyright; Avail.: Other Sources; Abstract Only

Throughout history, many have learned the hard way that adequate nutrition is crucial for successful exploration. Space exploration will be no different from earlier, Earth-bound expeditions, except that food will not be found during the course of a journey in space. Ensuring the health and safety of astronauts is critical, and nutrition will contribute in several ways to that end. Nutritional assessment of International Space Station (ISS) crew members allows us to evaluate the nutritional health of individuals and also to gain a better understanding of how space flight affects nutritional requirements, and how nutrition can mitigate the negative effects of weightlessness on humans. Available data suggest that the nutritional status of astronauts is compromised during and after flight. Inadequate dietary intake and subsequent weight loss are often considered hallmarks of space flight, although exceptions have occurred. Beyond energy intake, issues also exist with specific nutrients, indicating that the problem is not simply inadequate consumption. Decrements have been noted in blood concentrations of vitamins, including vitamin D and folate. Hematological and antioxidant defense systems are also affected: iron storage and markers of oxidative damage typically increase after flight. Bone loss during space flight remains a critical challenge. Ground-based studies have established that nutrition is a potent modulator of the bone response to simulated weightlessness. During studies of simulated weightlessness, protein and sodium are two nutrients that tend to exacerbate bone resorption and subsequent calcium loss, likely through alterations in acid-base balance. Unfortunately, the current space food system generally provides an abundance of protein and sodium, even when the total number of calories consumed is inadequate. Defining nutrient requirements and being able to provide and maintain the required amounts of nutrients on exploration missions will be critical for maintaining crew-member health. A full understanding of the role of nutrition during space flight will not only enhance crew health and safety during flight but also expand our knowledge of the role of nutrition in the health of humans on Earth.

Author

*Nutritional Requirements; International Space Station; Aerospace Medicine; Health; Spacecrews; Space Exploration; Vitamins; Calciferol; Caloric Requirements*

**20070016629** NASA Johnson Space Center, Houston, TX, USA

**Gender Differences in Cardiovascular Tolerance to Short Arm Centrifugation**

Fong, Kevin J.; Arya, Maneesh; Paloski, William H.; Apr. 13, 2007; 1 pp.; In English; 28th Annual International Gravitational Physiology, 8-13 Apr. 2007, San Antonio, TX, USA

Contract(s)/Grant(s): NIH-MOI-RR-0073; Copyright; Avail.: Other Sources; Abstract Only

In preparation for the NASA Artificial Gravity (AG) pilot study, the tolerability of the proposed AG parameters was tested in 11 ambulatory human subjects (6m, 5w) by exposing each to a short arm centrifuge trial. Subjects were oriented in the supine position (but inclined 6deg head down) on one arm of the centrifuge, and the rotation rate (30.6-33.4 rpm) and radial position of the feet were set to produce 2.5G of equivalent gravitational load at the force plate directly beneath the feet, 1G at the level of the mediastinum, and approximately 0.55G at the labyrinth. Amongst the 6 men participating in this preliminary study, 5 completed at least 60 minutes of the trial successfully with no adverse sequelae. However, amongst the female cohort the test was stopped by the medical monitor before 60 min in all but one case, with pre-syncope listed as the reason for termination in all cases. Mean time before abort of the centrifuge run amongst the women was 33.2 +/- 20.97 min. It is known that women have a greater predisposition to syncope during orthostatic stress, under normal tilt table conditions, during LBNP, and following space flight. The reasons for this difference are the subject of some debate, but anthropometric factors, the vasoactive effects of sex hormones, gender differences in susceptibility to motion sickness, catecholamine levels, ability to augment total peripheral resistance in response to orthostatic stress, and structural differences in cardiac anatomy and physiology have all been suggested. This finding led to the exclusion of women from the AG pilot study. Clearly if AG is to be employed as a multi-system countermeasure it must provide physiological protection at rotation rates within the tolerance limits of all potential astronauts. Further investigation of the responses of women to centrifugation will be necessary to determine how to adjust AG parameters for tolerance by female subjects before a more detailed investigation of the appropriate

dose in terms of G load, rotation rate, exposure duration and frequency can be performed.

Author

*Cardiovascular System; Exposure; Lower Body Negative Pressure; Orthostatic Tolerance; Physiology; Centrifuging*

**20070016630** NASA Johnson Space Center, Houston, TX, USA

**Recommendations for Refinement and Validation of Intermittent Artificial Gravity**

Young, Lauren R.; Paloski, William H.; Apr. 13, 2007; 1 pp.; In English; 28th Annual International Gravitational Physiology, 8-13 Apr. 2007, San Antonio, TX, USA

Contract(s)/Grant(s): NIH-M01-RR-00073; NCC9-59; No Copyright; Avail.: Other Sources; Abstract Only

The IMAG Pilot Study, recently completed at the University of Texas Medical Branch, filled in the second major gap in knowledge standing in the way of development of a practical Short Radius Centrifuge (SRC) and the use of Artificial Gravity (AG) as a multi-system countermeasure to combat the deconditioning associated with extended weightlessness. (The first challenge, to adapt rapidly rotating subjects to permit unlimited head movements without excessive motion sickness, was achieved in a series of studies at MIT involving incremental increases in head and centrifuge velocity.) It remained to be demonstrated that intermittent exposure to AG, at only one hour per day for 21 days, would have any positive effect on slowing or eliminating of deconditioning. Bed-rested normal subjects were used as a ground analog for astronauts in weightlessness. The results are clearly positive for the key physiological systems of interest: cardiovascular, muscle, and bone. No functionally relevant changes were observed in immune, cognitive, or sensory-motor function. Furthermore, we found that our initial concerns about the inability of deconditioned subjects to withstand daily centrifugation without syncope were misplaced. These encouraging initial results clearly support the further development of AG protocols. We recommend, as the next steps, the integration of a controlled exercise device on the SRC to determine the synergy between AG and exercise. Coupled with appropriate exercise device(s) the AG protocol will be tuned to-ward an optimal prescription for minimum exposure duration and frequency, maximum AG level and SRC speed.. Performance of these next steps will require extensive use of bed-rest/centrifuge facilities and eventually validation using an SRC in space. A space SRC could be placed in the ISS or on a planetary surface.

Author

*Artificial Gravity; Weightlessness; Sensorimotor Performance; Physiology; Centrifuging; Cardiovascular System; Aerospace Medicine; Physical Exercise; Motion Sickness*

**20070016631** NASA Johnson Space Center, Houston, TX, USA

**Artificial Gravity as a Multi-System Countermeasure to Bed Rest Deconditioning: Pilot Study Overview**

Paloski, William H.; Young, L. R.; Apr. 13, 2007; 1 pp.; In English; 28th International Gravitational Physiology Meeting, 8-13 Apr. 2007, San Antonio, TX, USA

Contract(s)/Grant(s): NIH-MO1-RR-0073; Copyright; Avail.: Other Sources; Abstract Only

Efficient, effective, multi-system countermeasures will likely be required to protect the health, safety, and performance of crews aboard planned exploration-class space flight missions to Mars and beyond. To that end, NASA, DLR, and IMBP initiated a multi-center international project to begin systematically exploring the utility of artificial gravity (AG) as a multi-system countermeasure in ground based venues using test subjects deconditioned by bed rest. The goal of this project is to explore the efficacy of short-radius, intermittent AG as a countermeasure to bone, muscle, cardiovascular, and sensory-motor adaptations to hypogravity. This session reports the results from a pilot study commissioned to validate a standardized protocol to be used by all centers involved in the project. Subject selection criteria, medical monitoring requirements, medical care procedures, experiment control procedures, and standardized dependent measures were established jointly. Testing was performed on 15 rigorously screened male volunteers subjected to 21 days of 6deg HDT bed rest. (All provided written consent to volunteer after the nature of the study and its hazards were clearly explained to them.) Eight were treated with daily 1hr AG exposures (2.5g at the feet decreasing to 1.0g at the heart) aboard a short radius (3m) centrifuge, while the other seven served as controls. Multiple tests of multiple dependent measures were made in each of the primary physiological systems of interest during a 10 day acclimatization period prior to HDT bed rest and again during an 8 day recovery period after the bed rest period was complete. Analyses of these data (presented in other papers in this session) suggest the AG prescription had salutary effects on aspects of the bone, muscle, and cardiovascular systems, with no untoward effects on the vestibular system, the immune system, or cognitive function. Furthermore, treatment subjects were able to tolerate 153/160 centrifuge sessions over the 21 day deconditioning protocol, suggesting that tolerance was unaffected by deconditioning. These positive results set the stage for full implementation of the planned multi-center international AG project. Future work will be devoted to developing optimization techniques for AG prescriptions (likely supplemented by exercise) to provide maximum physiological protection across all systems subject to space flight deconditioning in both men

and women with minimum time and/or side effects. While a continuous AG solution (rotating vehicle) would likely be more efficient, this study suggests that intermittent AG could be an effective multi-system countermeasure.

Author

*Aerospace Medicine; Artificial Gravity; Bed Rest; Countermeasures; Deconditioning; Health; Sensorimotor Performance; Microgravity*

**20070016633** NASA Johnson Space Center, Houston, TX, USA

**Stroboscopic Vision as a Treatment for Retinal Slip Induced Motion Sickness**

Reschke, M. F.; Somers, J. T.; Ford, G.; Krnavek, J. M.; Hwang, E. J.; Leigh, R. J.; Estrada, A.; [2007]; 1 pp.; In English; VIMS 2007, First International Symposium Induced Motion Sickness, Fatigue, and Photosensitive Epileptic Seizures, 10-11 Dec. 2007, Hong Kong; Copyright; Avail.: CASI: [A01](#), Hardcopy

Motion sickness in the general population is a significant problem driven by the increasingly more sophisticated modes of transportation, visual displays, and virtual reality environments. It is important to investigate non-pharmacological alternatives for the prevention of motion sickness for individuals who cannot tolerate the available anti-motion sickness drugs, or who are precluded from medication because of different operational environments. Based on the initial work of Melvill Jones, in which post hoc results indicated that motion sickness symptoms were prevented during visual reversal testing when stroboscopic vision was used to prevent retinal slip, we have evaluated stroboscopic vision as a method of preventing motion sickness in a number of different environments. Specifically, we have undertaken a five part study that was designed to investigate the effect of stroboscopic vision (either with a strobe light or LCD shutter glasses) on motion sickness while: (1) using visual field reversal, (2) reading while riding in a car (with or without external vision present), (3) making large pitch head movements during parabolic flight, (4) during exposure to rough seas in a small boat, and (5) seated and reading in the cabin area of a UH60 Black Hawk Helicopter during 20 min of provocative flight patterns.

Author

*Motion Sickness; Display Devices; Signs and Symptoms; Retina; Parabolic Flight; Head Movement*

**20070016652** CNI Aviation, LLC, Ada, OK, USA, Civil Aerospace Medical Inst., Oklahoma City, OK, USA

**Index to FAA Office of Aerospace Medicine Reports: 1961 through 2006**

Collins, William E.; Wayda, Michael E.; January 2007; 97 pp.; In English  
Report No.(s): DOT/FAA/AM-071/1; No Copyright; Avail.: CASI: [A05](#), Hardcopy

The index is organized in three sections: a chronological index: a cumulative list of all research reports from 1961 through 2006; an author index that includes all contributing authors, in alphabetical order; and a subject index. A historical vignette of research accomplishments of a biochemistry research team dedicated to combustion toxicology with emphasis on smoke toxicity to survival in postcrash aircraft fires.

Derived from text

*Aerospace Medicine; Bibliographies; Aircraft Safety; Flight Hazards*

**20070016670** NASA Johnson Space Center, Houston, TX, USA

**Medical Monitoring during Short Radius Centrifugation in Bed-rested Subjects**

Reinertson, Randal; Nelson, Victor; Aunon, Serena; Schlegel, Todd; Paloski, William; Apr. 8, 2007; 1 pp.; In English; 28th Annual International Gravitational Physiology, 8-13 Apr. 2007, San Antonio, TX, USA  
Contract(s)/Grant(s): MOI-RR-00073; No Copyright; Avail.: Other Sources; Abstract Only

The artificial gravity pilot project was designed to investigate the efficacy of daily exposure to a Gz acceleration gradient for counteracting the physiologic decrements induced by prolonged bed rest. A short radius centrifuge was used to produce a Gz gradient such that 1 g was applied at the level of the subject's heart and 2.5 g at the feet. For inclusion in the study, subjects were required to complete a 75-minute screening spin on the centrifuge. During the study, each active treatment subject was scheduled for a 60-minute spin each day for 20 consecutive days. During centrifugation, subjects were continuously monitored by a physician for signs and symptoms of pre-syncope, motion sickness, arrhythmias, joint/muscle pain and any other unanticipated problems. The physician was also present to provide emergency care in the case of a medical emergency. Cameras mounted on the centrifuge were used to provide a means of observing the subject's face and torso. Audio communication was continuously maintained. Other monitoring tools included two-lead EKG tracings, pulse oximetry, intermittent sphygmomanometer readings, lights in the peripheral visual field, and continuous blood pressure readout from a tonometry device. Thirty screening runs were attempted using twenty-seven subjects. Seven of these runs were terminated early for symptoms of pre-syncope, motion sickness, or GI distress. A total of eight subjects completed the active treatment

arm of the study. Of the 160 centrifuge runs that were scheduled for these eight treatment subjects, 152 were completed, seven were terminated early, and one was not attempted. Of the seven early terminations, four were related to symptoms of pre-syncope, one to leg pain, one to GI discomfort, and one to equipment failure. Three terminations for adverse symptoms occurred on the first treatment day. Three terminations occurred on day nineteen of treatment and within 24 hours after scheduled soleus and quadriceps muscle biopsies. We have summarized the relative usefulness of the information obtained by the various monitoring modalities in making a decision to terminate a centrifuge run. The video and audio communication information was essential to the decision-making process. Heart rate and EKG tracings are considered valuable, even though no spins were terminated due to significant arrhythmias. The tonometer device was generally not reliable in this application. Our observations suggest that subjects may be less tolerant of centrifugation just after starting bed rest and after invasive procedures.

Author

*Artificial Gravity; Bed Rest; Physiology; Centrifuging; Motion Sickness; Arrhythmia; Electrocardiography; Exposure; Muscles*

**20070016671** NASA Johnson Space Center, Houston, TX, USA

#### **Implementation of the NASA AG-Bed Rest Pilot**

Warren, L. E.; Paloski, W. H.; Young, L. R.; Apr. 8, 2007; 1 pp.; In English; 28th Annual International Gravitational Physiology Meeting, 8-13 apr. 2007, San Antonio, TX, USA

Contract(s)/Grant(s): NIH MOI-RR-0073; Copyright; Avail.: Other Sources; Abstract Only

To examine the efficacy of artificial gravity (AG) as a countermeasure to spaceflight deconditioning, intermittent AG produced by a horizontal short-radius centrifuge (SRC) was utilized on human test subjects deconditioned by bed rest. This poster will present the subject screening, study design, logistics, and implementation of the 41 day pilot study conducted at the University of Texas Medical Branch, Galveston, TX bed rest facility. An extensive screening process was employed to exclude subjects that were dissimilar to the U.S. astronaut population. Candidates underwent a modified U.S. Air Force Class III physical and tests of bone density, cardiovascular fitness, vestibular system function, psychological fitness and centrifuge tolerance. 15 subjects completed the study; 7 control and 8 AG treatment. All provided written consent to volunteer after the nature of the study and its hazards were clearly explained to them. Standard conditions were strictly regulated;  $T_a = 72 \pm 2$  F, humidity =  $70 \pm 5\%$ , light/dark cycle 16h:8h. All fluid intake (minimum 28.5 ml/kg body weight/day) and urine output was monitored. Caloric intake was adjusted as necessary to maintain body weight. Carbohydrate, fat and protein were provided in a ratio of 55:30:15. Phosphorus intake was 1400 mg/d, sodium intake was 2 mmol/kg/d, potassium intake was 1.3 mmol/kg/d, and dietary calcium intake was 1000 mg/d. A physician examined each subject daily. During the first 11 days of the study protocol, subjects were ambulatory, but confined to the facility. Subjects participated in multiple baseline tests of bone, muscle, cardiovascular, sensory-motor, immunological, and psychological function. On the 12th day, subjects entered the bed rest phase of the study, during which they were confined to strict 6° head down tilt bed rest for 21 days. Beginning 24 hrs into this period, treatment subjects received 1 hour daily exposures to artificial gravity which was produced by spinning the subjects on a 3.0 m radius SRC. They were oriented radially in the supine position so that the centrifugal force was aligned with their long body axis, and while spinning, they stood on a force plate, supporting the centrifugal loading (2.5 g at the feet, 1.0 g at the heart). The subject station allowed free translation over approximately 10 cm to ensure full loading of the lower extremities and to allow for anti-orthostatic muscle contractions. Control subjects were positioned on the centrifuge but did not spin. Following the bed rest phase, subjects were allowed to ambulate again, but remained within the facility for an additional 9 days and participated in multiple follow-up tests of physiological function.

Author

*Bed Rest; Head Down Tilt; Artificial Gravity; Aerospace Medicine; Physiology; Centrifuges; Deconditioning; Exposure; Sensorimotor Performance*

## 54

### **MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

Includes human factors engineering, bionics, man-machine systems, life support, space suits and protective clothing. For related information see also *16 Space Transportation and Safety* and *52 Aerospace Medicine*.

**20070014822** Kentucky Univ., Lexington, KY, USA

#### **Research and Evaluation Methods for Measuring Nonroutine Mine Health and Safety Skills: Bibliography**

Cole, H. P.; Berger, P. K.; Vaught, C.; Lacefield, W. G.; Wasielewski, R. D.; Jun. 1988; 71 pp.; In English

Contract(s)/Grant(s): USBM-H0348040

Report No.(s): PB2007-107270; BRASH/R85-2; No Copyright; Avail.: CASI: [A04](#), Hardcopy



A comprehensive review of published research was carried out to identify methods for teaching and assessing critical but nonroutine skills needed for coping with emergency situations. Computerized searches of the relevant databases were carried out, along with identification of relevant articles and materials by personal contact with experts in many fields. The citations listed in this bibliography resulted from this systematic literature search and review. The computer searches and an analysis of this literature are described in technical report 1. Specific methods for assessing critical skills proficiency in aviation, medicine, organization management, the military, and other industrial technical workplaces were described. The potential application of these methods for teaching and assessing (1) critical first aid and (2) self-rescue and escape skills to underground coal miners in annual refresher training was explored. Research and development activities that may improve mine health and safety training were suggested. Most of the entries in this bibliography were assembled in 1984 through 1985. Study of these materials contributed to the completion of the project research that followed. This later work is reported in the project technical report 2 and the final report. This bibliography is most useful when combined with examination of technical reports 1 and 2 and the final project report.

NTIS

*Bibliographies; Education; Health; Mining; Rescue Operations; Safety; Survival*

**20070015061** Battelle Center for Human Performance and Safety, Seattle, WA, USA

**Crash Warning System Interfaces: Human Factors Insights and Lessons Learned**

Campbell, J. L.; Richard, C. M.; Brown, J. L.; McCallum, M.; Jan. 2007; 184 pp.; In English

Contract(s)/Grant(s): TNH22-02-D-02104

Report No.(s): PB2007-107430; No Copyright; Avail.: National Technical Information Service (NTIS)

The goal of this project has been to develop human factors insights and lessons learned for crash warning devices that emphasize driver performance and safety. The project reflects an important review of the human factors literature associated with the effective implementation of crash warning system interfaces; the lessons learned from this literature were characterized in terms of guidelines for interface design and driver performance. This document is intended to highlight issues to be addressed and provide guidance in the development of Collision Warning Systems (CWSs); the guidelines presented here reflect the best-available human factors information, and are neither requirements nor mandates. Information is presented on a variety of topics relevant to the driver-vehicle interface (DVI) of CWS devices. Chapters 2 through 11 contain the design guidelines produced through this effort. Chapter 2 provides general guidelines for CWS design, and focuses on issues associated with levels of warning and the prioritization of warnings, as well as recommendations for preventing false and nuisance alarms. Chapter 3 provides guidelines for presenting auditory warnings and focuses on the selection and design of various options for auditory warnings, including simple tones, earcons, auditory icons, and speech messages. Chapter 4 provides guidelines for visual warnings, focusing on recommendations for using visual displays and on determining the most appropriate visual display. Chapter 5 provides guidelines for haptic warnings, focusing on recommendations for using haptic displays and on determining the most appropriate haptic warnings. Chapter 6 provides a set of guidelines for selecting and designing user controls for CWS devices. Chapters 7, 8, and 9 provide respectively guidelines for forward collision (headway warning), lane change (blind spot warning) and road departure warnings; each of these chapters provides guidance on developing both cautionary and imminent warnings, as well as device-specific guidance for visual, auditory, and haptic warnings. Chapter 10 provides a series of guidelines specific to heavy truck and bus applications.

NTIS

*Collision Avoidance; Crashes; Human Factors Engineering; Warning Systems*

**20070015117** Army Research Lab., Aberdeen Proving Ground, MD USA

**An Initial Investigation of Factors Affecting Multi-Task Performance**

Branscome, Tera A; Swoboda, Jennifer C; Fatkin, Linda T; Feb 2007; 48 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463518; ARL-TR-4025; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463518>

This report presents the results of the first in a series of investigations designed to increase fundamental knowledge and understanding of the factors affecting multi-task performance in a military environment. The primary objective of this laboratory experiment was to measure and quantify the effects of individual differences on human performance in a multi-task environment. The secondary objective was to observe the effects of previous computer experience and practice and to determine which relationships, if any, exist between personality and self-efficacy traits and multi-task performance. In this study, each of 76 civilian and military participants completed a battery of questionnaires designed to gather information about individual differences. Included were a demographics questionnaire that solicited information regarding age, gender, vision and hearing, military service, and computer use and experience; the Zuckerman-Kuhlman Personality Questionnaire Form III

which identifies five components of personality in five subscales including activity, aggression-hostility, sociability, neuroticism-anxiety, and impulsive risktaking; the polychronicity scale which measures the extent to which individuals prefer working on several tasks at once as opposed to working on only one task at a time; and the Situational Self-Efficacy (SSE) scale which measures the participants level of confidence in their ability to do a task well. After completion of the questionnaires, multi-task performance was measured using SYNWORK (Synthetic Work Environment), a computer-based synthetic work environment that runs on a personal computer or a laptop (Elsmore, 1994). Participants were required to work simultaneously on four distinct tasks that were presented on a computer screen: Sternberg memory, three-column addition, visual tracking, and signal discrimination. These tasks required continuous attention and involved memory, arithmetic processing, and visual and auditory monitoring.

DTIC

*Human Factors Engineering; Human Performance; Tasks*

**20070015155** Johns Hopkins Univ., Laurel, MD USA

**A Hybrid Approach to Cognitive Engineering: Supporting Development of a Revolutionary Warfighter-Centered Command and Control System**

Ockerman, Jennifer; McKneely, Jennifer A; Koterba, Nathan; Jun 2005; 32 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463763; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463763>

Traditional cognitive engineering approaches do not adequately address the breadth of human performance issues in revolutionary Command and Control (C2) systems. Consequently, a best practices approach has been developed. This paper describes an integrated cognitive engineering approach the Effects-based Decision Analysis Methodology (EDAM) for the requirements analysis and design of revolutionary command and control systems and domains. This hybrid approach uses knowledge elicitation and representation techniques from several current cognitive engineering methodologies. The techniques were chosen to allow for decision analysis in the absence of an existing similar system or domain. EDAM focuses on the likely system or domain constraints and the decisions required within that structure independent of technology, existing or planned.

DTIC

*Command and Control; Decision Support Systems; Prototypes*

**20070015360** Cybernet Systems Corp., Ann Arbor, MI USA

**Improving Human Interfaces in Military Simulation Applications**

Rowe, Steve; Band, Joshua; Cohen, Charles J; Haas, Michael W; Sep 2006; 8 pp.; In English

Contract(s)/Grant(s): FA8650-05-M-6567; Proj-3005

Report No.(s): AD-A464169; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464169>

This paper highlights some of the key human factors issues that we found in OneSAF, and how we chose to remedy them in our own system design. The goal is to provide guidelines for application human interface design standards so that future tools developed for the Department of Defense allow the operator to perform more effectively.

DTIC

*Human-Computer Interface; Military Technology; Simulation*

**20070015866** Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA USA

**Performance in Non-to-Face Collaborative Information Environments**

Schaab, Brooke B; Dressel, J D; Sabol, Mark A; Rittman, Andrea L; Jan 2007; 29 pp.; In English

Contract(s)/Grant(s): Proj-A790

Report No.(s): AD-A464628; ARI-RR-1865; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Using technology to obtain and process information requires training not only in human-computer interaction but also in human-human-computer (collaborative) interaction. Warfighters must not only develop their own situational awareness (SA), they must understand each others' SA (Pew, 1995). This common ground is what each collaboration participant assumes about the others to ensure effective interactions (Ross, 2003; Wellons, 1993). Communication is key. Collaborators must coordinate

and share information. Collaboration influences military operations at all levels. Technical interoperability is not enough to produce the synchronization required.

DTIC

*Education; Human-Computer Interface; Leadership; Military Personnel; Personnel Development; Situational Awareness*

**20070016007** NASA Johnson Space Center, Houston, TX, USA

**The Walkback Test: A Study to Evaluate Suit and Life Support System Performance Requirements for a 10 Kilometer Traverse in a Planetary Suit**

Vos, Jessica R.; Gernhardt, Michael L.; Lee, Lesley; January 2007; 25 pp.; In English; International Conference on Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 731384.10.01.10

Report No.(s): Paper-07ICES-9; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016007>

As planetary suit and planetary life support systems develop, specific design inputs for each system relate to a presently unanswered question concerning operational concepts: What distance can be considered a safe walking distance for a suited EVA crew member exploring the surface of the Moon to 'walk-back' to the habitat in the event of a rover breakdown, taking into consideration the planned EVA tasks as well as the possible traverse back to the habitat? It has been assumed, based on Apollo program experience, that 10 kilometers (6.2 mi) will be the maximum EVA excursion distance from the lander or habitat to ensure the crew member's safe return to the habitat in the event of a rover failure. To investigate the feasibility of performing a suited 10 km Walkback, NASA-JSC assembled a multi-disciplinary team to design and implement the Lunar Walkback Test. The test was designed not only to determine the feasibility of a 10 km excursion, but also to collect human performance, biomedical, and biomechanical data relevant to optimizing space suit design and life support system sizing. These data will also be used to develop follow-on studies to understand interrelationships of such key parameters as suit mass, inertia, suit pressure, and center of gravity (CG), and the respective influences of each on human performance.

Author

*Biodynamics; Walking; Space Suits; Life Support Systems; Human Performance; Habitats; Flight Crews; Extravehicular Activity; Biomedical Data*

## 59

### MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

**20070014810** Fish and Richarson P.C., Minneapolis, MN, USA

**Data Processing for Three-Dimensional Displays**

Chun, W.; Cossairt, O. S.; 16 Mar 05; 44 pp.; In English

Patent Info.: Filed Filed 16 Mar 05; US-Patent-Appl-SN-11-082-169

Report No.(s): PB2007-105976; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Generating a three-dimensional image of a three-dimensional scene by generating projection data and projecting light rays based on the projection data to generate the three-dimensional image. Sampling of the data is based on at least one physical parameter associated with the projection of light rays by a projection system used to project the light rays.

NTIS

*Data Processing; Display Devices; Image Processing; Patent Applications*

**20070014850** Tope-McKay and Associates, Malibu, CA, USA

**System for Solving Diagnosis and Hitting Set Problems**

Fijany, A., Inventor; Vatan, F., Inventor; August 31, 2006; 27 pp.; In English

Patent Info.: Filed Filed 13 Feb 06; US-Patent-Appl-SN-11-353-673

Report No.(s): PB2007-101668; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014850>

The diagnosis problem arises when a system's actual behavior contradicts the expected behavior, thereby exhibiting symptoms (a collection of conflict sets). System diagnosis is then the task of identifying faulty components that are responsible for anomalous behavior. To solve the diagnosis problem, the present invention describes a method for finding the minimal set

of faulty components (minimal diagnosis set) that explain the conflict sets. The method includes acts of creating a matrix of the collection of conflict sets, and then creating nodes from the matrix such that each node is a node in a search tree. A determination is made as to whether each node is a leaf node or has any children nodes. If any given node has children nodes, then the node is split until all nodes are leaf nodes. Information gathered from the leaf nodes is used to determine the minimal diagnosis set.

Author

*Diagnosis; Problem Solving; Algorithms*

**20070014884** Lawrence Livermore National Lab., Livermore, CA USA

**State Compensation: A No-Cost Scheme for Scalable Failure Recovery in Tree-based Overlay Networks**

Arnold, D. C.; Miller, B. P.; Jul. 12, 2006; 7 pp.; In English

Report No.(s): DE2006-895989; UCRL-CONF-222793; No Copyright; Avail.: National Technical Information Service (NTIS)

Tree-based overlay networks (TB(O)Ns) have become important for scalable data multicast and aggregation. This infrastructure's generality has led to widespread usage in large scale and widely distributed environments--environments in which reliability must be addressed. This paper presents state compensation, a novel reliability concept for TB(O)N environments that avoids explicit state replication (such as checkpoints) for failure recovery by leveraging general properties of TB(O)N computations that allow computational state from non-failed processes to compensate for state lost from failed ones. In this paper, we present our state compensation mechanisms, prove sufficient properties of distributed computations that make these mechanisms feasible and show how to derive computation-specific recovery primitives from these properties. We also present a case study of the recovery process. The result is a general TB(O)N recovery model that requires no additional storage, network, or computational resources during normal operation.

NTIS

*Computer Networks; Costs; Failure; Fault Trees*

60

**COMPUTER OPERATIONS AND HARDWARE**

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

**20070015112** Army Research Lab., White Sands Missile Range, NM USA

**A Novel Method for Generating Non-Stationary Gaussian Processes for Use in Digital Radar Simulators**

Boehm, James A; Debroux, Patrick S; Mar 2007; 18 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463401; ARL-TR-4051; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463401>

This report presents a novel and simple way to determine the transient response of the output of any linear system, described in the s-domain by an nth order polynomial, subjected to white Gaussian noise. The transient response of the output of the linear system is observed, in this report, in the variance of the output as a function of time. In addition, the mean and probability density function of the output are obtained. These results let simulation engineers create stable, unstable, and periodic stochastic processes for evaluation of communication and radar systems.

DTIC

*Digital Radar Systems; Digital Simulation; Radar Equipment; Random Noise; Simulators*

**20070015385** Naval Postgraduate School, Monterey, CA USA

**Expeditionary Strike Group: Command Structure Design Support**

Hutchins, Susan G; Kemple, William G; Kleinman, David L; Hocevar, Susan P; Jun 2005; 37 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464230; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464230>

An Expeditionary Strike Group (ESG) is a new capability mix that combines the combat power of three surface combatants and one submarine with an Amphibious Readiness Group/ Marine Expeditionary Unit (Special Operations Capable) (ARG/MEU(SOC)). ESGs provide Combatant Commanders with more flexible, robust, and distributed offensive combat capability and enhance Naval expeditionary force survivability. Beginning in 2002, the Navy and Marine Corps began

an experiment to explore the offensive and defensive capabilities of the ESG as well as different command structure options. This paper describes the initial effort by the Adaptive Architectures for Command and Control research program to support the analysis and design of ESG-1 command structures through modeling and analysis.

DTIC

*Combat; Maintainability*

**20070015396** Defence Research and Development Canada, Ottawa, Ontario Canada

**The Role of the Coalition Warrior Interoperability Demonstration in the Canadian Forces Joint Experimentation Program**

Villeneuve, Sophie; Funk, Ronald; Wheaton, Kendall; Jun 2005; 54 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464248; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464248>

From its initial charter in 2001, the Canadian Forces Experimentation Centre (CFEC) inherited the responsibility for managing the Joint Warrior Interoperability Demonstration (JWID) program within Canada. With three years of experience coordinating JWID, while conducting a program of national and international experiments, it is timely to review the role of this event in CFEC's strategic plan, the Canadian Forces Joint Concept Development and Experimentation Plan (CF JCD&E Plan). This paper presents a strategy for integrating the JWID, renamed Coalition Warrior Interoperability Demonstration (CWID) in 2005, into the CF JCD&E Plan using two trials from the JWID in 2004 as case studies. These trials were sponsored by the Air Force and Defence Intelligence and used Defence Research and Development Canada (DRDC) technologies. The Portal-to-Portal Interoperability Trial used a situational awareness portal developed by the COP 21 (Common Operational Picture 21st Century) Technology Demonstration. The Collaborative Operations Planning System Trial tested a prototype for providing the ability to plan an operation in a net-enabled environment using integrated collaborative tools. This paper concludes with discussion of a strategy for using a program designed to trial and demonstrate technologies nearly ready for operational use in a Joint Concept Development and Experimentation program with a mandate to support transformation.

DTIC

*Canada; Interoperability; Military Operations*

## 61

### COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

**20070015104** Air Force Research Lab., Rome, NY USA

**The FrameWork: An Open-Architecture for Very Large Image Exploitation**

Ramseyer, George O; Spetka, Scott E; Linderman, Richard E; Romano, Brian C; Jun 2002; 8 pp.; In English

Report No.(s): AD-A462771; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA462771>

Advances in sensor collection and display technologies have led to increasingly larger imagery databases with increasingly complex processing requirements. Combining high-speed communications and remote parallel processing computers through shared access, sensor data can be transmitted and processed, and the resultant imagery products can then be efficiently disseminated through information-based systems. The FrameWork is a system that exploits very large image processing technology through Project Broadsword, and is being designed to interface with information-based Command and Control systems that are under development, such as the Joint Battlespace Infosphere (JBI).

DTIC

*Application Programming Interface; Architecture (Computers); Client Server Systems; Exploitation; Image Processing; Parallel Processing (Computers); Photographic Processing; Photographs*

**20070015111** Air Force Operational Test and Evaluation Center, Langley AFB, VA USA

**User's Epistle on Text Chat Tool Acquisition**

Simpson, Jr, Marvin L; Jun 2006; 9 pp.; In English

Report No.(s): AD-A463350; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463350>

Just as leaders of the world wars of the 20th century exploited advances in the industrial revolution, military leaders today

exploit the information revolution. Despite the hindrance of current military command, control and communications (C3) to adhere to a classic Napoleonic hierarchy, information revolution values strategically enable principles like Net-Centric Warfare and challenge the status quo. With a revolutionary technology like text chat, a monopoly of naysayers produce a litany of obstacles that predict inevitable failure and a monopoly of ideologues insist that only the purest implementation can succeed. The rest of us plug away -- testing, innovating, and using the new technology any way in which it works better than the old way. It is often said in the C3 world that amateurs talk tools while professionals discuss capabilities. This paper provides an acquisition philosophy to encourage Text Chat as a universally viable military capability. As the information age progressed, individuals came to regard Text Chat as a normal mode of communication. Chat Rooms enable members of a workgroup to visually converse and can include the ability to record that conversation.

DTIC

*Interprocessor Communication; Rooms; Software Development Tools; Texts*

**20070015114** Naval War Coll., Newport, RI USA

**Decision-Centric Warfare: Reading Between the Lines of Network-Centric Warfare**

DeLange, Eric P; Morris, Mike; Feb 13, 2006; 26 pp.; In English

Report No.(s): AD-A463459; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463459>

Network-Centric Warfare (NCW), as it has come to be called, is here to stay. While the benefits are proving to be many, there are also potential risks that can adversely affect operational leadership. Increasingly, commanders today must be aware of how the effects of information overload, instantaneous communications, and increased opportunities to insert themselves in levels of war outside their traditional sphere of influence can have a bearing on their decision-making. NCW's very name has a tendency to focus attention strictly on the technology, as if once 'the system' is implemented or 'the device' installed, that everything will work out for the best. The technology is merely an enabler, another addition to commanders' toolkits to help them make better decisions. To avoid the 'if you build it they will come' mentality, the focus must be maintained on decision-making and the decisions that result through a commander's application of operational art. This paper proposes replacing one word and calling it Decision-Centric Warfare to maintain the proper focus. Not only does the name change align more directly with Joint Vision 2020's concept of decision superiority, but when one looks at the NCW terminology and construct, decisions are really what NCW is all about.

DTIC

*Architecture (Computers); Computer Programming; Decision Making; Decision Support Systems; Reading; Software Engineering; Warfare*

**20070015121** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Phase Diversity and Polarization Augmented Techniques for Active Imaging**

Johnson, Peter M; Mar 2007; 213 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463586; AFIT/DS/ENG/07-05; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463586>

A multi-frame active phase diversity imaging (APDI) algorithm is derived for coherent light statistics and demonstrated. In addition to conventional focal-plane and diversity-plane data, a statistical description for pupil-plane (PP) intensity is formed and included in the derivation. The algorithm is implemented and characterized via Monte Carlo simulation. Analysis shows that it's robust, insensitive to detection noise for SNR  $\geq 7$ , performs well for SNR's as low as 2, and that the effect of system configuration on optimal parameters is minimal. Furthermore, introduction of PP data results in a 60% better reconstruction from dynamically aberrated data than obtained using only focal-plane and diversity-plane data. Both an EM-algorithm and a lensless-APDI approach are presented for generating imagery directly from PP polarization measurements. However, both approaches are currently impractical. Suggestions for improvement are offered. Finally, the APDI algorithm is modified to use PP polarization data in place of PP intensities. An initial statistical model is offered, and suggestions for performance improvement are presented.

DTIC

*Augmentation; Coherent Light; Imaging Techniques; Mathematical Models; Statistical Analysis*

**20070015148** Air Force Research Lab., Rome, NY USA

**Real-Time Course of Action Analysis (Briefing Charts)**

Gilmour, Duane; Hanna, Jim; McKeever, Bill; Walter, Mart; Jun 2005; 28 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-RTCO

Report No.(s): AD-A463689; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463689>

The military needs a dynamic decision support system that can operate in real-time. The challenge is to be able to process real-time situational data and at the same time use that data to generate force structure simulations for multiple predictive effects based courses of action. The AFRL Information Directorate's approach is to use high performance computing simulation technology to develop a dynamic decision support for command and control decision makers.

DTIC

*Charts; Computerized Simulation; Decision Support Systems; Real Time Operation*

**20070015152** MAK Technologies, Inc., Cambridge, MA USA

**Increasing Situational Awareness by Combining Realistic and Non-Realistic Rendering Techniques**

Summers, Valerie A; Normoyle, Aline; Flo, Robert; Jun 2005; 10 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F30602-02-C-0068; F30602-03-C-066

Report No.(s): AD-A463760; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463760>

Advances in computer graphics hardware have led to astounding increases in visual realism for 3D environments. Although this improved visual realism can lead to a better sense of immersion and a more faithful reproduction of the natural world, it does not necessarily promote increased awareness of an evolving situation. Although some requirements overlap with other applications such as off-the-shelf games, military Command and Control systems (including stability operations and homeland defense missions) have unique requirements. In particular, the overriding goal is to provide timely data effectively, independent of how visually pleasing it may be. The primary objective is to convert the abundance of information into concise knowledge. This paper proposes a method of combining realistic and non-realistic displays to increase display effectiveness, and hence improve situational awareness.

DTIC

*Combat; Graphical User Interface; Simulation; Situational Awareness*

**20070015153** MAK Technologies, Inc., Cambridge, MA USA

**Increasing Situational Awareness by Visualizing Uncertainty**

Summers, Valerie A; Jones, Richard L; Flo, Robert; Jun 2005; 10 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F30602-02-C-0068; F30602-03-C-066

Report No.(s): AD-A463761; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463761>

There are many sources of data available to enhance commanders situational awareness. Whether the mission is war fighting, stability operations, or the defense of the homeland, decisions must be made based on the information available. Information comes from many varied sources, in many formats, with a continuum of validity, and is presented in a variety of ways. Situational awareness and decision superiority opportunity is increased when relevant data is effectively presented in a timely manner and with a measure of confidence. Exact, precise data is easier to present than uncertain data; but often uncertain data may be enough for a decision, based on rules of engagement and the value of the action to the mission. We have developed visualization techniques that focus on uncertainty for the purpose of providing decision-quality command and control information for both ground-based and airborne applications. A key focus of our work is to manage the visualization techniques so they do not clutter the display, as a cluttered display can actually decrease situational awareness by masking relevant information. Data can be presented on a 2D or 3D visual display. This paper proposes a method for managing 2D visualizations to increase situational awareness.

DTIC

*Decision Support Systems; Graphical User Interface; Situational Awareness*

**20070015157** Johns Hopkins Univ., Laurel, MD USA

**Command and Control Autonomous UxV's**

Hawthorne, Chad; Scheidt, Dave; Jun 2005; 18 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463767; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463767>

The future unmanned battlespace will contain heterogeneous swarms of autonomous air and ground platforms. A significant hurdle in enabling a heterogeneous swarm is the ability to move the algorithms developed in simulation environments onto real-world unmanned vehicles (UxV's). The Applied Physics Lab has developed the Robotic Algorithm and Communications Environment (RACE), a platform independent behavior-based algorithm framework that supports air and ground vehicle hardware interfaces to enable swarms of unmanned vehicles to operate cooperatively. This briefing describes the command and control (C2) aspects of the RACE architecture and the results from recent hardware in the loop demonstrations. APL experiments have shown how swarms of autonomous vehicles can support complex C2 environments by cooperatively de-conflicting multiple user goals.

DTIC

*Autonomy; Command and Control; Robotics*

**20070015177** Army Command and General Staff Coll., Fort Leavenworth, KS USA

**Implementing Network-Centric Operations in Joint Task Forces: Changes in Joint Doctrine**

Dull, David S; Jun 16, 2006; 103 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463832; No Copyright; Avail.: CASI: A06, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463832>

This thesis examines joint publications and the emerging concept of Network-Centric Operations (NCO) as a basis for identifying recommended changes to doctrine in order to implement NCO in joint task forces (JTFs). Technology is allowing the USA military to evolve from the industrial age to the information age. The Office of the Secretary of Defense has termed this evolution 'Force Transformation' and identified Network-Centric Operations as the primary concept encompassing the future capabilities of the joint force. The Department of Defense calls for co-evolution of the doctrine, organization, and technology of NCO. The technology required to achieve NCO continues to rapidly expand, and individual military services have started procuring and implementing the technology as it becomes available. Subsequently, US military JTFs have already attempted to realize the benefits of NCO in operations such as Operation Enduring Freedom and Operation Iraqi Freedom, yet the military continues to organize JTFs according to Department of Defense planning guidance and doctrine that date to July of 2001. The conclusions reached in this thesis are that size, structure, interdependence, and synchronization are key NCO organizational attributes dictating shifts in basic joint doctrine and JTF organizational architecture.

DTIC

*Defense Program; Military Operations; Networks*

**20070015214** Defence Research and Development Canada, Valcartier, Quebec Canada

**On the Building of a UML Profile for the Description of Army Architectures in the Context of Complex Systems**

Couture, Mario; Duval, Antoine; Dorion, Eric; Jun 2005; 37 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463906; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463906>

This paper addresses the work surrounding the conception and building of a Unified Modeling Language (UML) profile to be used to model military architectures in the context of complex systems. The revolution in military affairs, which imposes fundamental change in strategic planning and management, causes a shift from the old stovepipe bottom-up threat-based planning to a new top-down Capability-Based Planning (CBP). CBP involves, for instance, the management of acquisition projects from a more global perspective (at enterprise level) and imposes the use of a more holistic and integrating approach. The UML and the proposed Military Architectures UML Profile (MAU-Profile) provide a language that makes it possible to model military systems and concepts by using such an approach. The MAU-Profile and modeling conventions, which guide the use of UML in the context of System Engineering and CBP, are presented in this paper. An important requirement expressed by military authorities about this profile was that it should be easy to be used by non-experts. In this regard, the structure of the stereotype list takes the form of a tree containing eight main entries from which stereotype names can be easily retrieved. This structure is based on our generic definition of the word system. Some examples showing the use of the profile in a context of CBP are also presented.

DTIC

*Architecture (Computers); Complex Systems; Programming Languages*

**20070015221** Defence Science and Technology Organisation, Edinburgh, Australia

**Area of Common Overlap of Three Circles**

Fewell, M P; Oct 2006; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463920; DSTO-TN-0722; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463920>



This Note presents the unsolved to an apparent hitherto tin solved geometrical problem: the derivation of a closed-form algebraic expression of the area of common overlap of three circles, such as can occur a three-circle Venn diagram. The results presented here have general significance in the corpus of menstruation formulae, and could be of specific use in any quantitative application of the three-circle Venn diagram such as for example, in search and screening problems.

DTIC

*Circles (Geometry); Geometry; Menstruation*

**20070015236** Naval Research Lab., Washington, DC USA

**Applying the SCR Requirements Method to the Light Control Case Study**

Heitmeyer, Constance; Bharadwaj, Ramesh; Jan 2000; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463943; No Copyright; Avail.: CASI: **A03**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463943>

To date, the SCR (Software Cost Reduction) requirements method has been used in industrial environments to specify the requirements of many practical systems, including control systems for nuclear power plants and avionics systems. This paper describes the use of the SCR method to specify the requirements of the Light Control System (LCS), the subject of a case study at the Dagstuhl Seminar on Requirements Capture, Documentation, and Validation in June 1999. It introduces a systematic process for constructing the LCS requirements specification, presents the specification of the LCS in the SCR tabular notation, discusses the tools that we applied to the LCS specification, and concludes with a discussion of a number of issues that arose in developing the specification.

DTIC

*Computer Programs; Requirements*

**20070015244** Carnegie-Mellon Univ., Pittsburgh, PA USA

**The State of Software Measurement Practice: Results of 2006 Survey**

Kasunic, Mark; Dec 2006; 67 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8721-05-C-0003

Report No.(s): AD-A463962; CMU/SEI-2006-TR-009; No Copyright; Avail.: CASI: **A04**, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463962>

In February 2006, the Software Engineering Measurement and Analysis Initiative at the Carnegie Mellon Software Engineering Institute (SEI) conducted the first in a series of yearly studies to gauge the state of the practice in software measurement. To conduct this study, a structured, self-administered survey consisting of 17 questions was distributed to a random sample of software practitioners who had contacted the SEI during 2004 and 2005. The results of this study, which are revealed in this technical report, offer these benefits: they can be used to indicate (1) what measurement definition and implementation approaches are being adopted and used by the community, (2) the most prevalent types of measures being used by organizations that develop or acquire software, and (3) what behaviors are preventing the effective use of measurement (so that these barriers can be addressed). In addition, when the studies are conducted on a periodic basis, the results can indicate trends over time.

DTIC

*Computer Programming; Software Engineering; Surveys*

**20070015333** Space and Naval Warfare Systems Command, San Diego, CA USA

**Advanced Propagation Model (APM) Version 2.1.04 Computer Software Configuration Item (CSCI) Documents**

Barrios, A E; Patterson, W L; Sprague, R A; Feb 2007; 439 pp.; In English

Report No.(s): AD-A464098; SPAWAR-TD-3214; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464098>

This document provides Version 2.1.04 Computer Software Configuration Item documents for the Advanced Propagation Model (APM). The APM calculates range-dependent electromagnetic system propagation loss and propagation factor within a heterogeneous atmospheric medium over variable terrain, where the radio-frequency index of refraction is allowed to vary vertically and horizontally. The first document specifies the functional requirements that are to be met by the APM CSCI. A discussion of the input software requirements is presented together with a general description of the internal structure of the APM CSCI as it relates to the CSCI's capability. The second document describes the design of the APM CSCI. An overview of the input software requirements is presented together with an overview of the CSCI design architecture and a detailed design description of each CSCI component. The third document specifies the test cases and test procedures necessary to

perform APM CSCI qualification testing. A discussion of precise input values of each input variable required to perform the test together with final expected test results is presented.

DTIC

*Computer Programs; Electromagnetic Wave Transmission*

**20070015341** Ceskoslovenska Akademie Ved, Prague, Czechoslovakia

**Computer Simulations of Molecular Propellers**

Vacek, Jaroslav; Sep 4, 1999; 6 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F61775-98-W-E043

Report No.(s): AD-A464113; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464113>

This report results from a contract tasking J. Heyrovsky Institute of Physical Chemistry & Electrochemistry as follows: The contractor will improve upon an existing computer code modeling the classical dynamics of a molecular structure within a solid (intramolecular bonding and vibrations intermolecular collisions and electrostatic interactions). The new program will be used to explore computationally a variety of possible structures for the synthesis of new materials capable acquiring significant internal mechanical angular momentum along a well defined macroscopic axis due to the rotation of nanoscale internal constituents (molecular propellers) at microwave frequencies. Two possible mechanisms for driving the internal rotation will be investigated. as well as lattice-induced loss mechanisms and inter-rotor interactions.

DTIC

*Computerized Simulation; Molecular Structure; Propellers*

**20070015346** Naval Postgraduate School, Monterey, CA USA

**Three Simulation Models of Naval Air Defense**

Ozkan, Baris; Rowe, Neil C; Calfee, Sharif H; Hiles, John E; Jun 2005; 45 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464120; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464120>

Naval air defense is a critical facility for ship survivability and has been subject of a number of studies. We investigate here three different approaches to modeling it with computer software. One approach focuses on the problems of information processing and communication for the air-defense team, and is good for analyzing its efficiency. Another approach focuses on the inference of the nature of observed tracks, and is based on the novel psychological theory of conceptual blending. A third approach uses an expert-systems approach that can learn from experience and be more substantially automated than the other two approaches. Each approach has its own advantages: The first provides insights for organizing and managing air-defense personnel, the second provides insights into cognitive biases in analysis that should be examined during training, and the third suggests a way to mostly automate the air-defense process to save money. This work suggests the value of multiple simulations of the same process when that process is important to understand.

DTIC

*Air Defense; Computerized Simulation; Military Operations; Simulation*

**20070015348** Defence Research and Development Canada, Valcartier, Quebec Canada

**Free and Open Source Software Overview and Preliminary Guidelines for the Canadian Forces**

Demers, David; Charpentier, Robert; Carbone, Richard; Jun 2005; 31 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464128; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464128>

(1) Administrative summary; (2) Report overview; (3) Summary and perspectives for the CF.

DTIC

*Canada; Computer Programming; Computer Programs; Open Source Licensing (Computers); Software Engineering*

**20070015355** Defence Research and Development Canada, Valcartier, Quebec Canada

**Towards a Formal Ontology for Military Coalitions Operations**

Dorion, Eric; Matheus, Christopher J; Kokar, Mieczyslaw M; Jun 2005; 12 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464161; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464161>

The goal of this paper is to raise some of the fundamental questions that underpin the development of formal ontologies, especially the ones that are used for systems interoperability. To realize this, the three authors independently collaborated on different aspects of this paper. In this way, questions naturally arose from the review of each others work. In essence, this paper represents the genesis of the authors collaboration and constitutes for them a basis for future research.

DTIC

*Internets; Interoperability; Military Operations; Semantics*

**20070015357** North Carolina Agricultural and Technical State Univ., Greensboro, NC USA

**Qualitative Simulation of Human Command & Control System Effectiveness**

Ntuen, Celestine A; Jun 2005; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464165; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464165>

Capturing information for performance modeling of the human aspect of C2 performance can be difficult and time consuming. Usually, a parametric approach is favored, but overall, technology performance is used to calibrate performance. It is difficult to determine or assess the aspects of human performance in the technologically driven C2 systems. This paper presents a novel approach using a qualitative evaluation metric based on fundamental matrix algebra. It is assumed that the performance of C2 to be achieved can be speculated by the commanders based on units to be commissioned and technological capabilities of the units. The ACAD software which allows commanders to simulate courses of action planning based on battle assets is used to demonstrate the model efficacy. The model illustrates the composite measure of C2 based on mission, as well as unit effectiveness based on the expectations of the higher command.

DTIC

*Command and Control; Manual Control; Simulation; Software Development Tools; System Effectiveness; War Games*

**20070015362** CHI Systems, Inc., Fort Washington, PA USA

**Human Behavioral Representations with Realistic Personality and Cultural Characteristics**

Zachary, Wayne; Le Mentec, Jean-Christopher; Miller, Lynn; Read, Stephen; Thomas-Meyers, Gina; Jun 2005; 37 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464171; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464171>

The Personality-enabled Architecture for Cognition or PAC is a new technical capability to create human behavioral representations (HBRs) with pre-defined and specific personality traits and cultural characteristics. This capability meets a current and growing need for human models that exhibit personality and cultural variability. The need arises from multiple sources, but primarily from the increased frequency and complexity of military operations involving coalition forces with great cultural and personality diversity, and the growing trend toward asymmetrical conflicts involving adversaries with poorly understood cultural values, characteristics, and behavior patterns. PAC integrates theory and empirical data from personality psychology, social psychology, cognitive science, and neuroscience. Unlike existing cognitive architectures that attempt to build affective and personality factors as customizations to an underlying formally rational symbolic architecture, PAC uses dimensions of personality, emotion, and culture as foundations for the cognitive process. The structure of PAC allows it to function as a personality/emotional layer that can be used stand-alone or integrated with existing constrainedrationality cognitive architectures. In addition, a set of tools was developed to support the authoring, analysis, and testing of PAC HBRs. Demonstration PAC-HBRs were based on characters from VECTOR, a game-based cultural familiarization trainer.

DTIC

*Personality*

**20070015379** Naval Postgraduate School, Monterey, CA USA

**Modeling and Simulation Support for the Standing Joint Force Headquarters Concept**

Hutchin, Susan G; Schacher, Gordon E; Dailey, James; Looney, John P; Saylor, Steven E; Jensen, Jack J; Osmundson, John S; Gallup, Shelley P; Jun 2005; 43 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464214; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464214>

A computational model of Standing Joint Force Headquarters (SJFHQ) processes was developed using EXTEND simulation software. In this paper we describe the use of this modeling and simulation approach for analyzing time-critical information systems and performing trade studies. An object-oriented model was constructed of the processes performed by

SJFHQ members and simulations were run to obtain system measures of performance. This model focuses on the planning processes performed by SJFHQ members to support the Effects-Based Planning processes and the Operational Net Assessment update. A complete four-level architecture was developed that captures all processes, sub-processes, information flows, and personnel task assignments. It includes detailed architectures and was based on US Joint Forces Combined publications and subject-matter expertise.

DTIC

*Computerized Simulation; Military Operations; Simulation*

**20070015398** Science Applications International Corp., Suffolk, VA USA

**Decision Factors for the Operational Warfighter: Explicit Insights**

Van Doren, Paul; Brandt, Kevin L; Carr, Frank; Jun 2005; 46 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464250; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464250>

The Defense Modeling and Simulation Office (DMSO) and the USA Joint Forces Command Joint Futures Laboratory sponsored the initial phase of a cooperative study addressing the decision factors relevant to decision makers at the operational level of war. The combined study team completed an initial literature review and questioned and interviewed 26 operational level commanders, planners, and analysts involved in the use of M&S in support of real world operations from El Dorado Canyon to OIF and on as small a scale as Special Forces operations in Haiti to as large a scale as a Corps assault on Baghdad. The paper reviews the insights and decision factors collected.

DTIC

*Computerized Simulation; Decision Making; Military Operations*

**20070015400** Soar Technology, Inc., Ann Arbor, MI USA

**Enabling Battlefield Visualization: An Agent-Based Information Management Approach**

Taylor, Glenn; Wood, Scott; Knudsen, Keith; Jun 2005; 40 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W911QX-04-C-0049

Report No.(s): AD-A464252; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464252>

A key task of a commander is that of Battlefield Visualization -- understanding the situation in order to make decisions to achieve operational goals. Central to this process is managing the information needed to make those decisions. As the battlefield becomes more complex, and the stresses on commanders more apparent, the need for automated tools to reduce the burden only increases. In this paper, we identify the requirements of a system for enabling battlefield visualization through automating the information management process. We describe an architecture for information management using intelligent interface agents to assist a commander with battlefield visualization. Our approach focuses on a knowledge-driven process of information management, in which the commander's information requirements (CCIRs) are understood within the current context by automatically decomposing them into specific, sensor-relevant collection needs, tasking available collection assets to gather the data to answer the information requirements, then fusing that data into decision-relevant knowledge to be presented to the commander. We describe the results of our effort and a feasibility prototype to illustrate the central ideas of our approach.

DTIC

*Data Processing; Decision Support Systems; Information Management*

**20070015401** Science Applications International Corp., McLean, VA USA

**Perpetual Enterprise Management Service (PEMS) for Next Generation SOA-based Command & Control Systems**

King, Erik; Jun 2005; 49 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464253; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464253>

USA Department of Defense (DoD) Services and Agencies are building and deploying Next Generation Command & Control (NGC2) systems that are based on highly distributed Service Oriented Architecture (SOA) applications. These new systems do not have end-to-end monitoring and reporting capabilities to establish realistic Service Level Objectives (SLO) and Agreements (SLA) that are needed to support this concept. As SOA and Web technologies proliferate, a service is required that collects and correlates business logic, platform, and network component metrics for problem analysis, resolution, and SLA establishment. Traditionally Combatant Commands have relied on disparate software, system, and network engineers to

pinpoint and resolve operational problems in fielded Command & Control (C2) systems. As these traditional client/server systems are upgraded to SOA-based applications, the highly distributed nature of this new Net-Centric Warfare (NCW) capability will require the three functions to merge into one. A Perpetual Enterprise Management Service (PEMS) is needed that enables the new function to effectively manage the emerging complexity that SOA-based C2 software will bring under new programs including Joint Command and Control (JC2) and Net-Centric Enterprise Services (NCES).

DTIC

*Application Programming Interface; Command and Control; Computers; Logic Design*

**20070015406** Office of the Secretary of Defense, Washington, DC USA

**The Impact of SOA Policy-Based Computing on C2 Interoperation and Computing**

Paul, Raymond; Tsai, W T; Bayne, Jay; Jun 2005; 44 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464259; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464259>

DoD is moving into GIG-based service-oriented network-centric policy-based enterprise computing. Specifically, network-centric operation means that each C2 system must be network ready, and must be able to interconnect and interoperate with other C2 systems. This paper presents issues related to policy-based computing in a service-oriented architecture (SOA) for network-centric warfare. Service-oriented computing and its associated architecture represent a new paradigm of computing and numerous issues need to be addressed. One of important issues is distributed policy computing. Issues such as policy specification, analysis, enforcement, synchronization, and communication are all related.

DTIC

*Command and Control; Computer Networks; Policies; Security*

**20070015410** Naval Submarine Medical Research Lab., Groton, CT USA

**A Comparison of Air Defense Warfare Task Performance with and without an Automated Task Manager Using a GOMS Modeling Tool**

Santoro, Thomas; Kieras, David; Jun 2005; 37 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464267; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464267>

Small teams of human performance models perform tasks in a simulated Air Defense Warfare (ADW) scenario to compare two designs for an advanced multi-modal watch station (MMWS). In the original design, the models select and perform tasks based on their own knowledge of the on-going air warfare situation as acquired through visual search of individual tactical situation (TACSIT) displays and information windows and verbal communications among model operators. In a revised design, an intelligent agent Task Manager (TM) monitors the situation and generates a list of tasks on a separate display for the operator to monitor. While exercises on a prototype TM with human teams were confounded by user issues, the modeling study produced a quantitative comparison of task execution latency and total critical tasks between the two designs that showed generally improved performance for the revised design, thereby demonstrating the utility of human performance modeling for the evaluation of systems for complex team tasks.

DTIC

*Air Defense; Human Performance; Models; Tasks; Warfare*

**20070015416** Naval Research Lab., Washington, DC USA

**Rewriting Requirements for Design**

Kirby, Jr, James; Nov 6, 2002; 8 pp.; In English

Report No.(s): AD-A464274; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464274>

Maintaining consistency between requirements and the design developed to satisfy them is both important and difficult. Maintaining consistency is important to satisfying stakeholders' desires, which the requirements express. Much of the difficulty of maintaining consistency stems from having redundant descriptions of requirements decisions one in the requirements document and a second in the design document typically recorded in widely divergent languages. To ameliorate this problem, we write requirements and design in such a way that requirements decisions and their expression in the requirements document are incorporated directly into the design document, which organizes the decisions and includes additional design decisions.

DTIC

*Computer Programming; Software Engineering*

**20070015417** Naval Research Lab., Washington, DC USA

**A Strategy for Efficiently Verifying Requirements Specifications Using Composition and Invariants**

Jeffords, Ralph D; Heitmeyer, Constance L; Sep 5, 2003; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464275; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464275>

This paper describes a compositional proof strategy for verifying properties of requirements specifications. The proof strategy, which may be applied using either a model checker or a theorem prover, uses known state invariants to prove state and transition invariants. Two proof rules are presented: a standard incremental proof rule analogous to Manna and Pnueli's incremental proof rule and a compositional proof rule. The advantage of applying the compositional rule is that it decomposes a large verification problem into smaller problems which often can be solved more efficiently than the larger problem. The steps needed to implement the compositional rule are described, and the results of applying the proof strategy to two examples, a simple cruise control system and a realworld Navy system, are presented. In the Navy example, compositional verification using either theorem proving or model checking was three times faster than verification based on the standard incremental (noncompositional) rule. In addition to the two above rules for proving invariants, a new compositional proof rule is presented for circular assume-guarantee proofs of invariants. While in principle the strategy and rules described for proving invariants may be applied to any state-based specification with parallel composition of components, the specifications in the paper are expressed in the SCR (Software Cost Reduction) tabular notation, the auxiliary invariants used in the proofs are automatically generated invariants, and the verification is supported by the SCR tools.

DTIC

*Computer Programming; Software Engineering; Specifications*

**20070015418** Naval Research Lab., Washington, DC USA

**Human-Style Theorem Proving Using PVS**

Archer, Myla; Heitmeyer, Constance; Aug 1997; 17 pp.; In English

Report No.(s): AD-A464276; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464276>

A major barrier to more common use of mechanical theorem provers in verifying software designs is the significant distance between proof styles natural to humans and proof styles supported by mechanical provers. To make mechanical provers useful to software designers with some mathematical sophistication but without expertise in mechanical provers, the distance between hand proofs and their mechanized versions must be reduced. To achieve this, we are developing a mechanical prover called TAME on top of PVS. TAME is designed to process proof steps that resemble in style and size the typical steps in hand proofs. TAME's support of more natural proof steps should not only facilitate mechanized checking of hand proofs, but in addition should provide assurance that theorems proved mechanically are true for the reasons expected and also provide a basis for conceptual level feedback when a mechanized proof fails. While infeasible for all applications, designing a prover that can process a set of high-level, natural proof steps for restricted domains should be achievable. In developing TAME, we have had moderate success in defining specialized proof strategies to validate hand proofs of properties of Lynch-Vaandrager timed automata. This paper reports on our successes, the services provided by PVS that support these successes, and some desired enhancements to PVS that would permit us to improve and extend TAME.

DTIC

*Computer Programs; Theorem Proving*

**20070015424** Naval Research Lab., Washington, DC USA

**An Algorithm for Strengthening State Invariants Generated from Requirements Specifications**

Jeffords, Ralph D; Heitmeyer, Constance L; Aug 2001; 11 pp.; In English

Report No.(s): AD-A464288; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464288>

In earlier work, we developed a fix point algorithm for automatically generating state invariants, properties that hold in each reachable state of a state machine model, from state-based requirements specifications. Such invariants are useful both in validating requirements specifications and as auxiliary lemmas in proofs that a requirements specification satisfies other invariant properties. This paper describes a new related algorithm that strengthens state invariants generated by our initial algorithm and demonstrates the new algorithm on a simplified version of an automobile cruise control system. The paper concludes by describing how the two algorithms were used to generate state invariants from a requirements specification of

a cryptographic device and how the invariants in conjunction with a theorem prover were used to prove formally that the device satisfies a set of critical security properties.

DTIC

*Algorithms; Computer Programming; Software Engineering; Specifications*

**20070015711** State Univ. of New York, Binghamton, NY USA

**Low Overhead Software/Hardware Mechanisms for Software Assurance and Producibility**

Aggarwal, Aneesh; Feb 2007; 8 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8750-06-1-0247; Proj-558B

Report No.(s): AD-A464355; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Memory related software vulnerabilities such as buffer overflow and dangling pointers make computer systems vulnerable to exploits and cost the US economy huge sums of money. Software tools proposed so far to address these vulnerabilities are limited in their applicability because they either have low detection rate and high false alarm rate or have a huge performance overhead. This report explores a new initiative to develop low overhead integrated hardware/software mechanisms to detect memory related vulnerabilities. These mechanisms are expected to resolve the limitations of software approaches by using specialized hardware for detecting the vulnerabilities, thus tremendously facilitating software assurance and producibility.

DTIC

*Computer Programs; Computers; Detection; Software Development Tools; Vulnerability*

**20070015743** Army Tank-Automotive Research and Development Command, Warren, MI USA

**Experiences Linking Vehicle Motion Simulators to Distributed Simulation Experiments**

Jacobson, Richard W; Jun 21, 2004; 7 pp.; In English

Report No.(s): AD-A464410; PAPER-NUMBER-14068; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The Tank Automotive Research, Development and Engineering Center (TARDEC) has been at the forefront in developing the hardware and software for physics-based, ride motion simulation, for over 30 years. In order to share this capability with the simulation community, it is necessary to develop an interface to link these motion simulators with other DoD distributed simulations. Various technologies such as the Distributed Interactive Simulation (DIS), Network Data Delivery Service (NDDS) and the High Level Architecture (HLA) have been used to try and accomplish this goal. The distributed simulations of interest are the Semi Automated Forces (SAF) -- ones such as Modular SAF (ModSAF), OneSAF Test Bed (OTB) Version 1.0 and OTB Version 2.0. There have been five projects, which incorporated various levels of interoperability. This paper will describe the current simulators and simulation environment at TARDEC, each of the five projects associated with developing a distributed simulation capability and the current ongoing effort to create a useful simulation federation consisting of the motion simulators and OTB Version 2.0. In order to develop this federation the Federation Development and Execution Process (FEDEP) is being used. The FEDEP is a generalized process for developing federations that have evolved from the activities and experiences of the simulation community.

DTIC

*Motion; Motion Simulators; Simulation; Simulators*

**20070015798** Idea Sciences, Inc., Alexandria, VA USA

**A C2 System for 'Winning hearts and Minds': Tools for Confrontation and Collaboration Analysis**

Crannell, Mary; Howard, Nigel; Norwood, George W; Tait, Andrew; Jun 2005; 22 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464500; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Asymmetric campaigns since the end of the Cold War have tended to have a brief war-fighting phase followed by a cultural phase in which victory is achieved by winning the hearts and minds of diverse ethnic and national groups that may side with us or with extremists. Actual fighting is limited to the tactical level; its strategic significance, like that of other operations, is in the political-psychological domain rather than the physical. It lies in whether it sends the right message to the right people, and makes it credible to them. This paper outlines a command and control system for managing the messages sent by a force (in words or in deeds) with the objective of winning hearts and minds. The system is supported by a new commercial, off-the-shelf software package called Confrontation Manager.

DTIC

*Decision Support Systems; Heart*

**20070015933** Defence Science and Technology Organisation, Victoria, Australia

**HPAC (Hazard Prediction and Assessment Capability) \h\g jSWAT (Joint Seminar Wargaming Adjudication Tool) Integration; A Technical Solution**

Brennan, Matt; Skvortsov, Alex; Gailis, Ralph; Sep 2006; 37 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463826; DSTO-TN-0721; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463826>

This paper provides an outline of the technical solution to be adopted when integrating the Hazard Prediction and Assessment Capability (HPAC) with DSTO's Joint Seminar Wargaming Adjudication Tool (jSWAT). Opportunities to conduct 'least path of resistance' integration between the two applications are explored to support an eventual Proof of Concept demonstration. The report concludes with some observations on achievable longer term integration goals.

DTIC

*Hazards; Human-Computer Interface; Military Operations; Planning; Strategy; War Games*

**20070015937** Joint Military Intelligence Coll, Washington, DC USA

**Red Zones: Improving the Enemy Ground Force Situation Display in Digital Battle Command and Control Systems**

Ceralde, Ray M; Jun 2005; 36 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463884; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463884>

The situation display of friendly force information in digital battle command and control systems has significantly improved with advances in position location technology. However, the timeliness, accuracy, and relevance of the enemy situation display (the red picture) lags behind the friendly situation display (the blue picture). This paper argues that the projection of enemy vehicle locations and activity through spatial analysis tools will improve the enemy ground situation display in digital battle command and control systems. The circular line-of-sight view is a spatial analysis tool that can depict an enemy vehicle's battlespace by displaying its weapons engagement area. A movement projection model is another spatial analysis tool that displays numerous possible enemy vehicle locations as an area of probability. This paper further argues to equip the digital battle command and control systems on combat platforms with these spatial analysis tools. The availability of these tools enables the warfighter to add value to combat information through simple, but on demand analysis.

DTIC

*Command and Control; Digital Command Systems; Graphical User Interface; Probability Theory*

**20070015948** Human Resources Research Organization, Alexandria, VA USA

**Econometric Estimates of Army Retention: Zones A, B, C, D and Retirement-Eligible, 1990-2004**

Moore, Carole; Hogan, Paul; Kirchner, Christian; Macklin, Patrick C; Greenston, Peter M; Jan 2007; 29 pp.; In English

Contract(s)/Grant(s): DASW01-03-D-0015-0016; Proj-D730

Report No.(s): AD-A464636; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Efficient allocation of reenlistment bonuses requires the ability to estimate the effect that the bonus will have on reenlistments in an occupational specialty. Previous research, conducted in developing the SRB Management System, estimated the effects of SRB on Zone A, B and C reenlistment decisions made between FY1990 and FY2000. In this analysis, we extend the years analyzed to include FY2001 through FY2004. The additional years of data include Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF). We tested the ability of the existing model to predict reenlistment decision-making post-FY2000. To improve fit, we generated new econometric estimates by MOS, CMF and Zone using the more recent years of data, and conducted out-of-sample prediction testing to confirm the validity of the updated model.

DTIC

*Econometrics; Estimates; Personnel Management; Retirement*

**20070015977** Arizona State Univ., Tempe, AZ USA

**Semantic Interoperability and Its Verification & Validation in C2 Systems**

Tsai, W T; Paul, R; Huang, Hai; Xiao, Bingnan; Chen, Yinong; Jun 2005; 61 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464119; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464119>

Interoperability is a critical issue for DoD C2 systems. Current research has mostly focused on the data interoperability and ontology of context. While these studies are important and useful, they have not addressed other important issues on



semantic interoperability and its verification & validation. This paper proposes a new technique called use scenario, which specifies the workflow of passing parameters among different services or the semantics of interoperation. For a C2 system, once the use scenario is specified, a family of automated analysis, verification, and validation techniques is available for testing and evaluating the system and its interoperability.

DTIC

*Command and Control; Interoperability; Semantics*

**20070016012** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The NASA SARP Software Research Infusion Initiative**

Hinchey, Mike; Pressburger, Tom; Markosian, Lawrence; Feather, Martin; July 20, 2006; 24 pp.; In English; Copyright;

Avail.: CASI: [A03](#), Hardcopy

A viewgraph presentation describing the NASA Software Assurance Research Program (SARP) research infusion projects is shown. The topics include: 1) Background/Motivation; 2) Proposal Solicitation Process; 3) Proposal Evaluation Process; 4) Overview of Some Projects to Date; and 5) Lessons Learned.

CASI

*Computer Programs; NASA Programs; Software Engineering; Technology Transfer*

**20070016040** Versatile Information Systems, Inc., Framingham, MA USA

**Towards a Formal Pedigree Ontology for Level-One Sensor Fusion**

Matheus, Christopher J; Tribble, David; Kokar, Mieczyslaw M; Ceruti, Marion; McGirr, Scott; Jun 2005; 12 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464124; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464124>

OUTLINE: (1) Objectives; (2) The Web Ontology Language OWL; (3) Pedigree as Metadata; (4) Proposed Pedigree Ontology; (5) A Candidate Application; (6) Challenges.

DTIC

*Multisensor Fusion; World Wide Web; Document Markup Languages*

**20070016045** Army Tank-Automotive Research and Development Command, Warren, MI USA

**Automated 2D to 3D CAD Conversions-- Myth or Reality?**

Iyer, Raj; Mar 24, 2004; 15 pp.; In English

Report No.(s): AD-A464405; 13974; No Copyright; Avail.: Defense Technical Information Center (DTIC)

These briefing charts discuss the computer aided design, including the need to move from 2D to 3D, issues with legacy data, decision factors, methodology, conversion issues and conclusions.

DTIC

*Computer Aided Design; Automation; Engineering Drawings; Three Dimensional Models*

## 62

### COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

**20070015107** Colorado School of Mines, Golden, CO USA

**Credible Mobile and Ad Hoc Network Simulation-Based Studies**

Kurkowski, Stuart H; Oct 26, 2006; 166 pp.; In English

Report No.(s): AD-A462915; CI07-0013; No Copyright; Avail.: CASI: [A08](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA462915>

Simulation is the research tool of choice for a majority of the mobile ad hoc network (MANET) community. However, while the use of simulation has increased, the credibility of the simulation results has decreased. To determine the state of MANET simulation studies, we surveyed the 2000-2005 proceedings of the ACM International Symposium on Mobile Ad Hoc Networking and Computing (MobiHoc). We present the results of our survey and summarize common simulation study pitfalls. We develop standards and algorithms that help enable MANET researchers to move toward the goal of simulation-based research with credible scenarios. We also document a large variable analysis of the Location Aided Routing

(LAR) protocol. This study discovers several variables that have a significant impact on LAR performance, but are not always considered in a MANET simulation study. Finally, we discuss tools we created that aid the development of credible simulation studies. We offer these results to the community with the hope of improving the credibility of MANET simulation-based studies.

DTIC

*Communication Networks; Simulation; Wireless Communication*

**20070015138** Naval War Coll., Newport, RI USA

**The BORG: Network Centric Operations**

Fraleigh, Michelle M; Oct 23, 2006; 31 pp.; In English

Report No.(s): AD-A463661; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463661>

The National Defense Strategy lists eight desired capabilities and attributes of our joint force. Conducting Network Centric Operations (NCO) is one of the eight capabilities providing the Department of Defense transformation focus. Despite academic guidance from the Information Superiority Metrics Working Group (ISMWG), and published goals and objectives from the Joint Staff, a key player remains in the background -- the Geographic Combatant Commander (CCDR). As a result of the Unified Command Plans 2002 thru 2006, there have been several organizational changes which include the Commander, DISA, as JTF-GNO under USSTRATCOM, to lead the Department of Defense to a Net-Centric Environment. This paper defines the components of NCO, but concentrates on three dimensions in the information domain to show, using six cases, that the CCDR is needed with DISA's regional Theater Network Center (TNC) as part of the Geographic Combatant Command's (GCC's) team to operationalize NCO. The paper draws a conclusion that the CCDRs are the players who can develop a joint professional net-centric force, by influencing the future of Service Component platforms (physical domain), but most importantly providing the network-value leadership to shape the information domain. Finally, the paper recommends changes to the current NetOps structure to make the TNC the execution arm of the CCDR for net-centric operations.

DTIC

*Communication Networks; Computer Networks*

**20070015183** Michigan State Univ., East Lansing, MI USA

**Authentication for Bulk Data Dissemination in Sensor Networks Using Symmetric Keys**

Wang, Limin; Kulkarni, Sandeep S; Jan 2007; 26 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-01-1-0744

Report No.(s): AD-A463844; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463844>

Authenticating bulk data dissemination in sensor networks is important as sensors need to verify that the data is truly from a trusted source. There are two ways to achieve authentication: asymmetric key based and symmetric key based. Although previous work has shown that asymmetric key authentication is feasible on sensor nodes if used sparingly, it is still quite expensive compared to symmetric key based approach. In this paper, we propose a symmetric key based protocol for authenticating data dissemination process. Our protocol uses the secret instantiation algorithm for distributing the keys. We apply the symmetric key signatures at the segment/group level and use hashed verification at the packet level. To improve the efficiency in the presence of packet loss/delay, we employ several techniques: the double connected hash chain, the caching scheme, and forward error correction (FEC). We show the effectiveness of our design through simulation. Moreover, since our protocol has much lower cost than the asymmetric key based approaches, it is especially valuable for the burst data dissemination, where the base station authenticates and transmits a moderate amount of data at a time.

DTIC

*Computer Information Security; Data Transmission; Networks; Security; Symmetry*

**20070015235** Naval Research Lab., Washington, DC USA

**Toward a Comprehensive INFOSEC Certification Methodology**

Payne, Charles N; Froscher, Judith N; Landwehr, Carl E; Sep 23, 1993; 9 pp.; In English

Report No.(s): AD-A463939; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463939>

Accreditors want to know what vulnerabilities will exist if they decide to turn on a system. TCSEC evaluations address products, not systems. Not only the hardware and software of a system are of concern; the accreditor needs to view these

components in relation to the environment in which they operate and in relation to the system's mission and the threats to it. This paper proposes an informal but comprehensive certification approach that can provide the accreditor with the necessary information. First, we discuss the identification of assumptions and assertions that reflect system INFOSEC requirements. Second, we propose the definition of an assurance strategy to integrate security engineering and system engineering. The assurance strategy initially documents the set of assumptions and assertions derived from the requirements. It is elaborated and refined throughout the development, yielding the assurance argument, delivered with the system, which provides the primary technical basis for the certification decision. With the assurance strategy in place, certification of the trusted system can become an audit of the development process.

DTIC

*Certification; Security*

**20070015237** Naval Research Lab., Washington, DC USA

**Requirements Specifications for Hybrid Systems**

Heitmeyer, Constance; Jan 1996; 12 pp.; In English

Report No.(s): AD-A463944; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463944>

The purpose of a computer system requirements specification is to describe the computer system's required external behavior. To avoid over specification, the requirements specification should describe the system behavior as a mathematical relation between entities in the system's environment. When some of these entities are continuous and others are discrete, the system is referred to as a 'hybrid' system. Although computer science provides many techniques for representing and reasoning about the discrete quantities that affect system behavior, practical approaches for specifying and analyzing systems containing both discrete and continuous quantities are lacking. The purpose of this paper is to present a formal framework for representing and reasoning about the requirements of hybrid systems. As background, the paper briefly reviews an abstract model for specifying system and software requirements, called the Four Variable Model [12], and a related requirements method, called SCR (Software Cost Reduction) [10, 1]. The paper then introduces a special discrete version of the Four Variable Model, the SCR requirements model [8] and proposes an extension of the SCR model for specifying and reasoning about hybrid systems.

DTIC

*Computer Networks; Specifications*

**20070015255** NATO Consultation, Command, and Control Agency, The Hague, Netherlands

**Observations on the Dissemination of ISR Data Employing Network-Enabled Capabilities in the Coalition Environment**

Mahaffey, John; Skaar, Trond; Jun 2005; 20 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463980; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463980>

No abstract available

*Computer Networks; Interoperability; Military Operations*

**20070015275** Army Construction Engineering Research Lab., Champaign, IL USA

**Condition and Performance Rating Procedures for Nonrubble Breakwaters and Jetties**

Pirie, Doug; Plotkin, Donald; Kubinski, Joseph; Foltz, Stuart; McKay, David; Nov 2005; 138 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-CW

Report No.(s): AD-A464021; ERDC/CERL-TR-REMR-OM-26; No Copyright; Avail.: CASI: [A07](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464021>

In an effort to improve maintenance techniques and practices for inland waterway and coastal structures, the U.S. Army Corps of Engineers (USACE) established the Repair, Evaluation, Maintenance, and Rehabilitation Research (REMR) program, which was funded from 1984 to 1998. Within the REMR program is a group of projects dedicated to the development of computerized maintenance management systems for coastal and inland waterway navigational structures. The general intent of these REMR Management Systems is to provide maintenance managers at all levels with tools to promote easier and more effective maintenance and budget planning. Additional objectives are to create uniform procedures for assessing the condition of structures and to create assessment methods that will allow the condition of structures, and their parts, to be expressed

numerically to take best advantage of the benefits available from the use of microcomputers in maintenance management. The condition and performance rating procedures described here evolved over several years through the joint effort of a number of people throughout the Corps coastal operations and maintenance (O&M), engineering, and research community. Representatives of each Coastal Engineer Division have been part of the advisory group guiding the project, and suggestions from people in every Coastal Engineer District have been used to produce the rating system documented here. It is expected that field application of these condition rating procedures will lead to further refinement and improvement over time.

DTIC

*Breakwaters; Decision Support Systems; Maintenance; Management Systems; Ratings*

**20070015321** Naval Research Lab., Washington, DC USA

**Architectural Impact on Performance of a Multilevel Database System**

Kang, Myong H; Froscher, Judith N; Jan 1994; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464081; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464081>

Since protection and assurance are the primary concerns in MLS databases, performance has often been sacrificed in some known MLS database approaches. Motivated by performance concerns, a replicated architecture approach which uses a physically distinct backend database management system for each security level is being investigated. This is a report on the behavior and performance issues for the replicated architecture approach. Especially, we compare the performance of the SINTRA1 MLS database system to that of a typical conventional (non-secure, single-level) database system. After observing the performance bottlenecks for the SINTRA, we present solutions that can alleviate them.

DTIC

*Data Bases; Data Management; Security*

**20070015324** Naval Research Lab., Washington, DC USA

**Extending Formal Cryptographic Protocol Analysis Techniques for Group Protocols and Low-Level Cryptographic Primitives**

Meadows, Catherine; Jan 2000; 5 pp.; In English

Report No.(s): AD-A464085; XB-NRL/MR/5540; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464085>

We have recently seen the development of a number of new tools for the analysis of cryptographic protocols. Many of them are based on state exploration, that is, they try to find as many paths through the protocol as possible, in the hope that, if there is an error, it will be discovered. But, since the search space offered by a cryptographic protocol is infinite, this search alone cannot guarantee security if no attack is found. However, some state exploration tools do offer the ability to prove security results as well as find flaws by the use of theoretical results about the system that they are examining. In particular, the NRL Protocol Analyzer [4] allows its user to interactively prove lemmas that limit the size of its search space. If the resulting search space is finite, then it too can guarantee that a protocol is secure by performing an exhaustive search. However, the ability to make such guarantees brings with it certain limitations. In particular, most of the systems developed so far model only a very limited set of cryptographic primitives, often only encryption (public and shared key) and concatenation. They also avoid low-level features of cryptographic algorithms, such as the commutativity and distributivity properties of RSA.

DTIC

*Computer Information Security; Cryptography; Protocol (Computers)*

**20070015327** Naval Research Lab., Washington, DC USA

**Invariant Generation Techniques in Cryptographic Protocol Analysis**

Meadows, Catherine; Jan 2000; 10 pp.; In English

Report No.(s): AD-A464088; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464088>

The growing interest in the application of formal methods of cryptographic protocol analysis has led to the development of a number of different techniques for generating and describing invariants that are defined in terms of what messages an intruder can and cannot learn. These invariants, which can be used to prove authentication as well as secrecy results, appear to be central to many different tools and techniques. However, since they are usually developed independently for different systems, it is often not easy to see what they have in common with each other, or to tell whether or not they can be used in systems other than the ones for which they were developed. In this paper we attempt to remedy this situation by giving an

overview of several of these techniques, discussing their relationships to each other, and developing a simple taxonomy. We also discuss some of the implications for future research.

DTIC

*Computer Information Security; Cryptography; Protocol (Computers)*

**20070015338** Illinois Univ., Urbana-Champaign, IL USA

**A Survey and Comparison of Human Monitoring of Complex Networks**

Su, Ramona; Yurcik, William; Jun 2005; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464108; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464108>

Networks of different types are essential infrastructures for society. Networks such as transportation networks and the electric power grid are becoming increasingly large and complex which create special challenges for human operators who must monitor these networks for safe operation. It is important to understand how human operators monitor these networks and the challenges they face in the monitoring task. In order to do this, we conducted a survey of how human operators monitor various networks water distribution networks, electric power grid, air traffic control, and nuclear power plant networks. From our survey in these specific extensively-studied networks, we are able to generalize the challenges of operators monitoring networks. The hope is that these results will provide human factors engineers with a better understanding so they can cater to the needs of the human operators when designing new interfaces for network monitoring tasks.

DTIC

*Engineers; Human Factors Engineering; Networks; Situational Awareness; Surveys; User Requirements*

**20070015377** Naval Postgraduate School, Monterey, CA USA

**Optimizing Lawful Responses to Cyber Intrusions**

Wingfield, Thomas C; Michael, James B; Wijesekera, Duminda; Jun 2005; 20 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464203; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464203>

Cyber intrusions are rarely met with the most effective possible response, less for technical than legal reasons. Different rogue actors (terrorists, criminals, spies, etc.) are governed by overlapping but separate domestic and international legal regimes. Each of these regimes has unique limitations, but also offers unique opportunities for evidence collection, intelligence gathering, and use of force. We propose a framework which automates the mechanistic aspects of the decision-making process, with human intervention for only those legal judgments that necessitate human judgment and official responsibility. The basis of our framework is a pair of decision trees, one executable solely by the threatened system, the other by the attorneys responsible for the lawful pursuit of the intruders. These parallel decision trees are interconnected, and contain pre-distilled legal resources for making an objective, principled determination at each decision point. We offer an open-source development strategy for realizing and maintaining the framework.

DTIC

*Intrusion; Law (Jurisprudence); Warfare*

**20070015397** Northrop Grumman Mission Systems, Arlington, VA USA

**Future Integrated Fire Control**

Young, Bonnie W; Jun 2005; 66 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464249; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464249>

Future advances in fire control for air and missile defense depend largely on a network-enabled foundation that enables the collaborative use of distributed warfare assets for time-critical operations. These advances enable major enhancements for tactical fire control. Selecting the best shooter from a set of geographically distributed firing units can improve the chances of intercepting targets and improve the economy of weapon resources. Earlier launch decisions are possible when sensors are intelligently tasked based on shared knowledge of the battlespace. No longer must collocated sensors and weapons be paired for engagements. Lifting such pairing constraints expands the effective kinematic range of weapons and enables additional operational capabilities such as forward pass and off-board engagement support for guidance relay and target illumination. For complex threat environments in which sophisticated or significant numbers of aerospace targets exist, automated collaborative fire control (or Integrated Fire Control (IFC)) may be a necessity for victory. This paper presents research in advanced data

fusion and decision aid capabilities as a means of enabling and enhancing IFC. It addresses the importance of achieving distributed information superiority shared, accurate, and timely situational awareness as the foundation of IFC capabilities. It discusses required IFC design and architecture guidelines. Finally, the paper proposes an IFC concept to meet the complex needs of future warfare.

DTIC

*Fire Control; Multisensor Fusion*

**20070015403** Stottler Henke Associates, Inc., San Mateo, CA USA

**Improving Information Exchange and Coordination amongst Homeland Security Organizations (Briefing Charts)**

Goan, Terrance; Mayk, Israel; Jun 2005; 16 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W15P7T-04-C-K610

Report No.(s): AD-A464255; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464255>

Command and Control for coordinated response to domestic terrorist attack will require the ability of Federal, state, and local agencies to maintain awareness of the status, capabilities, requirements, response plans, and C2 procedures, etc. of the other collaborating organizations. While progress is being made in improving information sharing, the TOPOFF exercises have demonstrated that organizations still lack any substantial ability to coordinate responses to large scale events that involve dozens of local, state, and Federal organizations. In this paper we describe progress made in the development of new information access services that provide for improved situation awareness. We have strived to develop a solution that enables User Defined Operational Picture (UDOP) functionality while respecting the unique information management practices of the collaborating Homeland Security organizations. Our system concept, Vista, employs an adaptive machine learning paradigm that supports a new form of context-sensitive information access, monitoring, and alerting that fills substantial gaps in existing Crisis Information Management System technologies. Experimental results demonstrate very substantial improvements in information access efficiency and provide strong evidence for the feasibility of the overall concept.

DTIC

*Charts; Coordination; Organizations; Security*

**20070015405** Thales-Raytheon Systems Co., LLC, Fullerton, CA USA

**Operation of Multiple Link 16 Terminals Connected to a Single Host**

Bradley, Kenneth D; Jun 2005; 10 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464258; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464258>

Link 16 is the backbone tactical datalink system for exchange of related surveillance, weapons coordination, and air control information. The standard for Link 16 operation is a single terminal. Until recently no platform employed more than one Link 16 terminal. The USA (US) military standard and North Atlantic Treaty Organization (NATO) standard organizations have not developed documentation for operating multiple terminals from a single command and control (C2) unit. The issues and proposed implementations are covered in this paper. The closest document available to define the remote C2 host with multiple connections was developed by the US for Joint Range Extension (JRE). The JRE document addresses beyond line of sight exchange of Link 16 information. The JRE standard was not adopted by NATO and there are no plans for a comparable document. The lack of a JRE or remote standard in NATO for C2 operation impacts US systems that are trying to achieve interoperability. Some of the issues that must be resolved include source track numbering for the host and the terminals, routing of data, control of duplicate data to and from multiple terminals, remote initialization, remote keying of the encryption devices, network design, network operation and management, and data forwarding. The paper also provides insight into how large C2 systems plan to interact in a coalition environment. Link 16 network design and management requires new and creative initiatives when operating with multiple data paths. Secure voice is a problem when data is sent over multiple paths. Can the non-C2 platform receive the secure voice transmission from multiple terminals on different time slot blocks? Network design has many issues to resolve. Link 16 operation when multiple terminals are connected to a single host impact US, NATO, Allied, and Coalition datalink operations. The issues must be identified and addressed. The paper will start that process.

DTIC

*Data Systems; Interoperability*

**20070015414** Mitre Corp., McLean, VA USA

**Applying Multi-Agency Executable Architectures to Analyze a Coastal Security Operation**

Pawlowski, III, Thomas J; Hoffman, Kenneth C; Jun 2005; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464271; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464271>

U.S. Federal agencies face the challenge of conducting a dynamic analysis of their architectures to determine the performance and effectiveness of the business processes and the supporting Information Technology (IT) systems. Most architectures are static representations and lack the capability to support the dynamic analysis required to generate the performance and effectiveness metrics. There is an added challenge for organizations that must interoperate with other Federal agencies. Failing to integrate with other agency architectures may create critical interoperability problems resulting in mission failure. The challenge is not only to ensure satisfactory interoperability, but also to determine that the mission will in fact be accomplished and that critical gaps do not exist among the architectures. This paper discusses a case study that addressed these challenges by examining an operation where architectures from multiple agencies, using different frameworks, were integrated to accomplish a coastal security mission. The paper describes the technical approach involving two phases. The Static Phase developed a Multi-agency Operations-Centric Architecture Activity Model consisting of the mission, supporting operations, and mission-essential tasks. The Dynamic Phase took this activity model and imported it into a set of simulation tools. The paper also identifies insights about applying multi-agency architectures.

DTIC

*Architecture (Computers); Coasts; Security*

**20070015426** Syracuse Univ., NY USA

**Privacy-Preserving Naive Bayesian Classification**

Zhan, Zhijun; Chang, LiWu; Matwin, Stan; Jan 2004; 8 pp.; In English

Report No.(s): AD-A464290; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464290>

Privacy is an important issue in data mining and knowledge discovery. In this paper, we propose to use the randomized response techniques to conduct the data mining computation. Specifically, we present a method to build naive Bayesian classifiers from the disguised data. We conduct experiments to compare the accuracy of our classifier with the one built from the original undisguised data. Our results show that although the data are disguised, our method can still achieve fairly high accuracy.

DTIC

*Bayes Theorem; Classifications; Privacy; Security*

**20070015427** Naval Research Lab., Washington, DC USA

**Anycast Routing for Mobile Networking**

Park, Vincent D; Macker, Joseph P; Jan 1999; 6 pp.; In English

Contract(s)/Grant(s): N00014-99-W-R20017

Report No.(s): AD-A464291; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464291>

This paper considers the problem of locating and forwarding network traffic to any one of a set of distributed servers or service points primarily in the context of mobile ad hoc networks. The advantages of providing such a capability in mobile networks through the use of anycast routing techniques at the network layer are discussed. The results of a simulation study are highlighted to demonstrate how anycast routing techniques can provide a one-to-any communication capability with greater efficiency than traditional unicast based techniques. The simulation results also indicate anycast routing simplifies required configuration and management and reduces connection setup latency and overall message packet delay. Potential applications of anycast routing technology in military networks are presented and related issues are discussed.

DTIC

*Client Server Systems; Military Technology; Networks*

**20070015701** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Beyond Passwords: Usage and Policy Transformation**

Alsop, Alan S; Mar 2007; 147 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464139; AFIT/GIR/ENV/07-M1; No Copyright; Avail.: CASI: [A07](#), Hardcopy

The purpose of this research is to determine whether the transition to a two-factor authentication system is more secure than a system that relied only on what users 'know' for authentication. While we found that factors that made passwords inherently vulnerable did not transfer to the PIN portion of a two-factor authentication system, we did find significant problems relating to usability, worker productivity, and the loss and theft of smart cards. The new authentication method has disrupted our ability to stay connected to ongoing mission issues, forced some installations to cut off remote access for their users and in one instance, caused a reserve unit to regress 10 years in their notification and recall procedures. The best-case scenario for lost productivity due to users leaving their CAC at work, in their computer, is costing 261 work years per year with an estimated cost of 10.4 million payroll dollars. Finally, the new authentication method is causing an increase in the loss or theft of CACs, our primary security mechanism for accessing DoD installations, at a rate of 28,222 a year. A single tool, such as the CAC, for all systems and services, carries much power, are we prepared for the responsibility?

DTIC

*Computer Information Security; Computer Networks; Policies*

**20070015704** Icosystem Corp., Cambridge, MA USA

**An Evolutionary, Agent-Based Model to Aid in Computer Intrusion Detection and Prevention**

Shargel, Ben; Bonabeau, Eric; Budynek, Julien; Gaudio, Paolo; Jun 2005; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464183; No Copyright; Avail.: Defense Technical Information Center (DTIC)

We have developed a realistic agent-based simulation model of hacker behavior. In the model, hacker scripts are generated using a simple but powerful hacker grammar that has the potential to cover all possible hacker scripts. The model can be used to characterize the evidence generated by any hacker script, including new scripts that appear every day, and to train inexperienced investigators and incident handlers how to deal with a compromised system and look for evidence. The model can also be used in order to design sophisticated artificial intelligence techniques to automate intrusion detection and evidence collection. Finally, we summarize an extension of this work in which an evolutionary algorithm was used to evolve scripts that achieve certain goals without being detected.

DTIC

*Detection; Prevention; Warning Systems*

**20070015710** Advanced Technical Concepts, Berkshire, NY USA

**Attack Analyzer: A Network Analysis and Visualization Tool**

Kahn, Russell L; Feb 2007; 12 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8750-06-1-0035; Proj-558B

Report No.(s): AD-A464353; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The massive amounts of data that confront systems analysts as they monitor computer networks for security violations can be overwhelming. As a result, analysts may overlook critical details that may signal network break-ins or other system intrusions. This flood of data can consume systems analysts time and lead to missed security violations and in extreme cases could lead to the complete collapse of a computer network or networks creating dangers to those who depend on them. The author addresses this problem with the development of a prototype visualization tool that attempts to clarify when a computer networks security may be compromised. The tool itself, Attack Analyzer is described and the methodology and fieldwork testing used to create it are detailed. The tool uses a somewhat novel top-down, or deductive approach, moving from the general to the specific, rather than a bottom-up, or inductive method.

DTIC

*Network Analysis; Software Development Tools; Systems Analysis; Warning Systems*

**20070015774** Naval Research Lab., Washington, DC USA

**A Cost-Based Framework for Analysis of Denial of Service in Networks**

Meadows, Catherine; Jan 2000; 25 pp.; In English

Report No.(s): AD-A464449; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Denial of service is becoming a growing concern. As computer systems communicate more and more with others that they know less and less, they become increasingly vulnerable to hostile intruders who may take advantage of the very protocols intended for the establishment and authentication of communication to tie up resources and disable servers. This paper shows how some principles that have already been used to make cryptographic protocols more resistant to denial of service by trading off the cost to defender against the cost to the attacker can be formalized based on a modification of the Gong-Syverson



fail-stop model of cryptographic protocols, and indicates the ways in which existing cryptographic protocol analysis tools could be modified to operate within this formal framework. We also indicate how this framework could be extended to protocols that do not make use of strong authentication.

DTIC

*Computer Information Security; Computer Networks; Cost Analysis; Cryptography; Protocol (Computers)*

**20070015857** Naval Research Lab., Washington, DC USA

**Environmental Requirements for Authentication Protocols**

Canetti, Ran; Meadows, Catherine; Syverson, Paul; Jan 2002; 18 pp.; In English

Report No.(s): AD-A464608; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Most work on requirements in the area of authentication protocols has concentrated on identifying requirements for the protocol without much consideration of context. Little work has concentrated on assumptions about the environment, for example, the applications that make use of authenticated keys. We will show in this paper how the interaction between a protocol and its environment can have a major effect on a protocol. Specifically we will demonstrate a number of attacks on published and/or widely used protocols that are not feasible against the protocol running in isolation (even with multiple runs) but become feasible in some application environments. We will also discuss the tradeoff between putting constraints on a protocol and putting constraints on the environment in which it operates.

DTIC

*Computer Information Security; Protocol (Computers)*

**20070015962** Office of the Chief of Naval Operations (OPNAV N71F), Arlington, VA USA

**Applying the NCW Conceptual Framework to FORCENet: A Case Study**

Bates, Edgar; Bell, Michael; Jun 2005; 62 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464499; No Copyright; Avail.: CASI: [A04](#), Hardcopy

FORCENet, the Naval implementation of network-centric warfare, in order to deliver the necessary capabilities in a timely and affordable way, requires an investment strategy that is based on objective analysis. Accordingly, a logical and comprehensive framework for FORCENet analysis has been developed by combining a capability-based description of FORCENet with the Conceptual Framework for Network Centric Warfare developed by the Office of the Secretary of Defense. The present paper documents the application of this analysis approach to several aspects of the FORCENet initiative, including resource and requirement decisions in the planning, programming, budgeting and execution (PPBE) process, analysis of FORCENet Fleet experiments, support of architecture and standards development, evaluation of tactics, techniques, and procedures (TTP), alignment of science and technology (S&T) and research, development, test, and evaluation (RDT&E) efforts with FORCENet requirements, and evaluation and selection of modeling and simulation (M&S) tools and scenarios. The results demonstrate how the proposed metrics can be used to assess the improvement in FORCENet capabilities over time, identify capability gaps, and guide acquisition and technology investments to close those gaps. Finally, the paper summarizes the challenges in applying the metrics.

DTIC

*Command and Control; Cost Analysis; Navy; Warfare*

**20070015978** USA Joint Forces Command, Suffolk, VA USA

**Multinational Force-Iraq Portal and Multinational Information Sharing**

McLarney, Ed; Jun 2005; 17 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464127; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464127>

OVERVIEW: (1) JFCOM J9 is pursuing cross domain solutions to allow information sharing and real time collaboration from one network/domain to another; (2) Deployed a single-domain instance to MNFI in February 2005; (3) Beginning certification, test, and evaluation (CT&E) with National Security Agency (NSA) in August 2005.

DTIC

*Iraq; Military Operations*

**20070016041** USA Joint Forces Command, Norfolk, VA USA

**Multi-National Information Sharing -- Cross Domain Collaborative Information Environment (CDCIE) Solution. Revision 4**

Fletcher, Boyd; Hare, Dana; Apr 12, 2005; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464126; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464126>

In February 2004, the Joint Forces Command (JFCOM) began its efforts to provide a near-term Multinational Information Sharing (MNIS) solution to support Warfighters operating in a coalition environment. The JFCOM Joint Futures Laboratory (JFL) solution to MNIS is the Cross Domain Collaborative Information Environment (CDCIE). The CDCIE is a suite of standards-based and largely open source code applications that provide the capability to collaborate, share and manage documents, and use web portals, from one classification domain to another. The applications will also work within a single classification domain. While the CDCIE is designed to run in today's environment, it is also a building block for the future information infrastructure -- the CDCIE is adhering to the same basic standards that are guiding Net-Centric Enterprise Services development. Currently portal, document management, and cross domain text chat capabilities have been developed for the CDCIE solution. The cross domain text chat capability will be submitted for Certification and Accreditation (C&A) this year. CDCIE development will continue to be expanded to include audio chat, application casting and whiteboarding. As the CDCIE is enhanced, the suite will return to C&A. The CDCIE project has been designed to function at the operational command and control level.

DTIC

*Military Operations; Information Transfer*

**20070016541** Newcyte, Inc., Oberlin, OH USA

**Mobile Language Study**

Dam, Mads; Giambiagi, Pablo; Aug 18, 2003; 60 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F61775-01-C-0006

Report No.(s): AD-A464112; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464112>

This report results from a contract tasking Swedish Institute of Computer Science AB as follows: Contractor will investigate security issues related to mobile code (dynamically loaded code) which can potentially compromise information system security. This is of special concern to the Air Force because of requirements to access data at various levels of classification. The contractor proposes realizing information flow controls for mobile code by expressing security policies as admissibility properties. The proposed architecture to be investigated has the following properties: code annotations and security guarantees, program analysis to verify security guarantees, and a specially designed user interface to aid in handling data of different security levels. The proposed effort spans two years and is divided into four tasks. Tasks 1 and 2 will be completed in the first year and Tasks 3 and 4 are to be completed the second year. Task 1: Program analysis techniques for admissibility. Task 2: Experimentation and prototyping. Pending successful completion of the first year's research and availability of funding, the second year's tasks include: Task 3: Security architecture. Task 4: Java Card and JCVM.

DTIC

*Security; Information Systems; Codes; Language Programming*

**20070016576** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**An Auto-Configuration System for the GMSEC Architecture and API**

Moholt, Joseph; Mayorga, Arturo; July 20, 2006; 16 pp.; In English; Space Mission Challenges for Information Technology 2006, 17-20, Jul. 2006, Pasadena, CA, USA; Original contains black and white illustrations; Copyright; Avail.: CASI:

A03, Hardcopy

A viewgraph presentation on an automated configuration concept for The Goddard Mission Services Evolution Center (GMSEC) architecture and Application Program Interface (API) is shown. The topics include: 1) The Goddard Mission Services Evolution Center (GMSEC); 2) Automated Configuration Concept; 3) Implementation Approach; and 4) Key Components and Benefits.

CASI

*Architecture (Computers); Application Programming Interface; Configuration Management; Systems Engineering; Automatic Control*

**20070016680** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Autonomous Information Unit: Why Making Data Smart Can also Make Data Secured?**

Chow, Edward T.; June 26, 2006; In English; IEEE 15th International Workshops on Enabling Technologies: Infrastructures for Collaborations, 26 Jun. 2006, Manchester, UK; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39936>

In this paper, we introduce a new fine-grain distributed information protection mechanism which can self-protect, self-discover, self-organize, and self-manage. In our approach, we decompose data into smaller pieces and provide individualized protection. We also provide a policy control mechanism to allow 'smart' access control and context based re-assembly of the decomposed data. By combining smart policy with individually protected data, we are able to provide better protection of sensitive information and achieve more flexible access during emergency conditions. As a result, this new fine-grain protection mechanism can enable us to achieve better solutions for problems such as distributed information protection and identity theft.

Author

*Access Control; Computer Information Security; Electronic Commerce; Information Dissemination*

**63**

**CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS**

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also *54 Man/System Technology and Life Support*.

**20070015233** Naval Research Lab., Washington, DC USA

**What Makes a Cryptographic Protocol Secure? The Evolution of Requirements Specification in Formal Cryptographic Protocol Analysis**

Meadows, Catherine; Jan 2003; 13 pp.; In English

Report No.(s): AD-A463937; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463937>

Much attention has been paid to the design of languages for the specification of cryptographic protocols. However, the ability to specify their desired behavior correctly is also important; indeed many perceived protocol flaws arise out of a misunderstanding of the protocol's requirements. In this talk we give a brief survey of the history of requirements specification in formal analysis of cryptographic protocols. We outline the main approaches and describe some of the open issues.

DTIC

*Cryptography; Protocol (Computers); Security; Specifications*

**20070015240** Naval Research Lab., Washington, DC USA

**A Taxonomy of Replay Attacks**

Syverson, Paul; Jan 1994; 6 pp.; In English

Report No.(s): AD-A463948; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463948>

This paper presents a taxonomy of replay attacks on cryptographic protocols in terms of message origin and destination. The taxonomy is independent of any method used to analyze or prevent such attacks. It is also complete in the sense that any replay attack is composed entirely of elements classified by the taxonomy. The classification of attacks is illustrated using both new and previously known attacks on protocols. The taxonomy is also used to discuss the appropriateness of particular countermeasures and protocol analysis methods to particular kinds of replays.

DTIC

*Cryptography; Taxonomy*

**20070015318** Integrated Wave Technologies, Inc., Fremont, CA USA

**A Fault-Tree Representation of NPATRL Security Requirements**

Cervesato, Iliano; Meadows, Catherine; Jan 2003; 11 pp.; In English

Contract(s)/Grant(s): N00173-00-C-2086

Report No.(s): AD-A464078; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464078>

In this paper we show how we can increase the ease of reading and writing security requirements for cryptographic protocols by developing a visual language based on fault trees. We develop such a semantics for a subset of NPATRL, a temporal language used for expressing safety requirements for cryptographic protocols, and show that the subset is sound and complete with respect to the semantics. We also show how the fault trees can be used to improve the presentation of some specifications that we developed in our analysis of the Group Domain of Interpretation (GDOI) protocol.

DTIC

*Cryptography; Fault Trees; Security*

**20070015319** Naval Research Lab., Washington, DC USA

**Visual Security Protocol Modeling**

McDermott, J; Jan 2005; 14 pp.; In English

Report No.(s): AD-A464079; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464079>

This paper argues that the existing model-driven architecture paradigm does not adequately cover the visual modeling of security protocols: sequences of interactions between principals. A security protocol modeling formalism should be not only well-defined but also support event-based, compositional, comprehensive, laconic, lucid, sound, and complete modeling. Candidate visual approaches from both the OMG's MDA and other more well-defined formalisms fail to satisfy one or more of these criteria. By means of two example security protocol models, we present the GSPML visual formalism as a solution.

DTIC

*Cryptography; Protocol (Computers); Security*

**20070015329** Washington State Univ., Pullman, WA USA

**Perceptual Issues in the Use of Head-Mounted Visual Displays**

Patterson, Robert; Winterbottom, Marc D; Pierce, Byron J; Jan 2006; 22 pp.; In English

Contract(s)/Grant(s): FA8650-05-D6502; Proj-1123

Report No.(s): AD-A464094; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464094>

We provide a review and analysis of much of the published literature on visual perception issues that impact the design and use of head-mounted displays (HMDs). Unlike the previous literature on HMDs, this review draws heavily from the basic vision literature in order to help provide insight for future design solutions for HMDs. Included in this review are articles and books found cited in other works as well as articles and books obtained from an Internet search. Issues discussed include the effect of brightness and contrast on depth of field, dark focus, dark vergence, and perceptual constancy; the effect of accommodation/vergence synergy on perceptual constancy, eyestrain, and discomfort; the relationship of field of view to the functioning of different visual pathways and the types of visual-motor tasks mediated by them; the relationship of binocular input to visual suppression; and the importance of head movements, head tracking, and display update lag. This paper offers a set of recommendations for the design and use of HMDs. Consideration of the basic vision literature will provide insight for future design solutions for HMDs.

DTIC

*Display Devices; Helmet Mounted Displays; Visual Perception*

**20070015428** Naval Research Lab., Washington, DC USA

**Formal Verification of Cryptographic Protocols: A Survey**

Meadows, Catherine A; Jan 1995; 17 pp.; In English

Report No.(s): AD-A464292; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464292>

In this paper we give a survey of the state of the art in the application of formal methods to the analysis of cryptographic protocols. We attempt to outline some of the major threads of research in this area, and also to document some emerging trends.

DTIC

*Cryptography; Program Verification (Computers); Surveys*

**20070015437** Mitre Corp., McLean, VA USA

**A Simplified Taxonomy of Command and Control Structures for Robot Teams**

Grabowski, Robert; Christiansen, Alan; Jun 2005; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464301; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464301>

For a team to be effective, it must coordinate and cooperate in some fashion. Often this ability is a direct function of the way the team is put together. Selecting the right architecture is driven by many factors including the skill of the individual, ability to communicate, availability of resources, and the size of the team. In this paper, we examine the issue of command and control from the perspective of coordinating a team of robots. We look at the existing field of robotics and select several representative teams that cover the spectrum from teleoperation to peer to peer interaction. We identify and examine the mechanisms that facilitate coordination and define a taxonomy that describes the coordination complexity. Finally we look at the role of the human as he interacts with the team and how this interaction influences the coordination between members of the team.

DTIC

*Command and Control; Robots; Taxonomy*

**20070015446** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Quantitative Object Reconstruction using Abel Transform X-ray Tomography and Mixed Variable Optimization**

Abramson, Mark A; Asaki, Thomas J; Dennis, J E; Pingel, Rachael L; O'Reilly, Kevin R; Feb 12, 2007; 21 pp.; In English

Contract(s)/Grant(s): F49620-01-1-0013

Report No.(s): AD-A464329; RICE-CAAM-TR07-03; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464329>

This paper introduces a new approach to the problem of quantitatively reconstructing cylindrically symmetric objects from radiograph data obtained via x-ray tomography. Specifically, a mixed variable programming (MVP) problem is formulated, in which the variables of interest are the number and types of materials and the thickness of each concentric layer. The objective function is a measure of distance between one-dimensional radiograph data and a material property vector operated on by a forward projection based on the Abel transform. The mixed variable pattern search (MVPS) algorithm for linearly constrained MVP problems is applied to the problem by means of the NOMADm MATLABr software package. Numerical results are presented for several test configurations and show that, while there are difficulties yet to be overcome, the method appears to be very promising for solving this class of problems in practice.

DTIC

*Abel Function; Image Reconstruction; Tomography; Transformations (Mathematics); X Rays*

**20070015459** Maryland Univ., Baltimore, MD USA

**Survey and Comparative Analysis of Entropy and Relative Entropy Thresholding Techniques**

Chang, C -I; Du, Y; Wang, J; Guo, S -M; Thouin, P D; Dec 2006; 15 pp.; In English

Contract(s)/Grant(s): MDA904-00-C-2120

Report No.(s): AD-A464347; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464347>

Entropy-based image thresholding has received considerable interest in recent years. Two types of entropy are generally used as thresholding criteria: Shannon's entropy and relative entropy, also known as Kullback-Leibler information distance, where the former measures uncertainty in an information source with an optimal threshold obtained by maximizing Shannon's entropy, whereas the latter measures the information discrepancy between two different sources with an optimal threshold obtained by minimizing relative entropy. Many thresholding methods have been developed for both criteria and reported in the literature. These two entropy-based thresholding criteria have been investigated and the relationship among entropy and relative entropy thresholding methods has been explored. In particular, a survey and comparative analysis is conducted among several widely used methods that include Pun and Kapur's maximum entropy, Kittler and Illingworth's minimum error thresholding, Pal and Pal's entropy thresholding and Chang et al.'s relative entropy thresholding methods. In order to objectively assess these methods, two measures, uniformity and shape, are used for performance evaluation.

DTIC

*Entropy; Image Processing; Surveys*

**20070016540** Naval Research Lab., Washington, DC USA

**Weakly Secret Bit Commitment: Applications to Lotteries and Fair Exchange**

Syverson, Paul; Jun 1998; 14 pp.; In English

Report No.(s): AD-A464109; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464109>

This paper presents applications for the weak protection of secrets in which weakness is not just acceptable but desirable. For one application, two versions of a lottery scheme are presented in which the result of the lottery is determined by the ticket numbers purchased, but no one can control the outcome or determine what it is until after the lottery closes. This is because the outcome is kept secret in a way that is breakable after a predictable amount of time and/or computation. Another presented application is a variant on fair exchange protocols that requires no trusted third party at all.

DTIC

*Cryptography; Computation*

**64**

**NUMERICAL ANALYSIS**

Includes iteration, differential and difference equations, and numerical approximation.

**20070014890** NASA Stennis Space Center, Stennis Space Center, MS, USA

**Application of ANSYS Workbench and CFX at NASA's John C. Stennis Space Center**

Woods, Jody L.; [2007]; 21 pp.; In English; 2007 ANSYS U.S. Regional Conference Series Texas, 20-22 Feb. 2007, Houston, TX, USA; Original contains color illustrations; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014890>

This viewgraph presentation reviews the overall work of the Stennis Space Center, with particular attention paid to the systems analysis and modeling being done with ANSYS Workbench and CFX. Examples of the analyses done with ANSYS Workbench and CFX and planned analyses are reviewed.

CASI

*Computational Fluid Dynamics; Models; Applications Programs (Computers)*

**20070015116** Delaware Univ., Newark, DE USA

**Development and Test of a Theory of Work Team Productivity**

Sawyer, John E; Pritchard, Robert D; Bennett, Jr , Winston R; Latham, William R; Jul 2001; 26 pp.; In English

Contract(s)/Grant(s): Proj-1123

Report No.(s): AD-A463501; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463501>

As noted in A Theory of Behavior in Organizations , by J.C. Naylor, R.D. Pritchard, and D.R. Ilgen's (1980), we extend their theory of behavior in organizations to explain work team productivity, and test it using time-series analysis on data from a large-scale study of teams. Priority scores for 37 indicators of productivity across five work teams over 23 months were used to predict month-by-month changes in productivity for each of the 37 team products. The results show that team productivity improvements can be explained by feedback including priority scores derived from nonlinear contingency functions of the product indicators. Furthermore, teams which initially performed more poorly benefited the most from the priority score feedback. Goal setting positively affected productivity gain and did so consistently across work teams, after the effects of priority feedback and the interaction of work team with priority feedback were controlled. Implications for team performance strategies are discussed.

DTIC

*Productivity; Time Series Analysis*

**20070015122** Defence Research and Development Canada, Valcartier, Quebec Canada

**SOCLe: Integrated Design of Software Applications and Security**

Painchaud, Frederic; Azambre, Damien; Bergeron, Matthieu; Mullins, John; Oarga, Raveca M; Jun 2005; 41 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463596; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463596>

Defense Research and Development Canada (DRDC) Valcartier, with the support of the CRAC Laboratory at Ecole

Polytechnique de Montreal, carried out an ambitious R&D project aiming at developing a tool called SOCLE which integrates the design of software applications with their security. Integrating the design of software applications and security into a unique tool is not only particularly innovative but also crucial to ensure the quality and security of critical command and control information systems. Moreover, as it is 50 to 100 times more expensive to correct a software error once the design phase is finished, detecting and correcting errors at design-time saves time and money. This paper presents the SOCLE project's major achievements along with a simplified case study on Caveats, as an illustrative example of a possible military application for this new technology.

DTIC

*Algorithms; Command and Control; Computer Programming; Security; Software Engineering*

**20070015137** Miami Univ., FL USA

**High-Order, Multi-Scale Ocean Modeling on Adaptive, Unstructured Meshes: Comparison of SEOM and ROMS in the Northwest Atlantic**

Iskandarani, Mohamed; Jan 2007; 5 pp.; In English

Contract(s)/Grant(s): N00014-03-1-0254

Report No.(s): AD-A463658; TR-663756; No Copyright; Avail.: CASI: [A01](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463658>

A novel oceanic test has revealed an interesting dynamical limit for the hydrostatic Navier-Stokes equation that argues against using high-order methods for simulating these types of flows. This strange behavior was uncovered largely due to the fidelity of the spectral element model to the mathematical setting of the hydrostatic equations. A non-hydrostatic version of the spectral element model has been produced that incorporates many of the advances developed in recent years; the model is currently being applied to simulating gravity currents at high Reynolds number. We have continued in our efforts to build an unstructured-grid ocean modeling community by organizing several national and international meetings where participants share their common experience in developing and running unstructured grid models.

DTIC

*Hydrostatics; Navier-Stokes Equation; Ocean Models; Oceans; Spectra; Unstructured Grids (Mathematics)*

**20070015208** Defence Science and Technology Organisation, Edinburgh, Australia

**Numerical Calculations for Passive Geolocation Scenarios**

Koks, Don; Jan 2007; 76 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463895; DSTO-RR-0319; No Copyright; Avail.: CASI: [A05](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463895>

This report reviews work done in gaining some familiarity with methods of passive geolocation, and a search for rules of thumb that might tell us how to optimize the geolocation for a given scenario. We first cover the main approaches to collecting angle of arrival data and point out typical accuracies. Following this is an account of the mathematics used to analyze this data to produce an estimate of an emitter's location. We then give an overview of some of the literature, and finish by demonstrating a Matlab programme that runs several geolocation algorithms. Simple rules of thumb that specify how to fly a baseline and take data, so as to maximize the accuracies of the different techniques, do not appear to be readily derivable.

DTIC

*Kalman Filters; Least Squares Method; Numerical Analysis; Position (Location)*

**20070015277** Virginia Univ., Charlottesville, VA USA

**Terrain Based Prediction to Reduce the Search Area in Response to Insurgent Attacks**

Brown, Donald E; Griffin, Gregory; Jun 2005; 60 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464024; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464024>

Insurgents have used mortars to attack their enemies for decades. Iraq is no exception. This paper describes a terrain based technique investigated to predict the most likely routes an insurgent will take after firing his mortar where along the routes he is likely to be located and which insurgent friendly area he is headed to. Specifically, this prediction method quantified knowledge of the terrain and knowledge of the enemy's habits to determine his most likely actions. Remote objects represent the quantification of the enemy's habits. These object's influence is calculated using a potential fields method. The k-best routes are generated with an A\* optimization algorithm using multiple methods to systematically alter the quantified information about the terrain and enemy's habits. Finally, the information is presented to the user through a graphical user

interface with the network routes and the predicted progress of the insurgents along the routes.

DTIC

*Algorithms; Terrain; Warfare*

**20070015301** Air Force Research Lab., Wright-Patterson AFB, OH USA

**FE-BI Analysis of a Leaky-Wave Antenna With Resistive Sheet Termination (Postprint)**

Kempel, Leo; Schneider, Steve; Radcliffe, Joshua; Janning, Dan; Thiele, Gary; Jul 2006; 6 pp.; In English

Contract(s)/Grant(s): Proj-7622

Report No.(s): AD-A464055; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464055>

Printed leaky-wave antennas offer the potential for a low-profile, wide-bandwidth antenna element that can be arrayed if desired. Microstrip leaky-wave antennas rely on the suppression of the familiar EH<sub>0</sub> mode and the propagation of the radiating EH<sub>1</sub> mode. It is well-known that above a critical frequency, this leaky-wave will propagate with little attenuation and that the phase difference between the two radiating edges of the microstrip leads to radiation. However, due to the limits of installation area, such antennas must be terminated in a manner that reduces back reflection. If this is not done, a standing wave is established on the antenna limiting its utility as a leaky-wave antenna in terms of front-to-back ratio and bandwidth. In this paper, the hybrid finite element-boundary integral method is used to investigate an antenna termination scheme involving the use of resistive sheet extensions to the antenna. It will be shown that such a termination increases the front-to-back ratio and usable bandwidth of the antenna as compared to an antenna without such termination.

DTIC

*Boundary Element Method; Electric Fields; Electric Potential; Power Gain; Standing Wave Ratios; Standing Waves; Waveguide Antennas*

**20070015313** Naval Research Lab., Stennis Space Center, MS USA

**Quantifying Consolidation and Reordering in Natural Granular Media from Computed Tomography Images**

Reed, Allen H; Thompson, Karsten E; Zhang, Wenli; Willson, Clinton S; Briggs, Kevin B; Jan 2006; 10 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464069; NRL/PP/7430-06-2; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464069>

Packing of granular media is an extremely important determinant in reservoir rock evolution, sound speed propagation, fluid flow and sediment compressibility. X-ray microfocus computed tomography (XMCT) images with high-resolution were evaluated using a grain-based algorithm that quantifies discrete components and bulk properties of sedimentary systems at different states of compaction or at approximately minimum and maximum packing densities. Angularity of these sands ranges from rounded to subrounded to subangular. Network permeability compares reasonably well to measured values; grain aspect ratios and coordination number are reasonable for sands. The grain-based algorithm provides a robust and efficient capability.

DTIC

*Computer Aided Tomography; Consolidation; Granular Materials; Images; Tomography; X Rays*

**20070015314** Naval Research Lab., Stennis Space Center, MS USA

**Application of a New Grain-Based Reconstruction Algorithm to Microtomography Images, for Quantitative Characterization and Flow Modeling**

Thompson, Karsten E; Willson, Clinton S; White, Christopher D; Nyman, Stephanie; Bhattacharya, Janok; Reed, Allen H; Oct 2005; 12 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464070; NRL/PP/7430-05-11; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464070>

X-ray computed microtomography (XMT) is used for high-resolution, non-destructive imaging and has been applied successfully to geologic media. Despite the potential of XMT to aid in formation evaluation, currently it is used mostly as a research tool. One factor preventing more widespread application of XMT technology is limited accessibility to microtomography beamlines. Another factor is that computational tools for quantitative image analysis have not kept pace with the imaging technology itself. In this paper, we present a new grain-based algorithm used for computer reconstruction and analysis of granular materials and subsequent network generation. The algorithm differs significantly from other methods because the first step is to extract the fundamental granular structure from a 3D data set, which provides a wealth of information such as grain sizes, aspect ratios, orientations, surface areas, etc. Knowledge of the basic granular structure serves



as a foundation for characterizing the void morphology and creating physically representative pore networks. The algorithm is applied to a sample of sandstone from the Frontier Formation in Wyoming, USA, which was imaged using Synchrotron microtomography. Morphologic and flow-modeling results are presented.

DTIC

*Algorithms; Characterization; Computer Aided Tomography; Granular Materials; Images; Mathematical Models; X Rays*

**20070015345** ILOG S.A., Gentilly, France

**Integration OR Algorithms And Randomization With Constraint Programming**

Sainte Marie, Christian De; Aug 16, 2004; 19 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-03-1-3022

Report No.(s): AD-A464117; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464117>

This report results from a contract tasking ILOG as follows: Several promising areas will be investigated: more efficient use of linear programming. new and more powerful relaxation techniques use of column generation techniques integration of graph theoretic algorithms use of randomization to search branch-and-bound trees and symmetry breaking. Techniques that are developed will be tested on challenging problems where current constraint programming technology is limited.

DTIC

*Algorithms; Measure and Integration*

**20070015375** Planning Systems, Inc., Reston, VA USA

**Advanced Physics-Based Modeling of Discrete Clutter and Diffuse Reverberation in the Littoral Environment**

Neumann, Peter; Holland, Charles; LePage, Kevin; Mar 16, 2007; 25 pp.; In English

Contract(s)/Grant(s): N00014-04-C-0399

Report No.(s): AD-A464200; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464200>

In response to the Navy STTR Topic N03-T011 'Physics-based modeling of Acoustic Reverberation in the Littoral Environment,' a team representing PSI ARL-PSU and NRL-DC was assembled to develop a broadband time series simulation capability for both discrete clutter and diffuse reverberation. This simulation capability is based upon the work by Kevin LePage (NRL-DC). who participated on this STTR as an outside funded resource. and uses the coherent summation of narrow band results using normal mode methods to generate the broadband time series simulations. This high level of simulation fidelity was proposed for use in the AEER (Advanced Extended Echo Ranging) programs as a tool for active. coherent sonar system development. Due to funding limitations in FY 07 at NAVAIR. that transition was not possible even with a high level of interest from the AEER program manager. The product of this Phase II STTR does not replace an existing modeling capability within the proposed program but rather will provide an entirely new simulation capability.

DTIC

*Broadband; Clutter; Reverberation; Simulation; Time Series Analysis*

**20070015386** Polytechnic Univ., Brooklyn, NY USA

**Enhancement of Stochastic Resonance by Tuning System Parameters and Adding Noise Simultaneously**

Wu, Xingxing; Jiang, Zhong-Ping; Repperger, Daniel; Nov 2005; 8 pp.; In English

Contract(s)/Grant(s): Proj-2313

Report No.(s): AD-A464231; ECS-009317; OISE-0408925; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464231>

The stochastic resonance effect can be realized by tuning system parameters or by adding noise. This paper investigates the possibility to enhance the stochastic resonance effect by tuning system parameters and adding noise simultaneously. First, we use some examples to demonstrate the situation where only the system parameters or noise can be adjusted for maximizing the stochastic resonance effect. Then, it is shown using standard optimization theory that the normalized power normal of the bistable double-well system with a periodic input signal can reach a larger maximal value by tuning the system parameter and adding noise simultaneously. Finally, for the purpose of practical implementation, searching for the optimal system parameter and noise intensity is realized by an on-line fast-converging optimization algorithm.

DTIC

*Algorithms; Augmentation; Signal Processing; Stochastic Processes; Tuning*

**20070015434** Purdue Univ., West Lafayette, IN USA

**Numerical Simulation and Experiments of Fatigue Crack Growth in Multi-Layer Structures of MEMS and Microelectronic Devices**

Siegmund, Thomas H; Dec 2006; 282 pp.; In English

Contract(s)/Grant(s): F49620-03-1-0152

Report No.(s): AD-A464298; No Copyright; Avail.: CASI: [A13](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464298>

Numerical simulation and experiments on the toughness and fatigue crack growth resistance of MEMS relevant thin film structures are reported. Structures consisting of metal films (aluminum, 0.1 to 2.0 micrometers thickness) confined between elastic substrates (semiconductor wafers) are considered. The study is concerned with the influence of the thickness of the metal film on the fatigue failure response. Numerical simulations of fatigue crack growth are conducted by use of cohesive zone models. Both a damage mechanics-based model as well as a model based on dislocation mechanics are employed. To enable these computations, a strain gradient plasticity model is developed. It is demonstrated that cohesive zone models of fatigue enable analysis of fatigue failure to cases where the Paris Law is no longer applicable. The influence of geometric constraint (thin film confinement, presence of interfaces), mechanical constrain (T-stress), size, and strain gradients on fatigue crack growth are demonstrated.

DTIC

*Crack Propagation; Fatigue (Materials); Laminates; Microelectromechanical Systems; Microelectronics; Numerical Analysis; Simulation*

**20070015451** California Inst. of Tech., Pasadena, CA USA

**Robust and Efficient Recovery of Rigid Motion from Subspace Constraints Solved using Recursive Identification of Nonlinear Implicit Systems**

Soatto, Stefano; Perona, Pietro; Mar 7, 1994; 17 pp.; In English

Contract(s)/Grant(s): N00014-98-1-0990

Report No.(s): AD-A464334; CIT-CDS-94-005; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464334>

The problem of estimating rigid motion from projections may be characterized using a non-linear dynamical system, composed of the rigid motion transformation and the perspective map. The time derivative of the output of such a system, which is also called the 'motion field', is bilinear in the motion parameters, and may be used to specify a subspace constraint on either the direction of translation or the inverse depth of the observed points. Estimating motion may then be formulated as an optimization task constrained on such a subspace. Heeger and Jepsen [5], who first introduced this constraint, solve the optimization task using an extensive search over the possible directions of translation. We reformulate the optimization problem in a systems theoretic framework as the identification of a dynamic system in exterior differential form with parameters on a differentiable manifold, and use techniques which pertain to nonlinear estimation and identification theory to perform the optimization task in a principled manner. The general technique for addressing such identification problems [14] has been used successfully in addressing other problems in computational vision [13, 121]. The application of the general method [14] results in a recursive and pseudo-optimal solution of the motion problem, which has robustness properties far superior to other existing techniques we have implemented. By releasing the constraint that the visible points lie in front of the observer, we may explain some psychophysical effects on the nonrigid percept of rigidly moving shapes. Experiments on real and synthetic image sequences show very promising results in terms of robustness, accuracy and computational efficiency.

DTIC

*Nonlinear Systems; Nonlinearity; Radioactive Decay; Recursive Functions*

**20070015452** California Inst. of Tech., Pasadena, CA USA

**Hoo Control of Nonlinear Systems: A Convex Characterization**

Lu, Wei-Min; Doyle, John C; Oct 22, 1993; 34 pp.; In English

Report No.(s): AD-A464337; CIT-CDS-93-020; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464337>

The so-called nonlinear X,-control problem in state space is considered with an emphasis on developing machinery with promising computational properties. Both state feedback and output feedback %,-control problems for a class of nonlinear systems are characterized in terms of continuous positive definite solutions of algebraic nonlinear matrix inequalities which

are convex feasibility problems. The issue of existence of solutions to these nonlinear matrix inequalities (NLMIs) is justified.  
DTIC

*Algebra; Characterization; Control Theory; Convexity; Nonlinear Systems; Nonlinearity; Partial Differential Equations*

**20070015454** California Inst. of Tech., Pasadena, CA USA

**Dynamic Estimation of Rigid Motion from Perspective Views via Recursive Identification of Exterior Differential Systems with Parameters on a Topological Manifold**

Soatto, Stefano; Frezza, Ruggero; Perona, Pietro; Feb 15, 1994; 34 pp.; In English

Contract(s)/Grant(s): N00014-93-1-0990

Report No.(s): AD-A464339; CIT-CDS-94-004; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464339>

We formulate the problem of estimating the motion of a rigid object viewed under perspective projection as the identification of a dynamic model in Exterior Differential form with parameters on a topological manifold. We first describe a general method for recursive identification of nonlinear implicit systems using prediction error criteria. The parameters are allowed to move slowly on some topological (not necessarily smooth) manifold. The basic recursion is solved in two different ways: one is based on a simple extension of the traditional Kalman Filter to nonlinear and implicit measurement constraints, the other may be regarded as a generalized 'Gauss-Newton' iteration, akin to traditional Recursive Prediction Error Method techniques in linear identification. A derivation of the 'Implicit Extended Kalman Filter' (IEKF) is reported in the appendix. The ID framework is then applied to solving the visual motion problem: it indeed is possible to characterize it in terms of identification of an Exterior Differential System with parameters living on a Co topological manifold, called the 'essential manifold'. We consider two alternative estimation paradigms. The first is in the local coordinates of the essential manifold: we estimate the state of a nonlinear implicit model on a linear space. The second is obtained by a linear update on the (linear) embedding space followed by a projection onto the essential manifold. These schemes proved successful in performing the motion estimation task, as we show in experiments on real and noisy synthetic image sequences.

DTIC

*Kalman Filters; Linear Systems; Manifolds (Mathematics); Recursive Functions; Topology; Vision*

**20070015460** California Inst. of Tech., Pasadena, CA USA

**Set Descriptions of White Noise and Worst Case Induced Norms**

Paganini, Fernando; Oct 15, 1993; 20 pp.; In English

Report No.(s): AD-A464348; CIT-CDS-93-017; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464348>

This paper provides a framework for analyzing white noise disturbances in linear systems. Rather than the usual stochastic approach, noise signals are described as elements in sets and the disturbance rejection properties of the system are described in a worst case setting. This type of modeling of noise and disturbances very much fits the philosophy of both the behavioral and robust control settings. The description is based on properties of finite records of signals, which may be verified directly on experimental data. Bounds of system gain for input signals in these sets are given, and their asymptotic behavior for long data records is analyzed. The presence of low-correlated disturbances (noise) in physical systems has usually been modeled by thinking of the disturbance as the realization of a stochastic process, which is white in the sense of having zero autocorrelations in the expected value sense. The basic result for analysis of linear systems in the presence of stochastic noise is that if unit variance white noise is input to a stable linear system, the output variance (expected value of power) is given by the 2-norm of the system function. Moreover, the spectral characteristics of the output signal are given by the filter. However, if in a real-world situation we want to use results of this type, we will have to convince ourselves that our disturbances can be accurately modeled as a stochastic white noise trajectory. Trying to decide this from experimental data leads to a statistical hypothesis test on a finite record of the signal. In other words, we will accept our signal as white noise if it belongs to a certain set, designed to give us reasonable confidence in the whiteness of the source. This set is typically described in terms of time autocorrelations.

DTIC

*Asymptotic Series; Autocorrelation; Norms; Statistical Tests; Stochastic Processes; Trajectories; White Noise*

**20070015702** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Robustness of Multiple Clustering Algorithms on Hyperspectral Images**

Williams, Jason P; Mar 2007; 127 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464144; AFIT/GOR/ENS/07-27; No Copyright; Avail.: CASI: A07, Hardcopy

By clustering data into homogeneous groups, analysts can accurately detect anomalies within an image. This research was conducted to determine the most robust algorithm and settings for clustering hyperspectral images. Multiple images were analyzed, employing a variety of clustering algorithms under numerous conditions to include distance measurements for the algorithms and prior data reduction techniques. Various clustering algorithms were employed, including a hierarchical method, ISODATA, K-means, and X-means, and were used on a simple two dimensional dataset in order to discover potential problems with the algorithms. Subsequently, the lessons learned were applied to a subset of a hyperspectral image with known clustering, and the algorithms were scored on how well they performed as the number of outliers was increased. The best algorithm was then used to cluster each of the multiple images using every variable combination tested, and the clusters were input into two global anomaly detectors to determine and validate the most robust algorithm settings.

DTIC

*Algorithms; Anomalies; Classifications; Cluster Analysis; Hierarchies; Imagery; Images; Principal Components Analysis; Robustness (Mathematics)*

**20070015703** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Improved Hyperspectral Image Testing Using Synthetic Imagery and Factorial Designed Experiments**

Bellucci, Joseph P; Mar 2007; 113 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464150; AFIT/GOR/ENS/07-01; No Copyright; Avail.: CASI: [A06](#), Hardcopy

The goal of any remote sensing system is to gather data about the geography it is imaging. In order to gain knowledge of the earth's landscape, post-processing algorithms are developed to extract information from the collected data. The algorithms can be intended to classify the various ground covers in a scene, identify specific targets of interest, or detect anomalies in an image. After the design of an algorithm comes the difficult task of testing and evaluating its performance. Traditionally, algorithms are tested using sets of extensively ground truthed test images. However, the lack of well characterized test data sets and the significant cost and time issues associated with assembling the data sets contribute to the limitations to this approach. This thesis uses a synthetic image generation model in cooperation with a factorial designed experiment to create a family of images with which to rigorously test the performance of hyperspectral algorithms. The factorial designed experimental approach allowed the joint effects of the sensor's view angle, time of day, atmospheric visibility, and the size of the targets to be studied with respect to algorithm performance. A head-to-head performance comparison of the two tested spectral processing algorithms was also made.

DTIC

*Algorithms; Factorials; Imagery; Images*

**20070015807** Naval Research Lab., Washington, DC USA

**Ocean Inherent Optical Property Determination from In-Water Light Field Measurements**

Leathers, Rober tA; Roesler, Collin S; McCormick, Norman J; Aug 20, 1999; 9 pp.; In English

Report No.(s): AD-A464514; No Copyright; Avail.: CASI: [A02](#), Hardcopy

An algorithm is described and evaluated for determining the absorption and backscattering coefficients  $a(z)$  and  $bb(z)$  from measurements of the nadir-viewing radiance  $Lu(z)$  and downward irradiance  $Ed(z)$ . The method, derived from radiative transfer theory, is similar to a previously proposed one for  $Eu(z)$  and  $Ed(z)$ , and both methods are demonstrated with numerical simulations and field data. Numerical simulations and a sensitivity analysis show that good estimates of  $a(z)$  and  $bb(z)$  can be obtained if the assumed scattering phase function is approximately correct. In an experiment in Long Island Sound, estimates of  $a(z)$  derived with these methods agreed well with those obtained from an in situ reflecting tube instrument.

DTIC

*Algorithms; Field Tests; Oceans; Optical Properties; Scattering; Water*

**20070015813** California Inst. of Tech., Pasadena, CA USA

**Motion from 'X' by Compensating 'Y'**

Soatto, Stefano; Perona, Pietro; Mar 7, 1995; 19 pp.; In English

Contract(s)/Grant(s): N00014-93-1-0990

Report No.(s): AD-A464527; CIT-CDS-95-009; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper analyzes the geometry of the visual motion estimation problem in relation to transformations of the input (images) that stabilize particular output functions such as the motion of a point, a line and a plane in the image. By casting the problem within the popular 'epipolar geometry', we provide a common framework for including constraints such as point, line of plane fixation by just considering 'slices' of the parameter manifold. The models we provide can be used for estimating

motion from a batch using the preferred optimization techniques, or for defining dynamic filters that estimate motion from a causal sequence. We discuss methods for performing the necessary compensation by either controlling the support of the camera or by pre-processing the images. The compensation algorithms may be used also for recursively fitting a plane in 3-D both from point-features or directly from brightness. Conversely, they may be used for estimating motion relative to the plane independent of its parameters.

DTIC

*Estimates; Geometry; Motion; Real Time Operation*

**20070015835** California Univ., Berkeley, CA USA

**The Performance and Scientific Rationale for an Infrared Imaging Fourier Transform Spectrograph on a Large Space Telescope**

Graham, James R; Abrams, Mark; Bennett, C; Carr, J; Cook, K; Dey, A; Najita, J; Wishnow, E; Jun 22, 1998; 12 pp.; In English

Report No.(s): AD-A464568; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We describe a concept for an imaging spectrograph for a large orbiting observatory such as NASA's proposed Next Generation Space Telescope (NGST) based on an imaging Fourier transform spectrograph (IFTS). An IFTS has several important advantages that make it an ideal instrument to pursue the scientific objectives of NGST. We review the operation of an IFTS and make a quantitative evaluation of the signal-to-noise performance of such an instrument in the context of NGST. We consider the relationship between pixel size, spectral resolution, and diameter of the beam splitter for imaging and nonimaging Fourier transform spectrographs and give the condition required to maintain spectral modulation efficiency over the entire field of view. We give examples of scientific programs that could be performed with this facility.

DTIC

*Field of View; Fourier Transformation; Hubble Space Telescope; Imaging Techniques; Infrared Imagery; Kuiper Belt; Signal to Noise Ratios; Spaceborne Telescopes; Spectrographs; Telescopes*

**20070016640** AI Solutions, Inc., Lanham, MD, USA

**Adapting Covariance Propagation to Account for the Presence of Modeled and Unmodeled Maneuvers**

Schiff, Conrad; [2006]; 1 pp.; In English; AAS/AIAA Astrodynamics Specialist Conference, 21-24 Aug. 2006, Keystone, CO, USA; Copyright; Avail.: Other Sources; Abstract Only

This paper explores techniques that can be used to adapt the standard linearized propagation of an orbital covariance matrix to the case where there is a maneuver and an associated execution uncertainty. A Monte Carlo technique is used to construct a final orbital covariance matrix for a 'propagate-burn-propagate' process that takes into account initial state uncertainty and execution uncertainties in the maneuver magnitude. This final orbital covariance matrix is regarded as 'truth' and comparisons between it and three methods using modified linearized covariance propagation are made. The first method accounts for the maneuver by modeling its nominal effect within the state transition matrix but excludes the execution uncertainty by omitting a process noise matrix from the computation. In the second method, the maneuver is not modeled but the uncertainty in its magnitude is accounted for by the inclusion of a process noise matrix. In the third method, which is essentially a hybrid of the first two, the nominal portion of the maneuver is included via the state transition matrix while a process noise matrix is used to account for the magnitude uncertainty. Since this method also correctly accounts for the presence of the maneuver in the nominal orbit, it is the best method for applications involving the computation of times of closest approach and the corresponding probability of collision,  $P_c$ . However, applications for the two other methods exist and are briefly discussed. Despite the fact that the process model ('propagate-burn-propagate') that was studied was very simple - point-mass gravitational effects due to the Earth combined with an impulsive delta-V in the velocity direction for the maneuver - generalizations to more complex scenarios, including high fidelity force models, finite duration maneuvers, and maneuver pointing errors, are straightforward and are discussed in the conclusion.

Author

*Covariance; Mathematical Models; Linearization; Propagation; Matrices (Mathematics); Maneuvers*

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

**20070015095** Missouri Agricultural Experiment Station, Columbia, MO, USA

**User Guide to Acute to Chronic Estimation**

Mayer, F. L.; Sun, K.; Lee, G.; Ellersieck, M. R.; Krause, G. F.; Jan. 1999; 26 pp.; In English  
Report No.(s): PB2007-106187; EPA/600/R-98/152; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Acute-to-Chronic Estimation (ACE) with Time-Concentration-Effect Models software allows prediction of chronic toxicity from acute toxicity datasets. ACE uses linear regression and accelerated life testing to predict no-effect and low-effect concentrations for chronic mortality.

NTIS

*Toxicity; Mathematical Models; Life Sciences*

**20070015149** Minnesota Univ., Minneapolis, MN USA

**NORTHSTAR: A Parameter Estimation Method for the Spatial Autoregression Model**

Celik, Mete; Kazar, Baris M; Shekhar, Shashi; Boley, Daniel; Lilja, David J; Feb 9, 2007; 46 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463739; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463739>

Parameter estimation method for the spatial autoregression model (SAR) is important because of the many application domains, such as regional economics, ecology, environmental management, public safety, transportation, public health, business, travel and tourism. However, it is computationally very expensive because of the need to compute the determinant of a large matrix due to Maximum Likelihood Theory. The limitation of previous studies is the need for numerous computations of the computationally expensive determinant term of the likelihood function. In this paper, we present a faster, scalable and NOvel pRediction and estimation TechNique for the exact SpaTial Auto Regression model solution (NORTHSTAR). We provide a proof of the correctness of this algorithm by showing the objective function to be unimodular. Analytical and experimental results show that the NORTHSTAR algorithm is computationally faster than the related approaches, because it reduces the number of evaluations of the determinant term in the likelihood function.

DTIC

*Maximum Likelihood Estimates; Parameter Identification*

**20070015184** Royal Inst. of Tech., Stockholm, Sweden

**Enhanced Situation Awareness using Random Particles**

Brynielsson, Joel; Engblom, Mattias; Franzen, Robert; Nordh, Jonas; Voigt, Lennart; Jun 2005; 34 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463850; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463850>

Modern command and control systems present the current view of the situation through a situation picture that is being built up from fused sensor data. However, merely presenting a comprehensible description of the situation does not give the commander complete awareness of the development of a situation. This article presents a generic tool for prediction of forthcoming troop movements. The technique is similar to particle filtering, a method used for approximate inference in dynamic Bayesian networks. The prediction tool has been implemented and installed into an existent electronic warfare system. The tool makes use of the system's geographic information system to extract geographic properties and calculate troop velocities in the terrain which is, in turn, being used for the construction of the tool's transition model. Finally, the result is presented together with the situation picture. The prediction tool has been evaluated in field tests performed in cooperation with the Swedish Armed Forces in an exercise in Sweden during the spring of 2005. Officers and operators of the electronic warfare system were interviewed and exposed to the tool. Reactions were positive and prediction of future troop movements was considered to be interesting for short-term tactical command and control.

DTIC

*Bayes Theorem; Command and Control; Inference; Prediction Analysis Techniques; Situational Awareness*

**20070015190** Aptima, Inc., Woburn, MA USA

**NetSTAR: Methodology to Identify Enemy Network Structure, Tasks, Activities, and Roles**

Levchuk, Georgiy; Chopra, Kari; Pattipati, Krishna; Jun 2005; 45 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463858; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463858>

To counteract the enemy organization, knowledge of the principles under which this organization operates is required. This knowledge provides the ability to detect and predict the activities of the enemy and to select the appropriate counter-actions. Certain counter-actions require additional knowledge about enemy organization and processes ranging from the specifics of organizational command, control, communication and information distribution (C3I) structures to the responsibility delegation and goals at the most important enemy nodes. Our paper proposes to solve the problem of identifying the enemy organization and activities via the NetSTAR system employing a hybrid multi-phase model-based structure and process identification approach. The basis for NetSTAR is an innovative methodology that integrates a social network model of coordination, a meta-task model of enemy goals, and a Hidden-Markov Model (HMM) of enemy activities to detect subgroups engaged in coordinated activities. This model enables the computation of the likelihood of the hypothesized organizational structure and processes given the observed behavior, and allows designing effective dynamic counter-action strategies via Partially Observable Markov Decision Processes (POMDP) modeling.

DTIC

*Electronic Countermeasures; Markov Processes; Models; Observation; Organizations*

**20070015224** George Mason Univ., Fairfax, VA USA

**Dynamic Influence Nets: An Extension of Timed Influence Nets for Modeling Dynamic Uncertain Situations**

Haider, Sajjad; Levis, Alexander H; Jun 2005; 34 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-03-1-0033

Report No.(s): AD-A463925; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463925>

This paper proposes structural and parametric enhancements in the Timed Influence Nets (TINs) based framework for modeling Effects-Based Operations (EBO). The existing TIN framework does not have the capability to model the impact of different sequences of actions. Thus, no matter what the sequence of action is, the final outcome remains the same. Furthermore, it is assumed that the influence of an event on another event is stationary, i.e., the influence remains the same throughout the campaign. Both of these constraints may turn out to be unrealistic in many real world situations. The enhancements proposed in this paper would overcome the above two limitations. The proposed structural enhancement would enable a system modeler to model the impacts of different sequences of actions on the desired effect; while the parametric enhancements would aid the mathematical modeling of time-varying influences. Together these enhancements make it possible to model the impact of repetitive actions in a dynamic uncertain situation.

DTIC

*Mathematical Models; Nets; Networks; Tin*

**20070015281** Naval Undersea Warfare Center, Newport, RI USA

**Coverage Statistics of Distributed Sensor Fields With Heterogeneous Range Sensitivity**

Rowe, Errol G; Dec 28, 2006; 25 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464030; NUWC-NPT-TR-11785; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464030>

This report presents analytical results for the coverage provided by a system of randomly distributed sensors having heterogeneous range sensitivities. The need to rapidly deploy even a moderately large number of sensors on short notice could place limitations on sensor quality. In particular, the requirement that all sensors have the same range sensitivity could pose a serious problem to the timely deployment of the sensor network. Through an entirely probabilistic approach, coverage statistics for a system of randomly distributed sensors having heterogeneous range sensitivities are obtained. Simulation studies that support the theoretical results are provided. Throughout this report, there are remarks on the implications of the analytical results on design guidance and sensor deployment.

DTIC

*Heterogeneity; Poisson Density Functions; Probability Distribution Functions; Sensitivity; Statistical Distributions*

**20070015351** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Commander and User Perceptions of the Army's Intransit Visibility (ITV) Architecture**

Ward, Charles W; Mar 2007; 58 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464142; AFIT/GLM/ENS/07M-13; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464142>

The purpose of this research was to investigate relationships between some of the current, most widely used ITV systems and how they measured up to fulfilling the needs and requirements of the Army. Specifically, this research sought to determine if there were any differences between the various ITV systems and their ability to provide commanders and users with data and information capable of helping them accomplish their mission.

DTIC

*Command and Control; Factor Analysis; Perception; Visibility*

**20070015402** Air Force Research Lab., Aberdeen Proving Ground, MD USA

**Perturbation by UV Light for Rapid Classification of Biological Particles by Fluorescence**

Bronk, Burt V; Czege, Jozsef; Li, Zhao Z; Booksh, Karl S; Cramer, Jeff; Jan 2007; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464254; ECBC-TR-533; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464254>

Some time ago investigations were initiated into the fluorescence of calcium dipicolinic acid (CaDPA) to improve detection of bacterial endospores. Although the native chemical, CaDPA, fluoresced very weakly, the application of UV irradiation to CaDPA or DPA caused substantial blue-violet emission when excitation is applied later. Further investigation demonstrated a similar phenomenon for dry and wet endospores. The luminescence excitation-emission (Ex-Em or EEM) pattern of vegetative bacteria of various Bacilli as well as vegetative cells of other unrelated bacteria also changes markedly after UV irradiation. We found that the Ex-Em patterns for unirradiated bacteria taken together with the patterns after UV exposure provide a way to rapidly and inexpensively distinguish several different classes of biological particles and distinguish each of these from common background interferences. In this report, the two dimensional experimental Ex-Em patterns using Parallel Factor Analysis and other modern pattern recognition techniques are analyzed. This analysis showed that gram positive bacteria and spores can be distinguished from gram negative bacteria, that vegetative bacteria can be distinguished from spores, and that all of these are distinguishable from certain common backgrounds using this potentially automatable technique.

DTIC

*Bacteria; Classifications; Discriminant Analysis (Statistics); Excitation; Fluorescence; Least Squares Method; Perturbation; Ultraviolet Radiation*

**20070015771** George Mason Univ., Fairfax, VA USA

**Course of Action Development and Evaluation**

Wagenhals, Lee W; Levis, Alexander H; Jan 2000; 19 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-00-1-0267; F49620-98-0-0179

Report No.(s): AD-A464444; No Copyright; Avail.: CASI: A03, Hardcopy

This paper describes a set of procedures that will enhance the analysis, synthesis, and execution of courses of action (COA). The paper presents a set of formal methods for extending the capability of probabilistic models (influence nets) to produce rigorous mathematical models that reveal the impact of the sequence and timing of actionable events on the outcome and effects desired in a situation. By incorporating timing information, such a model can be converted to a Discrete Event System (DES) model in the form of a Colored Petri Net. The DES model, when run as a simulation, can reveal the changes in the likelihood of the desired effects over time for any timed sequence of actionable events that constitute a COA. The paper presents DES analysis techniques that can generate all of the possible sequences of probability values of the outcome given any COA without simulation. Procedures are presented to select desirable sequences from the set of all sequences and determine the temporal relationships among the actionable events that will generate a selected sequence of probability values.

DTIC

*Command and Control; Decision Making; Mathematical Models; Military Operations; Planning; Probability Theory; Sequencing; Software Development Tools*



**20070015772** George Mason Univ., Fairfax, VA USA

**Effects-Based Operations: A Historical Perspective for a Way Ahead**

Wagenhals, Lee W; Levis, Alexander H; McCrabb, Maris; Jun 2003; 20 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-00-1-0267; F49620-02-1-0332

Report No.(s): AD-A464445; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Since the Gulf War, there has been a technology-driven rapid enhancement of military capabilities across a spectrum of disciplines. At the same time, the concept of Effects-Based Operations (EBO) has been evolving and gaining acceptance as a better way of thinking about military planning, execution, and assessment. In this paper, the authors review what the research and development community has done to support this change. They investigate methods, tools, and techniques that have been developed to enable the warfighters in the theater and civilian and military leadership to analyze complex situations, determine desired effects, and develop alternative courses of action that can be compared and evaluated. Their purpose is to focus on the directions that the R&D community should take to provide this needed capability to the operator. This is, unfortunately, a case of the R&D community not leading, but trying to catch up to the operator's needs.

DTIC

*Command and Control; Decision Making; Histories; Mathematical Models; Military Operations; Planning; Probability Theory; Software Development Tools*

**20070015918** North Carolina Univ., Chapel Hill, NC USA

**Stochastic and Deterministic Models for Agricultural Production Networks**

Bai, P; Banks, H T; Dediu, S; Govan, A Y; Last, M; Lloyd, A; Nguyen, H K; Olufsen, M S; Rempala, G; Slenning, B D; Feb 22, 2007; 37 pp.; In English

Contract(s)/Grant(s): FA9550-04-1-0220

Report No.(s): AD-A463581; NCSU-CRSC-TR07-06; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An approach to modeling the impact of disturbances in an agricultural production network is presented. A stochastic model and its approximate deterministic model for averages over sample paths of the stochastic system are developed. Simulations, sensitivity and generalized sensitivity analyses are given. Finally, it is shown how diseases may be introduced into the network and corresponding simulations are discussed.

DTIC

*Agriculture; Computerized Simulation; Diseases; Impact Prediction; Livestock; Stochastic Processes; Viruses*

**20070016056** Connecticut Univ., Storrs, CT USA

**Patrolling in a Stochastic Environment**

Ruan, Sui; Meirina, Candra; Yu, Feili; Pattipati, Krishna R; Popp, Robert L; Jun 2005; 28 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-00-1-0101

Report No.(s): AD-A464265; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464265>

The patrolling problem considered in this paper has the following characteristics: Patrol units conduct preventive patrolling and respond to call-for-service. The patrol locations (nodes) have different priorities, and varying incident rates. We design a patrolling scheme such that the locations are visited based on their importance and incident rates. The solution is accomplished in two steps. First, we partition the set of nodes of interest into subsets of nodes, called sectors. Each sector is assigned to one patrol unit. Second, for each sector, we exploit a response strategy of preemptive call-for-service response, and design multiple sub-optimal off-line patrol routes. The net effect of randomized patrol routes with immediate call-for-service response would allow the limited patrol resources to provide prompt response to random requests, while effectively covering the nodes of different priorities having varying incidence rates. To obtain multiple routes, we design a novel learning algorithm (Similar State Estimate Update) under a Markov Decision Process (MDP) framework, and apply softmax action selection method. The resulting patrol routes and patrol unit visibility would appear unpredictable to the insurgents and criminals, thus creating the impression of virtual police presence and potentially mitigating large scale incidents.

DTIC

*Stochastic Processes; Reconnaissance; Decision Making*

## SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

**20070015124** Naval War Coll., Newport, RI USA

### **The Snake-eaters Might Want One Too**

Hackbarth, Karl; Oct 30, 2006; 20 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463630; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463630>

We can win the 'hot war.' We can out-shoot, out-move, and out-communicate any force lined up against us. In stark contrast, success during shaping operations and post conflict reconstruction is often met with abject indifference. We are the best organized, best trained, best equipped, and best educated killing machine the world has ever seen. We are exceptionally good at our core capability. We are not, however, adept at nation building; Security, Stabilization, Transition, and Reconstruction (SSTR) or coalition building. We must get better. The importance of interagency coordination, the complexity of operations, and the need for clearer guidance and directives has been recognized for nearly a century. Codifying the progress that has been made to date and expanding upon the successes will require legislative action of the Goldwaters-Nichols variety.

DTIC  
*Coordination; Snakes*

**20070015158** Science Applications International Corp., McLean, VA USA

### **Architecture Modeling Approach for Net-Centric Enterprise Services (Briefing Charts)**

Lau, Yun-Tung; King, Michelle; Okon, Walter J; Kye, Davied; Jun 2005; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463768; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463768>

This briefing presents an architecture modeling approach for service-oriented architectures such as the Net-Centric Enterprise Services (NCES). The approach is driven by operational mission threads. It uses Unified Modeling Language and the Department of Defense Architecture Framework to capture, analyze, and present the architecture products. Steps in this approach include: 1. Formulating activity models for a mission thread. 2. Mapping the activities to NCES and existing systems. 3. Developing logical deployment architecture with NCES included. 4. Developing logical data models. 5. Constructing executable architecture models. This architecture development approach has been applied to NCES mission threads, which cover a wide range of activities in the Warfighting, Intelligence, and Business domains. It provides a direct trace from NCES capabilities to operational requirements and shows how NCES will support various communities of interest. We illustrate the approach using mission threads that are closely related to Command and Control. Examples include Time-Sensitive Targeting, Joint Close Air Support, and Global Strike.

DTIC  
*Charts; Command and Control; Data Management*

**20070015188** National Inst. of Public Health, Ljubljana, Slovenia

### **Effects of Averaging Mass on Predicted Specific Absorption Rate (SAR) Values**

Gajsek, Peter; Sep 2002; 48 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F61775-01-W-E041

Report No.(s): AD-A463856; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463856>

This report results from a contract tasking National Institute of Public Health as follows: The contractor will investigate the role of averaging mass on calculated specific absorption rate (SAR) values in predicting the effects of radiofrequency radiation (RFR) exposures on body tissues and organs. A Finite Difference Time Domain (FDTD) program will be used to predict localized and whole body SAR values in 3-dimensional anatomical model of a human. Results will address the error margin in RF dosimetry.

DTIC  
*Dosimeters; Mathematical Models; Radio Frequencies*

**20070015201** Cranfield Univ., Shrivenham, UK

**Using assessment Methods and Tools to Understand Joint Battlespace Digitization (JBD)**

Al-Duwaish, Naif M; John, Phil; Jun 2005; 48 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463888; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463888>

This paper reports the author's current research into an integrated approach to Joint Battlespace Digitization (JBD) analysis. The work describes an approach to establishing a toolset that is useful to understand the JBD, existing policies on JBD lack clear directives in certain areas, which may inhibit its benefits and timely exploitation of military situations. There are several methods being developed that are potentially useful for analyzing JBD but several question arise: 1) How do they relate to the overall needs of the JBD analyst? 2) How do they integrate within an overall analytical approach? 3) What methods can we employ for assessing the completeness of our analysis? A new assessment is used to interact and share information between the various aspects of JBD analysis. This toolset is built around Strategy To Task (STT), which enables identification of requirements for JBD and to assess potential options, and System Dynamics (SD) to enable analysis of factors which contribute to mission effectiveness of JBD and to investigate the importance of these factors and also to enable the analysis of specific technical parameters leading to validation of STT assessment. Using different analysis elements is, illustrating the use of these methods tools in the study.

DTIC

*Command and Control; Digital Techniques; Systems Analysis*

**20070015203** Science Applications International Corp., Beavercreek, OH USA

**Course of Action Simulation Analysis**

Hanna, James; Reaper, Jerry; Cox, Tim; Walter, Martin; Jun 2005; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463890; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463890>

The implications of Effects Based Operations (EBO) on Course of Action (COA) development and evaluation are significant. EBO will potentially increase both COA complexity and the number of options one must evaluate to optimize results. Further, metrics must be found that can adequately describe and quantify the goodness of such disparate COAs as a propaganda campaign versus a major military interdiction. The USA Air Force Research Laboratory Information Directorate (US AFRL/IF) continues to lead efforts to prototype a Modeling and Simulation (M&S) based methodology and toolset that allows quick and thorough exploration of this expanding tradespace. Specific thrusts within these efforts include: concurrent multi-hypothesis exploration via cluster computing; automated COA generation; automated simulation scenario generation; COA descriptive metadata representations; metrics metadata representations; and automated data reduction, comparison and visualization techniques. The Course of Action Simulation Analysis (CASA) task was created to address several facets of these thrusts, with a focus on metrics identification, data representation for comparison and visualization. This paper first presents the motivations and concepts behind CASA, and chronicles this past year's efforts. Further, we discuss current and planned activities, and describe the final capabilities expected to result from this task. Specific areas discussed include: the use of mission level simulations to examine multiple-hypothesis; the use of eXtensible Markup Language (XML) for metadata representation; identification of COA metrics; development of tools for data reduction, comparison and visualization; adversarial modeling; and co-evolving red-blue COAs. Finally, we discuss lessons learned to date and present potential future research.

DTIC

*Computerized Simulation; Decision Support Systems; Military Operations; Planning; Simulation*

**20070015204** Johns Hopkins Univ., Laurel, MD USA

**Evaluation of Net-centric Command and Control via a Multi-resolution Modeling Evaluation Framework**

Forsythe, Steven L; North, Paul D; Barnes, Valerie B; Jun 2005; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463891; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463891>

Net-centric transformation and its associated practice of portfolio management require Department of Defense (DOD) managers to understand the effects various net-centric command and control (C2) services have on operational outcomes. This paper discusses an approach developed by the Johns Hopkins University Applied Physics Laboratory (JHU/APL) to qualitatively and quantitatively evaluate the technical, functional, and mission effectiveness of C2 processes and services in a complex, hybrid architectural environment. The complexity of that environment arises from the need for legacy C2 systems and newly-developed net-centric processes and services to interoperate in a common environment. The JHU/APL approach

uses scenarios to bound the mission space to be evaluated and employs simulation techniques to represent and execute the scenarios with differing levels of fidelity. Simulation types include constructive, virtual, and live simulations. The technical evaluation results obtained from the simulations can be combined with estimated deployment, operations, and maintenance costs to facilitate a combined technical/cost comparison among service offerings from competing portfolios. Thus, this scenario- and simulation-based evaluation approach is expected to help DOD managers make better-informed, best-of-breed decisions regarding which net-centric C2 services should be deployed in an operational environment.

DTIC

*Command and Control; Computerized Simulation*

**20070015205** Johns Hopkins Univ., Laurel, MD USA

**A Systems Engineering Approach to Metrics Identification for Command and Control**

Wilcox, Robb; Jun 2005; 13 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463892; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463892>

Command and Control (C2) is an important element to military operations. This is a concept that has been around for a long time and is recognized for its importance on military effectiveness. However, identifying the scope of C2 and the effectiveness as a component of a system is difficult. Differing opinion exists as to what really contributes to C2 and how to measure C2 performance. There is a significant need as new C2 concepts and systems are being developed for a systems approach to define and measure C2. It is helpful to define C2 in the context of a system and develop an approach to Metrics identification for evaluating C2 performance and effectiveness. The metrics must be dynamic to account for the different goals of C2 systems. This paper provides a recommended approach to help solve this problem by viewing C2 as a component of a system. Metrics need to help identify effectiveness and performance measures to help indicate C2 performance. Metrics can be used to help identify system requirements and testing and evaluation for the effectiveness of the C2 approach.

DTIC

*Command and Control; Metrology; Systems Analysis; Systems Engineering; Taxonomy*

**20070015372** Naval Postgraduate School, Monterey, CA USA

**Concept of Deployable Network Operations Center (DNOC)**

Bordetsky, Alex; Thiry, Jeff; Johnson, Shawn; Jun 2005; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464196; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464196>

The movement and collaboration of information has never before been more important to the success of tactical missions. Advanced mobile and wireless networking technologies have the capability to put critical information at the fingertips of the operator, enabling tactical units to successfully carry out their missions. The increasing use of expeditionary and special operations forces in ad hoc, dynamic, and tactical environments poses a need for an adaptable, flexible, and responsive deployable network operations center (DNOC) to support their efforts. Whether co-located or virtual, the DNOC must support tactical units by supplying them with the right information, at the right time, and in the right format. This platform must also provide a rapid, reliable, and secure communications network so forces can collaborate in a manner which builds quality interaction and trust.

DTIC

*Interoperability; Prototypes; Warfare*

**20070015709** Naval Postgraduate School, Monterey, CA USA

**Distributed Holistic Bounding: Structuring Testbeds for Emerging Virtual Environments**

Iatrou, Steven J; Jun 2005; 40 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464327; No Copyright; Avail.: CASI: A03, Hardcopy

Adequately testing, evaluating and analyzing large, scale-free information systems is very difficult due to the nebulous nature of the systems boundaries and ever-changing number of links and nodes that comprise the overall system. This paper proposed that it is possible to conduct such studies through distributed holistic bounding and employment of disciplined experiment campaigning. Beginning with identification of the overarching purpose of the entire system and identifying the boundaries of the sub-systems that contribute to the overall system's functionality we can develop effective experiments that will identify critical environmental variables that affect system performance. By adhering to an experiment campaign strategy

we can discover those variables, develop hypotheses that help determine optimal system configurations and ultimately build and demonstrate that optimal system.

DTIC

*Evaluation; Information Systems; System Effectiveness*

**20070015843** California Inst. of Tech., Pasadena, CA USA

**Distributed Receding Horizon Control With Application to Multi-Vehicle Formation Stabilization**

Dunbar, William B; Murray, Richard M; Jan 26, 2004; 48 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-01-1-0361; F33615-98-C-3613

Report No.(s): AD-A464586; CIT-CDS-04-003; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We consider the control of interacting subsystems whose dynamics and constraints are uncoupled, but whose state vectors are coupled non-separably in a single centralized cost function of a finite horizon optimal control problem. For a given centralized cost structure, we generate distributed optimal control problems for each subsystem and establish that the distributed receding horizon implementation is asymptotically stabilizing. The communication requirements between subsystems with coupling in the cost function are that each subsystem obtain the previous optimal control trajectory of those subsystems at each receding horizon update. The key requirements for stability are that each distributed optimal control not deviate too far from the previous optimal control, and that the receding horizon updates happen sufficiently fast. The theory is applied in simulation for stabilization of a formation of vehicles.

DTIC

*Active Control; Adaptive Control; Distributed Parameter Systems; Horizon*

**20070016055** National Univ. of Defense Technology, Changsha, China

**Effects-Based Designing Organizational Processes: Methodology and Applications**

Yang, Dong-sheng; Xiu, Bao-xin; Peng, Xiao-Hong; Liu, Zhong; Zhang, Wei-Ming; Jun 2005; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464040; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464040>

Designing organizational processes is to select best course of action (COA) to accomplish organizational mission, which is under organizational resources capability constraints. In this paper, a new methodology is advanced to obtain an optimal strategy of organizational processes, which is based on organizational resource capability and desired effects. We define the basic conceptions that include statements of organizational environment and organizational resource capability, actions, events and effects, on which dynamic Bayesian network (DBN) and Markov chain are employed to represent the evolving of organization with its environments. An example of joint landing campaigns is analyzed in our paper, and the new methodology is applied to design optimal strategy for a military organization to accomplish its missions. The optimal COA, obtained from our new methodology under diverse campaigns conditions, are given and analyzed. Results from the simulation of the COA show that our approach to solve optimal strategy of organizational processes accord with traits of general landing campaign.

DTIC

*Networks; Organizations; Organizing*

**20070016059** University of Southern California, Marina del Rey, CA USA

**COLAB: A Laboratory Environment for Studying Analyst Sensemaking and Collaboration**

Morrison, Clayton T; Cohen, Paul R; Jun 2005; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464219; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464219>

COLAB is a laboratory for studying tools that facilitate collaboration and sensemaking among groups of human analysts as they build interpretations of unfolding situations based on accruing intelligence data. The laboratory has three components. The Hats Simulator provides a challenging problem domain involving thousands to millions of agents engaged in individual and collective behaviors, a small portion of which are terrorist. The second component, the AIID Bayesian blackboard, is an instrumented working environment within which analysts collaborate to build their interpretation of the problem domain. The third component is a web based user interface that integrates the Trellis hypothesis authoring and management tool with a query language to allow human analysts to interact with AIID and each other. Looking to the big picture, COLAB is not merely a laboratory for studying collaboration and shared knowledge creation. COLAB is a tool to explore and develop the analyst working environment of the future, in which analyst tools and methods for collaboration in edge organizations are developed

and tested. We present COLAB and its components and outline our plans for the system.

DTIC

*Intelligence; Multidisciplinary Design Optimization*

**20070016539** Wyoming Univ., Laramie, WY USA

**Data-Based Control of a Free-Free Beam in the Presence of Uncertainty**

VanZwieten, Tannen S; Bower, Gregory M; Lacy, Seth L; Sep 2006; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464075; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464075>

Linear control development is typically based on deterministic models that approximate the system under consideration. This approach neglects uncertainty in the system response. System uncertainty can arise from a number of sources including disturbances, noise, unmodeled dynamics, and nonlinearity. This may result in a reduction in performance or even instability in the closed loop system. The goal of this research is to account for measured uncertainty in control design. Our approach is to tune a baseline controller using a cost function that balances performance and robustness given measured system uncertainty. The approach is demonstrated on a free-free beam, with the goal of mitigating the flexural vibration. A lumped mass model is tuned to match the experimentally measured Frequency Response Function (FRF) of an experimental beam. This evaluation model and a reduced order model are used to approximate the beam dynamics. The baseline (LQG) controller is designed around the reduced order model of the beam. This controller is tuned according to the proposed cost function using the FRF and postulated variance. The cost function includes closed loop performance and stability robustness metrics. The resulting baseline and tuned controllers are evaluated on lumped mass models consistent with the measured data and uncertainty.

DTIC

*Frequency Response; Linearity; Mathematical Models; Data Bases; Determinants*

67

**THEORETICAL MATHEMATICS**

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

**20070015119** Pennsylvania State Univ., University Park, PA USA

**Quantum Random Networks for Type 2 Quantum Computers**

Allara, David L; Hasslacher, Brosl; Jan 9, 2006; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9550-04-1-0409

Report No.(s): AD-A463556; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463556>

Random boolean networks (RBNs) have been studied theoretically and computationally in order to be able to use their remarkable self-healing and large basins of alteration properties as quantum computing architectures, especially focused on problems of physical interest which do not require universal computational structures. This preliminary study was limited primarily to ID strings, but eventually work should be directed beyond two state networks to multi-state ones. Available software was used to study selected, important properties of RBNs in 1-D. The results of this preliminary study suggest that extensive work will be needed to apply the basic principles to physical manifestations. for example, building type II architectures in self-assembled spin lattices on a chip.

DTIC

*Boolean Algebra; Dynamic Programming; Networks; Quantum Computers; Quantum Theory*

**20070015292** Texas Univ., Austin, TX USA

**Studies of Refinement and Continuity in Isogeometric Structural Analysis (Preprint)**

Cottrell, J A; Hughes, T J; Reali, A; Jan 26, 2007; 53 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-03-0263

Report No.(s): AD-A464045; UTEXAS-ICES-07-05; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464045>

We investigate the effects of smoothness of basis functions on solution accuracy within the isogeometric analysis framework. We consider two simple one-dimensional structural eigenvalue problems and two static shell boundary value problems modeled with trivariate NURBS solids. We also develop a local refinement strategy that we utilize in one of the shell

analyses. We find that increased smoothness, that is, the 'k-method,' leads to a significant increase in accuracy for the problems of structural vibrations over the classical  $C^0$ -continuous 'p-method,' whereas a judicious insertion of  $C^0$ -continuous surfaces about singularities in a mesh otherwise generated by the k-method, usually outperforms a mesh in which all basis functions attain their maximum level of smoothness. We conclude that the potential for the k-method is high, but smoothness is an issue that is not well understood due to the historical dominance of  $C^0$ -continuous finite elements and therefore further studies are warranted.

DTIC

*Boundary Value Problems; Finite Element Method; Structural Analysis*

**20070015453** California Inst. of Tech., Pasadena, CA USA

**A State-Space Approach to Parametrization of Stabilizing Controllers for Nonlinear Systems**

Lu, Wei-Min; May 12, 1994; 32 pp.; In English

Report No.(s): AD-A464338; CIT-CDS-94-009; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464338>

A state-space approach to Youla-parametrization of stabilizing controllers for linear and non-linear systems is suggested. The stabilizing controllers (or a class of stabilizing controllers for nonlinear systems) are characterized as (linear/nonlinear) fractional transformations of stable parameters. The main idea behind this approach is to decompose the output feedback stabilization problem into state feedback and state estimation problems. The parametrized output feedback controllers have separation structures. A separation principle follows from the construction. This machinery allows the parametrization of stabilizing controllers to be conducted directly in state space without using coprime-factorization.

DTIC

*Controllers; Liapunov Functions; Linear Systems; Nonlinear Systems; Parameterization; Stabilization*

**20070015455** Nuparadigm Government Systems, Inc., Chesterfield, MO USA

**Resolving the Problem of Aligning Communities of Interest, Data Format Differences, Orthogonal Sensor Views, Intermittency, and Security - DoD Homeland Security Command and Control Advanced Concept Technology Demonstration**

Haury, Harry R; Jun 2005; 19 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464342; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464342>

The existence of diverse sensor, human intel and assessment information within isolated communities of interest creates blind spots in classic command and control environments where it is too expensive to instantiate standing capabilities to address a particular threat or align organizations to asymmetric attacks prior to an event. The problem is further exacerbated by the relatively rigid definition of community boundaries and views of relevant data within a community. The DoD/OSD Homeland Security Command and Control ACTD has attempted to address specific issues surrounding the problem of sharing C2 data between organizations and realigning data to address different roles and missions that might consume such data. In order to meet Department of Defense objectives to extend reach and improve agility through net-centricity, the ACTD implemented a sophisticated alerting framework to integrate various data sources and direct appropriately filtered and formatted data to users that have authority and need to see it. The design of the system, known as the Homeland Security On-Line Services Alerting Framework addressed the very real need to dynamically realign mission threads, organizations, and C2 systems to address the creation of new communities to address highly eccentric asymmetric attacks. Such dynamic capabilities also infer the use of secure service oriented applications that eliminate the provisioning problems associated with traditional C2 systems. Further the reach to civilian participants with a minimum of advanced training requires the implementation of highly automated simple to use systems, to this end the Alerting Framework has implemented a flexible interface for remote subscription and user characterization that directly modifies rules based data distribution driven from the edge.

DTIC

*Command and Control; Data Processing; Format; Intermittency; Orthogonality; Resolution; Security*

70  
**PHYSICS (GENERAL)**

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography*; for geophysics, astrophysics, or solar physics see *46 Geophysics, 90 Astrophysics, or 92 Solar Physics*.

**20070014799** Stanford Linear Accelerator Center, CA, USA, Wisconsin Univ., Milwaukee, WI, USA, Saxon Surface Science, Austin, TX, USA

**Transport Mechanisms in Polarized Semiconductor Photocathodes**

Ioakeimidi, K.; Brachmann, A.; Clendenin, J. E.; Garwin, E. L.; Kirby, R. E.; Dec. 2006; 6 pp.; In English  
Report No.(s): DE2006-896723; SLAC-PUB-12261; No Copyright; Avail.: Department of Energy Information Bridge

We investigated the effect of an accelerating field on the spin polarization of photogenerated electrons in a 100nm thick GaAs based photocathode active region. By decreasing the transport time of the electrons and the number of scattering events that cause depolarization, we expected to increase the polarization as was indicated by Monte Carlo simulations of the scattering and transport time statistics of the electrons. A tungsten (W) grid was deposited on the cathode surface to provide a uniform voltage distribution across the cathode surface. The metal grid formed a Schottky contact with the semiconductor surface. The bias voltage was primarily dropped at the metal semiconductor interface region, which is the cathode active region. For positive surface bias, the accelerating voltage not only increased the polarization, but it also enhanced the quantum efficiency of the photocathode. Preliminary results verify the bias effect on both quantum efficiency and polarization by a factor of 1.8 and 1% respectively.

NTIS

*Gallium Arsenides; Photocathodes; Semiconductors (Materials)*

**20070014804** Brookhaven National Lab., Upton, NY USA

**Design of a Large-Area Fast Neutron Directional Detector**

Vanier, P. E.; Forman, L.; Salwen, C.; Dioszegi, I.; Nov. 2006; 7 pp.; In English  
Report No.(s): DE2006-896731; BNL-77298-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

A large-area fast-neutron double-scatter directional detector and spectrometer is being constructed using 1-meter-long plastic scintillator paddles with photomultiplier tubes at both ends. The scintillators detect fast neutrons by proton recoil and also gamma rays by Compton scattering. The paddles are arranged in two parallel planes so that neutrons can be distinguished from muons and gamma rays by time of flight between the planes. The signal pulses are digitized with a time resolution of one gigasample per second. The location of an event along each paddle can be determined from the relative amplitudes or timing of the signals at the ends. The angle of deflection of a neutron in the first plane can be estimated from the energy deposited by the recoil proton, combined with the scattered neutron time-of-flight energy. Each scattering angle can be back-projected as a cone, and many intersecting cones define the incident neutron direction from a distant point source. Moreover, the total energy of each neutron can be obtained, allowing some regions of a fission source spectrum to be distinguished from background generated by cosmic rays. Monte Carlo calculations will be compared with measurements.

NTIS

*Fast Neutrons; Neutron Counters; Scintillation Counters*

**20070014807** Brookhaven National Lab., Upton, NY USA

**Single-Transverse Spin Asymmetries**

Vogelsang, W.; January 2005; 8 pp.; In English  
Report No.(s): DE2006-896732; BNL-77311-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

We give a brief overview of some of the recent results on single-transverse spin asymmetries, highlighting in particular progress in theoretical understanding.

NTIS

*Asymmetry; Spin*

**20070014809** Brookhaven National Lab., Upton, NY, USA

**Threshold Resummation Effects in the Polarized Drell-Yan Mechanism**

Yokoya, H.; Vogelsang, W.; Oct. 2006; 6 pp.; In English  
Report No.(s): DE2006-896733; BNL-77312-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

We present theoretical predictions for the cross sections and spin asymmetries in dilepton pair production in transversely



polarized pp and ( $\bar{p}p$ ) collisions. We use the available fixed-order corrections as well as the all-order resummation of threshold logarithms for the pair mass and rapidity distributions. Numerical results for pp collisions at  $\sqrt{s} = 10$  GeV at J-PARC and for ( $\bar{p}p$ ) collisions at  $\sqrt{s} = 14.5$  GeV at GSI-PAX are given.

NTIS

*Pair Production; Cross Sections*

**20070014811** Fermi National Accelerator Lab., Batavia, IL, USA, Five Colleges, Inc., Amherst, MA, USA  
**Measurement of the Top Quark Pair Production Cross Section in P Anti-P Collisions at  $\sqrt{s} = 1.96$  TeV**

Gustavo, J.; Garzon, O. Y.; Mar. 01, 2006; 37 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-879069; FERMILAB-THESIS-2006-02; No Copyright; Avail.: National Technical Information Service (NTIS)

A measurement of the top quark pair ( $t\bar{t}$ ) production cross section ( $\sigma_{t\bar{t}}$ ) in ( $\bar{p}p$ ) collisions at a center of mass energy of 1.96 TeV is presented. The measurement is based on data recorded by the D0 Detector at the Fermilab Tevatron Collider, and preselected in the e+jets (366 pb( $\sup -1$ )) and ( $\mu$ )+jets (363 pb( $\sup -1$ )) channels. The cross section is extracted by applying a lifetime-tagging technique to the data, and yields  $\sigma_{t\bar{t}} = 6.96(\sub -0.98)(\sup +1.07)(\text{stat} + \text{syst}) (+-) 0.45(\text{lumi})$  pb, for a top quark mass  $m_t = 175$  GeV, in good agreement with the Standard Model prediction.

NTIS

*Collisions; Pair Production; Quarks*

**20070014813** Fermi National Accelerator Lab., Batavia, IL, USA, Louisiana State Univ., Baton Rouge, LA USA  
**Prospects for Antineutrino Running at MiniBooNE**

Wascko, M. O.; Feb. 01, 2006; 6 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-879092; FERMILAB-CONF-06-039-E; No Copyright; Avail.: Department of Energy Information Bridge

MiniBooNE began running in antineutrino mode on 19 January, 2006. We describe the sensitivity of MiniBooNE to LSND-like ( $\bar{\nu}_e$ ) oscillations and outline a program of antineutrino cross-section measurements necessary for the next generation of neutrino oscillation experiments. We describe three independent methods of constraining wrong-sign (neutrino) backgrounds in an antineutrino beam, and their application to the MiniBooNE antineutrino analyses.

NTIS

*Antineutrinos; Cross Sections*

**20070014814** Fermi National Accelerator Lab., Batavia, IL, USA, Ludwig-Maximilians-Univ., Munich, Germany  
**Searches For Scalar Top and Bottom Quarks at the Tevatron**

Nunnemann, T.; Feb. 01, 2006; 4 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-897084; FERMILAB-CONF-06-034-E; No Copyright; Avail.: National Technical Information Service (NTIS)

Searches for the supersymmetric partners of top and bottom quarks using data up to 340 pb( $\sup -1$ ) taken at the Tevatron ( $\bar{p}p$ ) collider are described. We report on searches for scalar top quarks ( $\tilde{t}$ ) in the decays ( $\tilde{t} \rightarrow c\tilde{\chi}_1^0$ ) and ( $\tilde{t} \rightarrow b\tilde{\nu}$ ) and for scalar bottom quarks in the decay ( $\tilde{b} \rightarrow b\tilde{\chi}_1^0$ ). No evidence for a signal has been found, but improved exclusion regions have been derived in the framework of a generic minimal supersymmetric extension of the standard model.

NTIS

*Particle Accelerators; Quarks; Scalars*

**20070014815** Fermi National Accelerator Lab., Batavia, IL, USA  
**Hard Diffraction at the LHC and the Tevatron Using Double Pomeron Exchange**

Royon, C.; Jan. 01, 2006; 11 pp.; In English

Contract(s)/Grant(s): FERMILAB-CONF-06-018-E

Report No.(s): DE2007-879102; FERMILAB-CONF-06-018-E; No Copyright; Avail.: Department of Energy Information Bridge

We use a Monte Carlo implementation of recently developed models of inclusive and exclusive diffractive W, top, Higgs and stop productions to assess the sensitivity of the LHC experiments. We also discuss how the Tevatron experiments could test the models and measure the gluon density in the pomeron, which is needed to make precise predictions at the LHC.

NTIS

*Diffraction; Particle Accelerators; Pomerons*

**20070014816** Fermi National Accelerator Lab., Batavia, IL, USA, Ludwig-Maximilians-Univ., Munich, Germany

**Inclusive Jet Cross-Sections and Dijet Azimuthal Decorrelations With D0**

Strohmer, R.; Jan. 01, 2006; 4 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-897087; FERMILAB-CONF-06-015-E; No Copyright; Avail.: Department of Energy Information Bridge

We present a preliminary measurement of the inclusive jet cross-sections based on an integrated luminosity of 378 pb(sup -1) acquired with the D0 detector between 2002 and 2004 at a center of mass energy of (radical)s = 1.96 TeV and a measurement of azimuthal dijet decorrelations based on an integrated luminosity of 150 pb(sup -1). The cross section measurements are based on an iterative cone algorithm with a cone size of  $R = 0.7$ . They are performed in two rapidity bins between 0.0 and 0.8. The measurements are in good agreement with next to leading order calculations. The azimuthal angle between the two leading jets is sensitive to higher order QCD effects. The measurement of dijet azimuthal decorrelations therefore probes these effects without explicitly reconstructing more than two jets. Except for large azimuthal angles where soft effects are important the measurements are well described by the next to leading order perturbation theory.

NTIS

*Azimuth; Cross Sections; Iteration; Jets*

**20070014829** Fulbright and Jaworski, LLP, Houston, TX, USA

**MALDI-IM-Ortho-TOF Mass Spectrometry with Simultaneous Positive and Negative Mode Detection**

Furutani, H.; Ugarov, M. V.; Prather, K.; Schulz, J. A.; 29 Dec 04; 29 pp.; In English

Patent Info.: Filed Filed 29 Dec 04; US-Patent-Appl-SN-11-025-3095

Report No.(s): PB2007-105979; No Copyright; Avail.: CASI: [A03](#), Hardcopy

An ion mobility/mass spectrometry method and instrument using aerosolized samples and dual positive and negative mode detection is described. Sample preparation methods are also described.

NTIS

*Ions; Mass Spectroscopy; Patent Applications*

**20070014831** Fermi National Accelerator Lab., Batavia, IL, USA, Comitato Nazionale per l'Energia Nucleare, Frascati, Italy

**Top Mass Measurement at CDF**

Kordas, K.; Mar. 01, 2006; 7 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-897081; FERMILAB-CONF-06-068; No Copyright; Avail.: Department of Energy Information Bridge

We report on recent measurements of the top quark mass using  $t(\bar{t})$  candidate events selected in (approx-equal) 320 pb(sup -1) of data from the 'Run II' operation period of the Tevatron  $p(\bar{p})$  collider. More emphasis is given on the best single measurement to date ( $M(\text{sub top}) = 173.5(\text{sub } -3.8)(\text{sup } +3.9) \text{ GeV}/c(\text{sup } 2)$ ), provided by CDF using the 'lepton plus jets' channel, where one W decays to a lepton-neutrino pair and the other into quarks (top quarks decay to  $Wb$  almost 100% of the time).

NTIS

*Quarks; Particle Decay; Nuclear Reactions; Particle Accelerators*

**20070014832** Fermi National Accelerator Lab., Batavia, IL, USA, Ludwig-Maximilians-Univ., Munich, Germany

**Search for Charged Massive Stable Particles**

Nunnemann, T.; Feb. 01, 2006; 4 pp.; In English

Contract(s)/Grant(s): AC02-76CH03000

Report No.(s): DE2007-897083; FERMILAB-CONF-06-035-E; No Copyright; Avail.: Department of Energy Information Bridge

A search for charged massive (quasi-) stable particles with the D0 detector at the Tevatron collider based on 390 pb(sup -1) of data is presented. The search is performed in the frameworks of gauge-mediated supersymmetry breaking and the minimal supersymmetric extension of the standard model. The hypothetical particles are assumed to be pair-produced in p(bar p) collisions giving a signature of two reconstructed muon-like objects with high invariant mass and time-of-flights indicative of heavy particles. Since no excess over background is observed, cross-section limits for the pair-production of stable staus and charginos are set. Mass limits of 140 GeV for a higgsino-like chargino and 174 GeV for a gaugino-like chargino are set. NTIS

*Charged Particles; High Energy Interactions; Particle Accelerators; Supersymmetry*

**20070014835** Lawrence Livermore National Lab., Livermore, CA USA

**Analytic Expressions for Minimizing Hohlräum Wall Losses**

Rosen, M. D.; Jun. 09, 2006; 8 pp.; In English

Report No.(s): DE2006-896293; UCRL-CONF-221911; No Copyright; Avail.: Department of Energy Information Bridge

We apply our recent analytic solutions to the radiation diffusion equation to problems of interest for ICF hohlraums. The solutions provide quantitative values for absorbed energy, which are of use for generating a desired radiation temperature vs. time within the hohlraum. In particular we use analytic fits to the Rosseland mean opacity and to the specific heat of combinations of materials ('cocktails') designed to maximize the former while minimizing the latter. By doing so we find good agreement with numerical simulations and with experimental results. In particular we find that the wall loss savings of cocktails vs. the standard gold walled hohlraums have both pulse-length and temperature dependencies. Due to those dependencies we predict that NIF cocktail hohlraums will perform better than present day cocktail experiments. In addition, we apply our solutions to finding that density of foam hohlraum walls which minimizes wall loss by being of sufficiently low density to be supersonic, thus reducing kinetic energy losses, yet high enough density to not unduly suffer from enhanced specific heat capacity.

NTIS

*Hohlraums; Optimization; Walls*

**20070014843** New York Univ., NY, USA

**Investigation of Anomalous Transport and Study of Particle Dynamics in the Ergodic Layer**

Zaslavsky, G. M.; Oct. 08, 2006; 5 pp.; In English

Contract(s)/Grant(s): FG02-92ER54184

Report No.(s): DE2007-893030; No Copyright; Avail.: Department of Energy Information Bridge

Chaotic dynamics can be considered as a physical phenomenon that bridges the regular evolution of systems with the random one. These two alternative states of physical processes are, typically, described by the corresponding alternative methods: quasiperiodic or other regular functions in the first case, and kinetic or other probabilistic equations in the second case. What kind of kinetics should be for chaotic dynamics that is intermediate between completely regular (integrable) and completely random (noisy) cases. What features of the dynamics and in what way should they be represented in the kinetics of chaos. These are the subjects of the research under our project, where the new concept of fractional kinetics is reviewed for systems with Hamiltonian chaos. Particularly, we show how the notions of dynamical quasi-traps, Poincare recurrences, Levy flights, exit time distributions, phase space topology prove to be important in the construction of kinetics. The concept of fractional kinetics enters a different area of applications, such as particle dynamics in different potentials, particle advection in fluids, plasma physics and fusion devices, quantum optics, and many others. New characteristics of the kinetics are involved to fractional kinetics and the most important are anomalous transport, superdiffusion, weak mixing, and others. The fractional kinetics does not look as the usual one since some moments of the distribution function are infinite and fluctuations from the equilibrium state do not have any finite time of relaxation. Different important physical phenomena: cooling of particles and signals, particle and wave traps, Maxwell's Demon, etc. represent some domains where fractional kinetics proves to be valuable.

NTIS

*Ergodic Process; Transport Properties*

**20070014879** Savannah River National Lab., Aiken, SC, USA

**Feasibility of Hydrogen Production Using Laser Inertial Fusion as the Primary Energy Source (U). Revision 1**

Gorensek, M. B.; Nov. 03, 2006; 57 pp.; In English

Contract(s)/Grant(s): DE-AC09-96SR18500

Report No.(s): DE2006-895967; WSRC-STI-2006-00221; No Copyright; Avail.: National Technical Information Service (NTIS)

The High Average Power Laser (HAPL) program is developing technology for Laser IFE with the goal of producing electricity from the heat generated by the implosion of deuterium-tritium (DT) targets. Alternatively, the Laser IFE device could be coupled to a hydrogen generation system where the heat would be used as input to a water-splitting process to produce hydrogen and oxygen. The production of hydrogen in addition to electricity would allow fusion energy plants to address a much wider segment of energy needs, including transportation. Water-splitting processes involving direct and hybrid thermochemical cycles and high temperature electrolysis are currently being developed as means to produce hydrogen from high temperature nuclear fission reactors and solar central receivers. This paper explores the feasibility of this concept for integration with a Laser IFE plant, and it looks at potential modifications to make this approach more attractive. Of particular interest are: (1) the determination of the advantages of Laser IFE hydrogen production compared to other hydrogen production concepts, and (2) whether a facility of the size of FTF would be suitable for hydrogen production.

NTIS

*Hydrogen Production; Laser Fusion; Lasers; Electrolysis; Hydrogen*

**20070014911** Lawrence Livermore National Lab., Livermore, CA USA

**Tuning the Magnetic Transport of an Induction LINAC Using Emittance**

Houck, T. L.; Brown, C. G.; Ong, M. M.; Paul, A. C.; Wargo, P. E.; Aug. 14, 2006; 5 pp.; In English

Report No.(s): DE2006-895998; UCRL-CONF-223696; No Copyright; Avail.: National Technical Information Service (NTIS)

The Lawrence Livermore National Laboratory Flash X-Ray (FXR) machine is a linear induction accelerator used to produce a nominal 18 MeV, 3 kA, 65 ns pulse width electron beam for hydrodynamic radiographs. A common figure of merit (FOM) for this type of radiographic machine is the x-ray dose divided by the spot area on the bremsstrahlung converter where a higher FOM is desired. Several characteristics of the beam affect the minimum attainable x-ray spot size. The most significant are emittance (chaotic transverse energy), chromatic aberration (energy variation), and beam motion (transverse instabilities and corkscrew motion). FXR is in the midst of a multi-year optimization project to reduce the spot size. This paper describes the effort to reduce beam emittance by adjusting the fields of the transport solenoids and position of the cathode. If the magnetic transport is not correct, the beam will be mismatched and undergo envelope oscillations increasing the emittance. We measure the divergence and radius of the beam in a drift section after the accelerator by imaging the optical transition radiation (OTR) and beam envelope on a foil. These measurements are used to determine an emittance. Relative changes in the emittance can be quickly estimated from the foil measurements allowing for an efficient, real-time study. Once an optimized transport field is determined, the final focus can be adjusted and the new x-ray spot measured. A description of the diagnostics and analysis is presented.

NTIS

*Emittance; Linear Accelerators; Magnetic Induction; Tuning*

**20070014912** Lawrence Livermore National Lab., Livermore, CA USA

**Recovery of a CVD Diamond Detection System from Strong Pulses of Laser Produced X-Rays**

Dauffy, L. S.; Koch, J. A.; Izumi, N.; Tommasini, R.; Lerche, R. A.; May 07, 2006; 6 pp.; In English

Report No.(s): DE2006-896002; UCRL-CONF-221162; No Copyright; Avail.: National Technical Information Service (NTIS)

We are studying the response of a CVD diamond detector to a strong x-ray pulse followed by a second weaker pulse arriving 50 to 300 ns later, with a contrast in amplitude of about 1000. These tests, performed at the LLNL Jupiter laser facility, are intended to produce charge carrier densities similar to those expected during a DT implosion at NIF, where a large 14.1 MeV neutron pulse is followed by a weak downscattered neutron signal produced by slower 6-10 MeV neutrons. The number of downscattered neutrons must be carefully measured in order to obtain an accurate value for the areal density, which is proportional to the ratio of downscattered to primary neutrons. The effects of the first strong pulse may include saturation of the diamond wafer, saturation of the oscilloscope, or saturation of the associated power and data acquisition electronics. We are presenting a double pulse experiment that will use a system of several polycrystalline CVD diamond detectors irradiated by 8.6 keV x-rays emitted from a zinc target. We will discuss implication for a NIF areal density measurement.

NTIS

*Detection; Diamonds; Lasers; Vapor Deposition; X Rays*

**20070014919** Brookhaven National Lab., Upton, NY USA

**Latest Results from MINOS**

Nov. 2006; 7 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-895872; BNL-77206-2006; No Copyright; Avail.: Department of Energy Information Bridge

Among the goals of the MINOS experiment are the test of the  $(\nu_{\mu})$  ( $\nu_{\tau}$ ) oscillation and the search for sub-dominant  $(\nu_{\mu})$  ( $\nu_{\tau}$ ) oscillations. The former proceeds by a  $(\nu_{\mu})$  ‘disappearance’ analysis while the latter would involve the ‘appearance’ of  $(\nu_e)$  interactions in a predominantly  $(\nu_{\mu})$  beam. The disappearance of muon neutrinos is described by  $P((\nu_{\mu}) \rightarrow (\nu_{\mu})) = 1 - \sin^2(2\theta_{23}) \sin^2(2\Delta m_{23}^2 L/E)$  in the two-flavor approximation where  $\theta_{23}$  is the angle between the second row and third column of the neutrino mixing matrix,  $\Delta m_{23}^2 = m_{23}^2 - m_{33}^2$  ( $eV^2$ ),  $L$  is the neutrino flight distance in km and  $E$  is the neutrino energy in GeV. A generic disappearance experiment compares a measured muon neutrino energy spectrum at a fixed baseline to the known energy spectrum of muon neutrino beam to extract the oscillation parameters  $\sin^2(2\theta_{23})$  which controls the overall magnitude of the disappearance and  $\Delta m_{23}^2$  which controls the energy dependence.

NTIS

*Muons; Neutrinos*

**20070014920** Brookhaven National Lab., Upton, NY USA, Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, European Organization for Nuclear Research, Geneva, Switzerland

**Procedures and Accuracy Estimates for Beta-Beat Correction in the LHC**

Tomas, R.; Bruning, O.; Fatoukh, S.; Giovannozzi, M.; Papaphilippou, Y.; January 2006; 5 pp.; In English

Report No.(s): DE2006-895873; BNL-75452-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

The LHC aperture imposes a tight tolerance of 20% on the maximum acceptable beta-beat in the machine. An accurate knowledge of the transfer functions for the individually powered insertion quadrupoles and techniques to compensate beta-beat are key prerequisites for successful operation with high intensity beams. They perform realistic simulations to identify quadrupole errors in LHC and explore possible ways of correction to minimize beta-beat below the 20% level.

NTIS

*Accuracy; Synchronism*

**20070014921** Brookhaven National Lab., Upton, NY USA, European Organization for Nuclear Research, Geneva, Switzerland, Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany

**Global and Local Coupling Compensation in RHIC Using AC Dipoles**

Calaga, R.; Tomas, R.; Franchi, A.; Jun. 2006; 5 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-895874; BNL-75455-2006; No Copyright; Avail.: Department of Energy Information Bridge

Compensation of transverse coupling during the RHIC energy ramp has been proven to be non-trivial and tedious. The lack of accurate knowledge of the coupling sources has initiated several efforts to develop fast techniques using turn-by-turn BPM data to identify and compensate these sources. This paper aims to summarize the beam experiments performed to measure the coupling, matrix and resonance driving terms with the aid of RHIC ac dipoles at injection energy.

NTIS

*Alternating Current; Accelerators*

**20070014922** Brookhaven National Lab., Upton, NY USA, Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, European Organization for Nuclear Research, Geneva, Switzerland

**Fast Compensation of Global Linear Coupling in RHIC using AC Dipoles**

Franchi, A.; Calaga, R.; Tomas, R.; January 2006; 5 pp.; In English

Report No.(s): DE2006-895875; BNL-75456-2006-CP; No Copyright; Avail.: Department of Energy Information Bridge

Global linear coupling has been extensively studied in accelerators and several methods have been developed to compensate the coupling coefficient  $C$  using skew quadrupole families scans. However, scanning techniques can become very time consuming especially during the commissioning of an energy ramp. In this paper they illustrate a new technique to measure and compensate, in a single machine cycle, global linear coupling from turn-by-turn BPM data without the need of

a skew quadrupole scan. The algorithm is applied to RHIC BPM data using AC dipoles and compared with traditional methods.

NTIS

*Alternating Current; Accelerators*

**20070014927**, Old Dominion Univ., Norfolk, VA, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

**Isospin Mixing in the He Bound State and the Nucleon Strange Form Factor**

Viviani, M.; Girlanda, L.; Kievsky, A.; Marcucci, L. E.; Rosati, S.; Dec. 05, 2006; 8 pp.; In English

Report No.(s): DE2006-895917; JLAB-THY-06-597; DOE/ER/40150-4151; No Copyright; Avail.: Department of Energy Information Bridge

The contribution of isospin admixtures in the ground state of the (<sup>sup</sup>4)He nucleus is studied using wave functions derived from the most modern nuclear interactions, including isospin symmetry breaking terms. The present calculations show that this contribution is larger than previous estimates had indicated. Its effect on parity violating elastic scattering of polarized electrons from (<sup>sup</sup>4)He is investigated. In particular, a simple analysis of the recently measured left-right asymmetry at low Q(<sup>sup</sup>2) shows that the contribution of these isospin admixtures is of comparable magnitude to that associated with strangeness components in the nucleon electric form factor.

NTIS

*Form Factors; Isotopic Spin; Nucleons*

**20070014956** Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA

**Recent Results from HAPPEX**

Materials, R.; Nov. 29, 2006; 12 pp.; In English

Report No.(s): DE2006-895744; No Copyright; Avail.: National Technical Information Service (NTIS)

New measurements of the parity-violating asymmetry in elastic scattering of 3GeV electrons off hydrogen and helium-4 targets at  $\theta(\text{sub lab}) = 6$  degrees are reported. The helium-4 result is  $A = (+6.40 (\pm) 0.23 (\text{stat}) (\pm) 0.12 (\text{syst})) * 10(\text{sup} -6)$ . The hydrogen result is  $A = (-1.58 (\pm) 0.12 (\text{stat}) (\pm) 0.04 (\text{syst})) * 10(\text{sup} -6)$ . The asymmetry for hydrogen is a function of a linear combination of  $G(\text{sub E})(\text{sup s})$  and  $G(\text{sub M})(\text{sup s})$ , the strange quark contributions to the electric and magnetic form factors of the nucleon respectively, and that for helium-4 is a function solely of  $G(\text{sub E})(\text{sup s})$ . The combination of the two measurements separates  $G(\text{sub E})(\text{sup s})$  and  $G(\text{sub M})(\text{sup s})$  and provide new limits on the role of strange quarks in the nucleon charge and magnetization distributions. We extract  $G(\text{sub E})(\text{sup s}) = 0.002 (\pm) 0.014 (\pm) 0.007$  at  $Q(\text{sup} 2) = 0.077$  GeV(<sup>sup</sup>2) and  $G(\text{sub E})(\text{sup s}) + 0.09 G(\text{sub M})(\text{sup s}) = 0.007 (\pm) 0.011 (\pm) 0.006$  at  $Q(\text{sup} 2) = 0.109$  GeV(<sup>sup</sup>2).

NTIS

*Asymmetry; Elastic Scattering*

**20070014961** Academy of Sciences (Russia), Moscow, Russian Federation, North Carolina Agricultural and Technical State Univ., Greensboro, NC, USA, Northwestern Univ., Evanston, IL USA

**Performance of the PrimEx Electromagnetic Calorimeter**

Kubantsev, M.; Larin, I.; Gasparian, A.; Jun. 05, 2005; 12 pp.; In English

Report No.(s): DE2006-892100; No Copyright; Avail.: National Technical Information Service (NTIS)

We report the design and performance of the hybrid electromagnetic calorimeter consisting of 1152 PbWO(<sub>sub</sub>4) crystals and 576 lead glass blocks for the PrimEx experiment at the Jefferson Laboratory. The detector was built for high precision measurement of the neutral pion lifetime via the Primakoff effect. Calorimeter installation and commissioning was completed with the first physics run in fall of 2004. We present the energy and position resolution of the calorimeter. Obtained ( $\pi$ )(<sup>sup</sup>0) mass resolution of 1.3 MeV/c(<sup>sup</sup>2) and its production angle resolution of 0.34 mrad demonstrate the ability of the experiment to extract the ( $\pi$ )(<sup>sup</sup>0) lifetime on one percent level.

NTIS

*Calorimeters; Electromagnetism*

**20070015049** Stanford Linear Accelerator Center, USA, Academy of Sciences (Russia), Saint Petersburg, Russian Federation

**Improved Superlattices for Spin-Polarized Electron Sources**

Mamaev, Y. A.; Gerechikov, L. G.; Yashin, Y. P.; Maruyama, T.; Clendenin, J. E.; Dec. 01, 2006; 7 pp.; In English

Report No.(s): DE2006-896157; SLAC-PUB-12249; No Copyright; Avail.: National Technical Information Service (NTIS)

Photoemission of polarized electrons from heterostructures based on InAlGaAs/GaAs superlattices with minimum conduction-band offsets is investigated. The comparison of the excitation energy dependence of the photoemission polarization degree with the calculated spectra makes it possible to determine the polarization losses at different stages of the photoemission. A maximum polarization of  $P = 91\%$  and a quantum efficiency of  $QE = 0.5\%$  are close to the best results obtained for photocathodes that are based on strained semiconductor superlattices.

NTIS

*Augmentation; Electron Sources; Superlattices*

**20070015051** Stanford Linear Accelerator Center, CA, USA, Sheffield Univ., UK

**Enhancement of Spin-Polarized Electron Emission from Strain-Compensated AlInGaAs-GaAsP Superlattices**

Roberts, J. S.; Yashin, Y. P.; Mamaev, Y.; Gerchikov, L. G.; Maruyama, T.; Dec. 01, 2006; 5 pp.; In English

Report No.(s): DE2006-896158; SLAC-PUB-12248; No Copyright; Avail.: Department of Energy Information Bridge

Resonance enhancement of the quantum efficiency of new polarized electron photocathodes based on a short-period strain-compensated AlInGaAs/GaAsP superlattice structure is reported. The superlattice is a part of an integrated Fabry-Perot optical cavity. We demonstrate that the Fabry-Perot resonator enhances the quantum efficiency by up to a factor 10 in the wavelength region of the main polarization maximum. The high structural quality implied by these results points to the very promising application of these photocathodes for spin-polarized electron sources.

NTIS

*Augmentation; Electron Emission; Superlattices*

**20070015053** Stanford Linear Accelerator Center, CA, USA

**Precision Measurements at the ILC**

Nelson, T. K.; Aug. 01, 2006; 4 pp.; In English

Report No.(s): DE2006-896161; SLAC-PUB-12246; No Copyright; Avail.: Department of Energy Information Bridge

With relatively low backgrounds and a well-determined initial state, the proposed International Linear Collider (ILC) would provide a precision complement to the LHC experiments at the energy frontier. Completely and precisely exploring the discoveries of the LHC with such a machine will be critical in understanding the nature of those discoveries and what, if any, new physics they represent. The unique ability to form a complete picture of the Higgs sector is a prime example of the probative power of the ILC and represents a new era in precision physics.

NTIS

*Precision; Images*

**20070015054** Stanford Linear Accelerator Center, CA, USA, Mississippi Univ., University, MS, USA

**Measurement of the Absolute Branching Fraction of  $D^0 \rightarrow K^0 \pi^0$**

Godang, R.; Dec. 01, 2006; 8 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515; DE-FG05-91ER40622

Report No.(s): DE2006-896163; SLAC-PUB-12244; No Copyright; Avail.: National Technical Information Service (NTIS)

The authors measure the absolute branching fraction for  $D^0 \rightarrow K^0 \pi^0$  (yields)  $K^0 \pi^0$  using partial reconstruction of  $(\bar{B}^0 \rightarrow D^+ X^0)$  ( $D^0 \rightarrow K^0 \pi^0$ ) decays. Only the charged lepton and the soft pion from the decay  $D^0 \rightarrow K^0 \pi^0$  are used. Based on a data sample of 230 million  $B\bar{B}$  pairs collected at the (Upsilon)(4S) resonance with the BABAR detector at the PEP-II asymmetric-energy B Factory at SLAC, they obtain  $\mathcal{B}(D^0 \rightarrow K^0 \pi^0) = (4.025 \pm 0.038 \pm 0.098)\%$ , where the first error is statistical and the second error is systematic.

NTIS

*Particle Decay; Errors; Asymmetry*

**20070015060** Los Alamos National Lab., NM USA

**Practical Review of the Kompaneets Equation and Its Application to Compton Scattering**

Shirk, D. G.; May 2006; 20 pp.; In English

Report No.(s): DE2006-891567; LA-14297; No Copyright; Avail.: National Technical Information Service (NTIS)

In this study, we explore both inverse Compton and Compton scattering processes using the Chang and Cooper scheme to form a deterministic solution of the Kompaneets equation. We examine the individual terms of the Kompaneets equation and illustrate their effect on the equilibrium solution. We use two examples (a Gaussian line profile and a Planck profile) to

illustrate the advective and diffusive properties of the Kompaneets operator. We also explore both inverse Compton scattering and Compton scattering, and discuss and illustrate the Bose-Einstein condensation feature of the Compton scattering spectrum.

NTIS

*Electron Scattering; Condensation; Quantum Statistics*

**20070015062** Stanford Linear Accelerator Center, CA, USA

**Study of CP Symmetry Violation in the Charmonium- $K^*(892)$  Channel by a Complete Time Dependent Angular Analysis. (BaBar Experiment)**

T'Jampens, S.; Dec. 2002; 262 pp.; In French

Report No.(s): DE2006-891862; SLAC-R-836; No Copyright; Avail.: National Technical Information Service (NTIS)

This thesis presents the full-angular time-dependent analysis of the vector-vector channel  $B(\text{sub } d)(\text{sup } 0)$  (yields)  $J(\text{psi})(K(\text{sub } S)(\text{sup } 0)(\text{pi})(\text{sup } 0))^*(\text{sup } 0)$ . After a review of the CP violation in the B meson system, the phenomenology of the charmonium- $K^*(892)$  channels is exposed.

NTIS

*Charm (Particle Physics); CP Violation; Invariance; Mesons; Symmetry; Time Dependence*

**20070015069** Cincinnati Univ., OH, USA

**Review of Recent Measurements of the Sides of the CKM Unitarity Triangle**

Mancinelli, G.; Aug. 01, 2006; 9 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-896165; SLAC-PUB-12182; No Copyright; Avail.: National Technical Information Service (NTIS)

The authors give a review of the status of the global effort to measure the sides of the CKM Unitarity Triangle.

NTIS

*Elementary Particles; Triangles*

**20070015071** Stanford Linear Accelerator Center, CA, USA

**Search for b to u transitions in B- to  $(K+\text{pi}-\text{pi}^0)$ -D  $K^-$**

Aubert, B.; Barate, R.; Bona, M.; Boutigny, D.; Karyotakins, Y.; Dec. 01, 2006; 15 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-896167; SLAC-PUB-12010; No Copyright; Avail.: National Technical Information Service (NTIS)

The authors search for decays of a B meson into a neutral D meson and a kaon, with the D meson decaying into  $K(\text{sup } +)(\text{pi})(\text{sup } -)(\text{pi})(\text{sup } 0)$ . This final state can be reached through the b (yields) c transition  $B(\text{sup } -)$  (yields)  $D(\text{sup } 0)K(\text{sup } -)$  followed by the doubly Cabibbo-suppressed  $D(\text{sup } 0)$  (yields)  $K(\text{sup } +)(\text{pi})(\text{sup } -)(\text{pi})(\text{sup } 0)$ , or the b (yields) u transition  $B(\text{sup } -)$  (yields)  $(\text{bar } D)(\text{sup } 0)K(\text{sup } -)$  followed by the Cabibbo-favored  $(\text{bar } D)(\text{sup } 0)$  (yields)  $K(\text{sup } +)(\text{pi})(\text{sup } -)(\text{pi})(\text{sup } 0)$ . The interference of these two amplitudes is sensitive to the angle ( $\gamma$ ) of the unitarity triangle. They present preliminary results based on  $226 \times 10(\text{sup } 6)$   $e(\text{sup } +)e(\text{sup } -)$  (yields)  $(\text{Upsilon})(4S)$  (yields)  $B(\text{bar } B)$  events collected with the BABAR detector at SLAC.

NTIS

*High Energy Interactions; Mesons*

**20070015073** Stanford Linear Accelerator Center, CA, USA, Stanford Univ., Stanford, CA USA

**Effect of the Coupled Bunch Modes on the Longitudinal Feedback System**

Heifets, S.; Teytelman, D.; Sep. 2006; 21 pp.; In English

Report No.(s): DE2006-895814; SLAC-PUB-12103; No Copyright; Avail.: National Technical Information Service (NTIS)

The Pedersen analysis (1, 2) of the low-level rf feedback system assumes that all bunches oscillate in phase what corresponds to the lowest coupled bunch mode. This analysis is extended here to take into account all other coupled-bunch modes what might be important for the strongly detuned cavities in large storage rings such as PEP-II.

NTIS

*Coupled Modes; Feedback; Storage Rings (Particle Accelerators)*



**20070015074** Stanford Linear Accelerator Center, Stanford, CA, USA

**Search for Charmonium States Decaying to  $J/\psi$   $\gamma$   $\gamma$  Using Initial-State Radiation Events**

Aug. 02, 2006; 16 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895816; SLAC-PUB-11971; BABAR-CONF-06/003; No Copyright; Avail.: National Technical Information Service (NTIS)

We study the processes  $e^{(\text{sup } +)}e^{(\text{sup } -)}$  (yields)  $J/\psi(\gamma)(\gamma)(\gamma)$  and  $e^{(\text{sup } +)}e^{(\text{sup } -)}$  (yields)  $J/\psi(\pi)(\pi)^{(\text{sup } -)}(\pi)^{(\text{sup } +)}(\gamma)$  where the hard photon radiated from an initial  $e^{(\text{sup } +)}e^{(\text{sup } -)}$  collision with center-of-mass (CM) energy near 10.58 GeV is detected. In the final state  $J/\psi(\gamma)(\gamma)$  we consider  $J/\psi(\pi)(\pi)^{(\text{sup } 0)}$ ,  $J/\psi(\eta)$ ,  $(\chi)_{c1}(\gamma)$ , and  $(\chi)_{c2}(\gamma)$  candidates. The invariant mass of the hadronic final state defines the effective  $e^{(\text{sup } +)}e^{(\text{sup } -)}$  CM energy in each event, so these data can be compared with direct  $e^{(\text{sup } +)}e^{(\text{sup } -)}$  measurements. We report 90% CL upper limits for the integrated cross section times branching fractions of the  $J/\psi(\gamma)(\gamma)$  channels in the  $Y(4260)$  mass region.

NTIS

*Charm (Particle Physics); Mesons*

**20070015075** Stanford Univ., CA, USA

**Environmental Remediation Sciences Program at the Stanford Synchrotron Radiation Laboratory. FY2006 Annual Report**

Nov. 15, 2006; 5 pp.; In English

Report No.(s): DE2006-896175; ERSD-95709-2006; No Copyright; Avail.: Department of Energy Information Bridge

Synchrotron radiation (SR)-based techniques provide unique capabilities to address scientific issues underpinning environmental remediation science and have emerged as major research tools in this field. The high intensity of SR sources and x-ray photon-in/photon-out detection allow noninvasive in-situ analysis of dilute, hydrated, and chemically/structurally complex natural samples. SR x-rays can be focused to beams of micron and sub-micron dimension, which allows the study of microstructures, chemical microgradients, and microenvironments such as in biofilms, pore spaces, and around plant roots, that may control the transformation of contaminants in the environment. The utilization of SR techniques in environmental remediation sciences is often frustrated, however, by an 'activation energy barrier', which is associated with the need to become familiar with an array of data acquisition and analysis techniques, a new technical vocabulary, beam lines, experimental instrumentation, and user facility administrative procedures. Many investigators find it challenging to become sufficiently expert in all of these areas or to maintain their training as techniques evolve. Another challenge is the dearth of facilities for hard x-ray micro-spectroscopy, particularly in the 15 to 23 KeV range, which includes x-ray absorption edges of the priority DOE contaminants Sr, U, Np, Pu, and Tc. Prior to the current program, there were only two (heavily oversubscribed) microprobe facilities in the U.S. that could fully address this energy range (one at each of APS and NSLS); none existed in the Western U.S., in spite of the relatively large number of DOE laboratories in this region.

NTIS

*Synchrotron Radiation; Microanalysis; X Ray Absorption*

**20070015076** Stanford Linear Accelerator Center, CA, USA

**Search for the Baryon and Lepton Number Violating Decays  $\tau$  to  $\Lambda b$**

Aug. 18, 2006; 15 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895818; SLAC-PUB-11974; BABAR-CONF-06/014; No Copyright; Avail.: National Technical Information Service (NTIS)

The authors have searched for the violation of baryon number  $B$  and lepton number  $L$  in the  $(B-L)$ -conserving modes  $(\tau)^{(\text{sup } -)}$  (yields)  $(\bar{\Lambda})^{(\text{sup } 0)}(\pi)^{(\text{sup } -)}$  and  $(\tau)^{(\text{sup } -)}$  (yields)  $(\bar{\Lambda})^{(\text{sup } 0)}K^{(\text{sup } -)}$  as well as the  $(B-L)$ -violating modes  $(\tau)^{(\text{sup } -)}$  (yields)  $(\Lambda)^{(\text{sup } 0)}(\pi)^{(\text{sup } -)}$  and  $(\tau)^{(\text{sup } -)}$  (yields)  $(\Lambda)^{(\text{sup } 0)}K^{(\text{sup } -)}$  using 237 fb<sup>(sup -1)</sup> of data collected with the BABAR detector at the PEP-II asymmetric-energy  $e^{(\text{sup } +)}e^{(\text{sup } -)}$  storage ring. They do not observe any signal and determine preliminary upper limits on the branching fractions  $(\text{Beta})((\tau)^{(\text{sup } -)}$  (yields)  $(\bar{\Lambda})^{(\text{sup } 0)}(\pi)^{(\text{sup } -)}) \lesssim 5.9 \times 10^{(\text{sup } -8)}$ ,  $(\text{Beta})((\tau)^{(\text{sup } -)}$  (yields)  $(\Lambda)^{(\text{sup } 0)}(\pi)^{(\text{sup } -)}) \lesssim 5.8 \times 10^{(\text{sup } -8)}$ ,  $(\text{Beta})((\tau)^{(\text{sup } -)}$  (yields)  $(\bar{\Lambda})^{(\text{sup } 0)}K^{(\text{sup } -)}) \lesssim 7.2 \times 10^{(\text{sup } -8)}$ , and  $(\text{Beta})((\tau)^{(\text{sup } -)}$  (yields)  $(\Lambda)^{(\text{sup } 0)}K^{(\text{sup } -)}) \lesssim 15 \times 10^{(\text{sup } -8)}$  at 90% confidence level.

NTIS

*Baryons; Leptons; Particle Decay; CP Violation*

**20070015077** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA  
**Environmental Science Program at the Advanced Light Source. FY06 Annual Report**

Ncio, P.; Hubbard, S.; Shuh, D.; Jun. 01, 2006; 5 pp.; In English

Report No.(s): DE2006-896200; ERSD-1027274-2006; No Copyright; Avail.: National Technical Information Service (NTIS)

The goal of the ERSP Environmental Science Program at the Advanced Light Source (ALS) is to further the research mission of OBERs Environmental Remediation Science Program (ERSP) program by improving utilization of the ALS. The ALS is a DOE national user facility with many unique spectroscopic and microscopic capabilities suited to application in research areas of interest to ERSP. The program supports the research mission of ERSP by supporting ERSP PIs on research projects that can benefit from the resources at the ALS. These collaborations take many different forms including participation in experimental design, novel sample cell development, data interpretation, beam time proposal writing, and data collection. The program is especially committed to improving the environmental relevance of measurements made at the ALS by working with ERSP PIs to design and build experimental equipment that allow for novel in situ measurements. Frequently, it is no longer sufficient to bring a series of samples from the field to the ALS. For the most innovated investigations, one must bring the field environment to the light source in as faithful a manner as possible. The program specifically focuses on four beam lines at the ALS which were identified through consultations with ERSP investigators as being of the most interest to the environmental science community. These beam lines include, BL 1.4.3-Infrared spectromicroscopy, BL 8.3.2-X-ray microtomography, BL 10.3.2-X-ray fluorescence, micro-X-ray absorption spectroscopy, and micro-X-ray diffraction, and BL 11.0.2-Scanning Transmission X-ray Microscopy (STXM) and Ambient Pressure Photoemission Spectroscopy (APPES).

NTIS

*Light Sources; Absorption Spectroscopy; Photoelectric Emission; X Ray Spectroscopy*

**20070015078** Stanford Linear Accelerator Center, CA, USA, Tohoku Univ., Sendai, Japan, Tokyo Univ., Japan  
**Possible Signals of Wino LSP at the Large Hadron Collider**

Ibe, M.; Moroi, T.; Yanagida, T. T.; Oct. 2006; 15 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895823; No Copyright; Avail.: Department of Energy Information Bridge

We consider a class of anomaly-mediated supersymmetry breaking models where gauginos acquire masses mostly from anomaly mediation while masses of other superparticles are from Kaehler interactions, which are as large as gravitino mass (approx) (Omicron)(10-100) TeV. In this class of models, the neutral Wino becomes the lightest superparticle in a wide parameter region. The mass splitting between charged and neutral Winos are very small and experimental discovery of such Winos is highly non-trivial. We discuss how we should look for Wino-induced signals at Large Hadron Collider.

NTIS

*Elementary Particles; Hadrons; Particle Theory; Supersymmetry*

**20070015083** Oak Ridge National Lab., TN USA, Pacific Northwest National Lab., Richland, WA, USA  
**Support for Synchrotron Access by Environmental Scientists**

Daly, M.; Madden, A.; Palumbo, A.; Qafoku, N.; Jun. 01, 2006; 5 pp.; In English

Report No.(s): DE2006-896204; ERSD-1023760-2006; No Copyright; Avail.: Department of Energy Information Bridge

To support ERSP-funded scientists in all aspects of synchrotron-based research at the Advanced Photon Source (APS). This support comes in one or more of the following forms: (1) writing proposals to the APS General User (GU) program, (2) providing time at MRCAT/EnviroCAT beamlines via the membership of the Molecular Environmental Science (MES) Group in MRCAT/EnviroCAT, (3) assistance in experimental design and sample preparation, (4) support at the beamline during the synchrotron experiment, (5) analysis and interpretation of the synchrotron data, and (6) integration of synchrotron experimental results into manuscripts.

NTIS

*Photons; Synchrotrons; Data Integration*

**20070015129** Pennsylvania State Univ., University Park, PA USA  
**Substructure Synthesis Methods and Their Application to Structural-Acoustic Simulations**

Campbell, Robert L; Pray, Carl M; Oct 2005; 33 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00024-02-D-6604

Report No.(s): AD-A463636; PSU/ARL-TR-05-012; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463636>

An overview of impedance- and modal-based substructure analysis techniques used in the Structural Acoustics Department is presented. The impedance technique described herein offers a substantial advantage over other coupling techniques because it is uniquely suited to handle data sets of varying origin. Of particular interest is the combination of numerically and experimentally derived frequency response data, which is especially useful for analyzing structures comprised of components too complex to model using the finite element technique. The impedance-based method is derived from the frequency domain substructure synthesis algorithm introduced by Jetmundsen et al., which offers a significant improvement over the traditional frequency domain technique in terms of the processing requirements. The modal-based methods involve the coupling of substructure eigen-analysis results to arrive at coupled system (complex-valued) eigen-vectors and allow forced response simulations for the coupled system. This method offers an alternative to traditional techniques employed by commercial finite element codes. Limitations of both techniques are identified and discussed along with potential methods for avoiding these shortcomings. Several example problems are presented that show each method's usefulness.

DTIC

*Impedance; Simulation; Substructures*

**20070015161** Stanford Linear Accelerator Center, CA, USA

**Low Emittance Guns for the ILC Polarized Electron Beam**

Clendenin, J. E.; Brachmann, A.; Ioakeimidi, K.; Kirby, R. E.; Maruyama, T.; Nov. 2006; 5 pp.; In English  
Report No.(s): DE2006-895804; SLAC-PUB-12241; No Copyright; Avail.: National Technical Information Service (NTIS)

Polarized electron beams generated by DC guns are routinely available at several accelerators including JLAB, Mainz and SLAC. These guns operate with a cathode bias on the order of -100 kV. To minimize space charge effects, relatively long bunches are generated at the gun and then compressed longitudinally external to the gun just before and during initial acceleration. For linear colliders, this compression is accomplished using a combination of rf bunchers. For the basic design of the International Linear Collider (ILC), a 120 kV DC photocathode gun is used to produce a series of nanosecond bunches that are each compressed by two sub-harmonic bunchers (SHBs) followed by an L-band buncher and capture section. The longitudinal bunching process results in a significantly higher emittance than produced by the gun alone. While high-energy experiments using polarized beams are not generally sensitive to the source emittance, there are several benefits to a lower source emittance including a simpler more efficient injector system and a lower radiation load during transport especially at bends as at the damping ring. For the ILC, the SHBs could be eliminated if the voltage of the gun is raised sufficiently. Simulations using the General Particle Tracer (GPT) package indicate that a cathode bias voltage of (ge)200 kV should allow both SHBs to be operated at 433 or even 650 MHz, while (ge)500 kV would be required to eliminate the SHBs altogether. Simulations can be used to determine the minimum emittance possible if the injector is designed for a given increased voltage. A possible alternative to the DC gun is an rf gun. Emittance compensation, routinely used with rf guns, is discussed for higher-voltage DC guns.

NTIS

*Electron Beams; Emittance; Electron Guns; Electron Bunching*

**20070015164** Stanford Linear Accelerator Center, CA, USA

**Polarized Electron Source for the International Collider (ILC) Project**

Brachmann, A.; Clendenin, J. E.; Garwin, E. L.; Ioakeimidi, K.; Kirby, R. E.; Nov. 2006; 4 pp.; In English  
Report No.(s): DE2006-895802; SLAC-PUB-12238; No Copyright; Avail.: National Technical Information Service (NTIS)

ILC project will be the next large high energy physics tool that will use polarized electrons (and positrons). For this machine spin physics will play an important role. The polarized electron source design is based on electron injectors built for the Stanford Linear Collider (polarized) and Tesla Test Facility (un-polarized). The ILC polarized electron source will provide a 5GeV spin polarized electron beam for injection into the ILC damping ring. Although most ILC machine parameters have been achieved by the SLC or TTF source, features of both must be integrated into one design. The bunch train structure presents unique challenges to the source laser drive system. A suitable laser system has not yet been demonstrated and is part of the ongoing R&D program for ILC at SLAC. Furthermore, ILC injector R&D incorporates photocathode development, increasing available polarization, and improving operational properties in gun vacuum systems. Another important area of research and development is advancing the design of DC and RF electron gun technology for polarized sources. This presentation presents the current status of the design and outlines aspects of the relevant R&D program carried out within the ILC community.

NTIS

*Damping; Electron Beams; Electron Sources; International Cooperation; Polarization; Test Facilities*

**20070015276** Stanford Linear Accelerator Center, CA, USA

**High Availability Instrumentation Packaging Standards for the ILC and Detectors**

Downing, R. W.; Larsen, R. S.; Nov. 2006; 5 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895809; SLAC-PUB-12208; No Copyright; Avail.: National Technical Information Service (NTIS)

ILC designers are exploring new packaging standards for Accelerator Controls and Instrumentation, particularly high-speed serial interconnect systems for intelligent instruments versus the existing parallel backplanes of VME, VXI and CAMAC. The High Availability Advanced Telecom Computing Architecture (ATCA) system is a new industrial open standard designed to withstand single-point hardware or software failures. The standard crate, controller, applications module and sub-modules are being investigated. All modules and sub-modules are hot-swappable. A single crate is designed for a data throughput in communications applications of 2 Tb/s and an Availability of 0.99999, which translates into a downtime of five minutes per year. The ILC is planning to develop HA architectures for controls, beam instrumentation and detector systems.

NTIS

*Packaging; Controllers; Accelerators; Measuring Instruments; Telecommunication; Detectors*

**20070015307** Stanford Linear Accelerator Center, CA, USA

**Spin Echo and Interference in Synchrotrons**

Chao, A.; Nov. 2006; 12 pp.; In English

Report No.(s): DE2006-895808; SLAC-PUB-12228; No Copyright; Avail.: National Technical Information Service (NTIS)

Spin dynamics in crossing a single depolarization resonance is a well-studied subject. One well-known example is that of Froissart and Stora in 1960. More is needed to complete the understanding, particularly of the transient effects, when crossing a single resonance, but question arises what happens if we cross two resonances or cross a single resonance twice. When a resonance is crossed twice, the particle's spin dynamics encounters two additional phenomena. First, the two crossings will interfere with each other, leading to an interference effect. Second, there will be a spin echo effect. We discuss these two effects in this report. Two proposals to test these effects experimentally are made at the end.

NTIS

*Depolarization; Mesons; Synchrotrons; Spin Dynamics*

**20070015347** Stanford Linear Accelerator Center, CA, USA, Bari Univ., Italy, Academia Sinica, Beijing, China, Bergen Univ., Norway

**Observation of  $B(\text{sup}+)\text{yields } \phi \phi K(\text{sup}+)$  and Evidence for  $B(\text{sup}0)\text{yields } \phi \phi K(\text{sup}0)$  below  $\eta(\text{sub } c)$  Threshold**

Aubert, B.; Bona, M.; Boutigny, D.; Couderc, F.; Karyotakis, Y.; Sep. 2006; 7 pp.; In English

Report No.(s): DE2006-895812; SLAC-PUB-12113; No Copyright; Avail.: Department of Energy Information Bridge

The authors report measurements of the decays  $B(\text{sup}+) \text{yields } (\phi)(\phi)K(\text{sup}+)$  and  $B(\text{sup}0) \text{yields } (\phi)(\phi)K(\text{sup}0)$  using a sample of 231 million  $B(\text{bar } B)$  pairs collected with the BABAR detector at the PEP-II asymmetric-energy B Factory at the Stanford Linear Accelerator Center. The branching fractions are measured to be  $(\text{Beta})(B(\text{sup}+) \text{yields } (\phi)(\phi)K(\text{sup}+)) = (7.5 (+-) 1.0(\text{stat}) (+-) 0.7(\text{syst})) \times 10(\text{sup } -6)$  and  $(\text{Beta})(B(\text{sup}0) \text{yields } (\phi)(\phi)K(\text{sup}0)) = (4.1(\text{sub } -1.4)(\text{sup } +1.7)(\text{stat}) (+-) 0.4(\text{syst})) \times 10(\text{sup } -6)$  for a  $(\phi)(\phi)$  invariant mass below 2.85 GeV/c(sup 2).

NTIS

*Mesons; Particle Decay; Linear Accelerators*

**20070015358** New Mexico Univ., Albuquerque, NM USA

**Experimental Studies of Electronic Transport of Chalcogenide Glass Electrical Switches**

Emin, Dave; Edwards, Arthur; Oct 1, 2006; 7 pp.; In English

Contract(s)/Grant(s): FA9453-04-1-0370; Proj-2305

Report No.(s): AD-A464166; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464166>

The electrical conductivity, Seebeck coefficient, and Hall coefficient of 3 micron thick films of amorphous Ge<sub>2</sub>Sb<sub>2</sub>Te<sub>5</sub> have been measured as functions of temperature from room temperature down to as low as 200 K. The electrical conductivity manifests an Arrhenius behavior. The Seebeck coefficient is p-type with behavior indicative of multi-band transport. The Hall mobility is n-type and low (near 0.07 sq cm/V sec at room temperature).

DTIC

*Chalcogenides; Electric Switches; Electrical Resistivity; Glass; Hall Effect; Seebeck Effect; Switches*

**20070015383** Stanford Linear Accelerator Center, CA, USA, Bari Univ., Italy, Academia Sinica, Beijing, China, Bergen Univ., Norway

**Measurement of the Absolute Branching Fractions  $B$  yields  $D(\pi)$ ,  $D^{(*)}(\pi)$   $D^{(*)}(\pi)$  with a Missing Mass Method**

Aubert, B.; Bona, M.; Boutigny, D.; Couderc, F.; Karyotakis, Y.; Sep. 2005; 8 pp.; In English

Report No.(s): DE2006-895813; SLAC-PUB-12107; No Copyright; Avail.: National Technical Information Service (NTIS)

We present branching fraction measurements of charged and neutral  $B$  decays to  $D(\pi)$ ,  $D^{(*)}(\pi)$  and  $D^{**}(\pi)$  with a missing mass method, based on a sample of 231 million  $(\Upsilon)(4S)$  (yields)  $B(\bar{B})$  pairs collected by the BABAR detector at the PEP-II  $e^{+}e^{-}$  collider. One of the  $B$  mesons is fully reconstructed and the other one decays to a reconstructed charged ( $\pi$ ) and a companion charmed meson identified by its recoil mass, inferred by kinematics. Here  $D^{**}$  refers to the sum of all the non-strange charm meson states with masses in the range 2.2-2.8 GeV/c<sup>2</sup>.

NTIS

*Mesons; Branching (Physics); Particle Mass; Charm (Particle Physics)*

**20070015825** Illinois Univ. at Urbana-Champaign, Urbana, IL USA

**Fatigue and Fracture of Polycrystalline Silicon and Diamond MEMS at Room and Elevated Temperatures**

Chasiotis, Ioannis; Dec 2006; 34 pp.; In English

Contract(s)/Grant(s): F49620-03-1-0080

Report No.(s): AD-A464542; No Copyright; Avail.: CASI: A03, Hardcopy

A high-resolution Atomic Force Microscopy (AFM)/Digital Image Correlation (DIC) method was developed to investigate the deformation and fracture of tetrahedral amorphous diamond-like carbon (ta-C) and polycrystalline silicon (polysilicon) for microelectromechanical systems (MEMS). Polysilicon and ta-C test structures were fabricated at the Sandia National Laboratories (SNL) and at MCNC-Cronos. Their Young's modulus, Poisson's ratio, strength, and fracture toughness were obtained, many of them for the first time. Compared to polysilicon, ta-C was found to have superior mechanical properties: Its fracture toughness and strength were 3.5 times and two times that of polysilicon, respectively. Its elastic modulus was 4.5 times that of polysilicon and its Poisson's ratio was 30% smaller than polysilicon. The mode I and mixed mode I/II fracture toughness of polysilicon showed 50% scatter due to its polycrystallinity. On the contrary, the mixed mode I/II fracture of the amorphous ta-C was described well by deterministic theories for brittle fracture. The stochastic failure of polysilicon was treated by a finite element model that combined NASA's code CARES Life (Ceramics Analysis and Reliability Evaluation of Structures Life). This model provided failure predictions for devices with arbitrary geometries. Finally, the multi-grain nature of polysilicon was found to present a potential risk in the accurate determination of its effective mechanical behavior, especially in MEMS with dimensions equal to a small multiple of the grain size. In general, devices with dimensions larger than 15x15 grains can be described by using the isotropic properties reported in literature and presented in this report.

DTIC

*Diamonds; Fatigue (Materials); High Temperature; Microelectromechanical Systems; Polycrystals; Silicon*

**20070016579** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Stability of the Helium-Antiproton System**

Drachman, Richard J.; [2006]; 1 pp.; In English; DAMOP06, 16-20 May 2006, Knoxville, TN, USA; No Copyright;

Avail.: Other Sources; Abstract Only

In the course of their Born-Oppenheimer calculations of this system Todd and Armour noted that the lowest-lying state closely resembles the hydrogen negative ion, since the antiproton lies very close to the helium nucleus and shields one unit of nuclear charge. In the present paper this observation will be taken seriously to produce a variationally correct estimate of the total energy of this system, along with a similar estimate of the energy of the once-ionized system. The nonadiabatic effect of exactly treating the reduced masses improves the results.

Author

*Born-Oppenheimer Approximation; Hydrogen Ions; Antiprotons; Helium; Stability*

71  
ACOUSTICS

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution*. For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion and Power*.

**20070015165** Library of Congress, Washington, DC USA

**Active Military Sonar and Marine Mammals: Events and References**

Buck, Eugene H; Calvert, Kori; Feb 12, 2007; 19 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463810; CRS-RL33133; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463810>

The deployment of active sonar by the U.S. Navy and its potential impacts on marine mammals has been an ongoing issue of intense debate; regulatory, legislative, and judicial activity; and international concern. Some peacetime use of military sonar has been regulated under the Marine Mammal Protection Act (MMPA) and other statutes due to concerns that active military sonars are operated at frequencies used by some cetaceans (i.e., whales, porpoises, and dolphins), and their high intensity sound pulses may travel long distances in the ocean. There is also concern that sonar transmissions of sufficiently high intensity might physically damage the hearing in cetaceans or cause them to modify their behavior in ways that are detrimental. Although mid-frequency sonar has been implicated in several beaked whale strandings, there is scientific uncertainty surrounding the totality of the effects active sonar transmissions may have on marine mammals.

DTIC

*Animals; Marine Biology; Sonar*

**20070015367** Naval Research Lab., Stennis Space Center, MS USA

**Marine Seismic Surveys with Vector Acoustic Sensors**

Lindwall, Dennis; Oct 1, 2006; 6 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464186; NRL/PP/7430-06-01; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464186>

Vector acoustic data will allow accurate three-dimensional imaging of a complex environment while corresponding pressure hydrophone data will fail. Newly developed sensors make vector acoustic-based surveys practical. This concept is demonstrated with data from an acoustic water tank. Using a simple but novel imaging algorithm, all of the main structures in the water tank were correctly located. This imaging algorithm uses none of the existing imaging or inversion methods common in exploration seismology.

DTIC

*Acoustic Imaging; Acoustics; Imaging Techniques; Motion; Seismology; Signal Detectors; Sound Waves; Targets*

**20070015695** Department of the Navy, Washington, DC USA

**Enhanced Sensitivity Pressure Tolerant Fiber Optic Hydrophone**

Ames, Gregory H, Inventor; Oct 19, 2006; 20 pp.; In English

Report No.(s): AD-D020283; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADD020283>

An interferometric hydrophone operable for use in surrounding fluid, includes an outer mandrel having an interior open to the surrounding fluid. A sensing optical fiber is wound on the exterior of the outer mandrel. An inner mandrel is positioned in the interior of the outer mandrel. A chamber defined between the inner mandrel and outer mandrel is in communication with the surrounding fluid. The inner mandrel has a sealed gas filled interior. Compression and expansion of the inner mandrel results in compression and expansion of the outer mandrel.

DTIC

*Fiber Optics; Hydrophones; Patent Applications; Sensitivity*

**20070015696** Department of the Navy, Washington, DC USA

**Pressure Tolerant Fiber Optic Hydrophone**

Ames, Gregory H, Inventor; Oct 19, 2006; 23 pp.; In English

Report No.(s): AD-D020284; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADD020284>

An interferometric hydrophone is disclosed that comprises a first mandrel defining an interior that is open to surrounding

fluid. A sensing optical fiber is wound upon the first mandrel. A second mandrel is positioned in surrounding relationship with respect to the first mandrel. The first and second mandrels define a first chamber there between. A case encloses the first and second mandrels and first chamber; The cylindrical case and the second cylindrical mandrel define a second chamber there between, which is sealed and filled with gas or vacuum.

DTIC

*Fiber Optics; Hydrophones; Patent Applications*

**20070015758** Space and Naval Warfare Systems Center, San Diego, CA USA

**High Frequency Side Scan Sonar for Target Reacquisition and Identification**

Wilcox, Thomas E; Fletcher, Barbara; Jan 2003; 7 pp.; In English

Report No.(s): AD-A464428; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The increasing use of small unmanned underwater vehicles (UUV's) for scientific, military and security applications has led to the development of new sensor technologies. Key among these has been the development of small, light, cost-effective side scan sonar systems, enabling small vehicles such as the REMUS and CETUS II to perform a variety of survey-type missions. New developments in side scan technology are increasing the capabilities of these systems, going beyond the simple detection of targets. Use of high frequencies such as 1.2 and 2.4 MHz can provide a sufficient degree of resolution for the recognition and identification of targets. The performance of these sonar systems will be discussed, as well as factors affecting performance such as speed, altitude, depression angle, and vehicle system interference.

DTIC

*Evaluation; High Frequencies; Sonar; System Effectiveness; Targets; Underwater Vehicles*

## 72

### ATOMIC AND MOLECULAR PHYSICS

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see [73 Nuclear Physics](#).

**20070014874** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Sensitivity Analysis Applied to Atomic Data Used for X-ray Spectrum Synthesis**

Kallman, Tim; [2006]; 2 pp.; In English; High Accuracy Atomic Physics in Astronomy, 7-9 Aug. 2006, Cambridge, MA, USA; No Copyright; Avail.: Other Sources; Abstract Only

A great deal of work has been devoted to the accumulation of accurate quantities describing atomic processes for use in analysis of astrophysical spectra. But in many situations of interest the interpretation of a quantity which is observed, such as a line flux, depends on the results of a modeling- or spectrum synthesis code. The results of such a code depends in turn on many atomic rates or cross sections, and the sensitivity of the observable quantity on the various rates and cross sections may be non-linear and if so cannot easily be derived analytically. In such cases the most practical approach to understanding the sensitivity of observables to atomic cross sections is to perform numerical experiments, by calculating models with various rates perturbed by random (but known) factors. In addition, it is useful to compare the results of such experiments with some sample observations, in order to focus attention on the rates which are of the greatest relevance to real observations. In this paper I will present some attempts to carry out this program, focussing on two sample datasets taken with the Chandra HETG. I will discuss the sensitivity of synthetic spectra to atomic data affecting ionization balance, temperature, and line opacity or emissivity, and discuss the implications for the ultimate goal of inferring astrophysical parameters.

Author

*Sensitivity Analysis; Spectrum Analysis; X Ray Spectra; Synthesis; Atomic Physics*

**20070015719** Naval Research Lab., Washington, DC USA

**Automatic Classification of Land Cover on Smith Island, VA, Using HyMAP Imagery**

Bachmann, Charles M; Donato, Timothy F; Lamela, Gia M; Rhea, W J; Bettenhauen, Michael H; Fusina, Robert A; Du Bois, Kevin R; Porter, John H; Truitt, Barry R; Oct 2002; 19 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-00-WX-40016; N00014-01-WX-40009

Report No.(s): AD-A464375; No Copyright; Avail.: CASI: [A03](#), Hardcopy

No abstract available

*Classifications; Imagery; Land*

**20070015805** Naval Research Lab., Washington, DC USA

**Ocean PHILLS Hyperspectral Imager: Design, Characterization, and Calibration**

Davis, Curtiss O; Bowles, Jeffrey; Leathers, Robert A; Korwan, Dan; Downes, T V; Snyder, William A; Rhea, W J; Chen, Wei; Fisher, John; Bissett, W P; Feb 25, 2002; 13 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464512; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Ocean Portable Hyperspectral Imager for Low-Light Spectroscopy (Ocean PHILLS) is a hyperspectral imager specifically designed for imaging the coastal ocean. It uses a thinned, backside illuminated CCD for high sensitivity and an all-reflective spectrograph with a convex grating in an Offner configuration to produce a nearly distortion free image. The sensor, which was constructed entirely from commercially available components, has been successfully deployed during several oceanographic experiments in 1999-2001. Here we describe the instrument design and present the results of laboratory characterization and calibration. We also present examples of remote-sensing reflectance data obtained from the LEO-15 site in New Jersey that agrees well with ground-truth measurements.

DTIC

*Calibrating; Characterization; Imagery; Oceans; Spectroscopy*

**20070015809** Naval Research Lab., Washington, DC USA

**Charge Sensitive Preamplifier and Pulse Shaper using CMOS process for Germanium Spectroscopy**

Kroeger, R A; Johnson, W N; Kinzer, R L; Kurfess, J D; Allen, M D; Alley, G T; Britton, C L; Clonts, L C; Ericson, M N; Simpson, M L; Jan 1994; 5 pp.; In English

Report No.(s): AD-A464517; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We have developed a low noise, low power charge sensitive amplifier and pulse shaping circuit. Our application is for a double-sided germanium strip detector, nominally providing 50 independent spectroscopy channels. An array of these detectors would provide significant improvements in imaging, spectroscopy, and sensitivity for space-based gamma-ray astronomy. The key features of these electronics are low noise, very low power, and small footprint per channel. Performance of our first circuit is in good agreement with simulations, with -205e noise rms (0 pF), and 3 mW/channel power consumption. Dynamic range is 0-3.3 MeV (germanium) with a linearity of plus or minus 0.6%. Performance of this prototype device will be discussed.

DTIC

*CMOS; Germanium; Preamplifiers; Sensitivity; Shapers; Spectroscopy*

**20070015839** Kennesaw State Univ., GA USA

**A New System of Parallel Isolated Nonthermal Filaments Near the Galactic Center: Evidence for a Local Magnetic Field Gradient**

LaRosa, T N; Lazio, T J; Kassim, Namir E; Aug 14, 2001; 10 pp.; In English

Report No.(s): AD-A464580; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We report the discovery of a system of isolated nonthermal filaments approximately northwest 0 degrees.5 (75 pc in projection) of Sgr A. Unlike other isolated nonthermal filaments which show subfilamentation, braiding of subfilaments, and flaring at their ends, these filaments are simple linear structures and more closely resemble the parallel bundled filaments in the Galactic center radio arc. However, the most unusual feature of these filaments is that the 20/90 cm spectral index uniformly decreases as a function of length, in contrast to all other nonthermal filaments in the Galactic center. This spectral gradient may not be due to simple particle aging but could be explained by a curved electron energy spectrum embedded in a diverging magnetic field. If so, the scale of the magnetic gradient is not consistent with a large scale magnetic field centered on Sgr A\* suggesting that this filament system is tracing a local magnetic field.

DTIC

*Electron Energy; Gradients; Magnetic Fields; Radio Astronomy; Spectra*

**20070015990** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Atomic and Molecular Physics**

Bhatia, Anand K.; [2005]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

A symposium on atomic and molecular physics was held on November 18, 2005 at Goddard Space Flight Center. There were a number of talks through the day on various topics such as threshold law of ionization, scattering of electrons from



atoms and molecules, muonic physics, positron physics, Rydberg states etc. The conference was attended by a number of physicists from all over the world.

Author

*Atomic Physics; Molecular Physics; Conferences*

**20070015992** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Formation of Triplet Positron-helium Bound State by Stripping of Positronium Atoms in Collision with Ground State Helium**

Drachman, Richard J.; [2006]; 1 pp.; In English; DAMOP06, 16-20 May 2006, Knoxville, TN, USA; No Copyright; Avail.: Other Sources; Abstract Only

Formation of triplet positron-helium bound state by stripping of positronium atoms in collision with ground state helium JOSEPH DI RIENZI, College of Notre Dame of Maryland, RICHARD J. DRACHMAN, NASA/Goddard Space Flight Center - The system consisting of a positron and a helium atom in the triplet state  $e(^+)\text{He}(S-3)(\text{sup } e)$  was conjectured long ago to be stable [1]. Its stability has recently been established rigorously [2], and the values of the energies of dissociation into the ground states of Ps and He(+) have also been reported [3] and [4]. We have evaluated the cross-section for this system formed by radiative attachment of a positron in triplet He state and found it to be small [5]. The mechanism of production suggested here should result in a larger cross-section (of atomic size) which we are determining using the Born approximation with simplified initial and final wave functions.

Author

*Ground State; Helium Atoms; Positrons; Atomic Collisions; Atomic Energy Levels*

**20070015996** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Scattering of Low Energy Electrons and Positrons from Hydrogenic Systems and Applications**

Bhatia, Anand K.; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

While the electron scatters from the target, the target no longer stays in its original form. One of the first methods to take into account the distortion of the target at low incident energies is the method of polarized orbitals. In this method the wave function for the process is written using the first-order perturbation theory and the equation for the scattering function is derived from the Schrodinger equation. This method has been very successful in calculating the phase shifts and therefore the cross sections at various energies. The total wave function can be used to calculate photoionization cross sections. The disadvantage of this approach is that the method is not variational and therefore does not provide bounds on the phase shifts. These difficulties can be overcome by using the Feshbach projection operator formalism. This approach has been employed for the scattering of electrons and positrons from targets. Results of various calculations will be discussed.

Author

*Positrons; Electron Scattering; Formalism; Targets*

**20070016019** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Sensitivity Analysis Applied to Atomic Data Used for X-ray Spectrum Synthesis**

Kallman, T.; [2006]; 1 pp.; In English; High Energy Astrophysics Division Meeting, 4-7 Oct. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

A great deal of work has been devoted to the accumulation of accurate quantities describing atomic processes for use in analysis of astrophysical spectra. But in many situations of interest the interpretation of a quantity which is observed, such as a line flux, depends on the results of a modeling- or spectrum synthesis code. The results of such a code depends in turn on many atomic rates or cross sections, and the sensitivity of the observable quantity on the various rates and cross sections may be non-linear and if so cannot easily be derived analytically. This talk describes simple numerical experiments designed to examine some of these issues.

Author

*Astrophysics; Atomic Physics; Sensitivity Analysis; Spectrum Analysis; Synthesis; X Ray Spectra*

73  
NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

**20070014844** Rensselaer Polytechnic Inst., Troy, NY, USA

**Reactor Sharing at Rensselaer Critical Facility**

Steiner, D.; Harris, D.; Trumbull, T.; Oct. 18, 2006; 5 pp.; In English

Contract(s)/Grant(s): FG02-00NE38172

Report No.(s): DE2007-893462; DOE-NE38172-1; No Copyright; Avail.: Department of Energy Information Bridge

This final report summarizes the reactor sharing activities at the Rensselaer Critical Facility. An example of a typical tour is also included.

NTIS

*Nuclear Reactors; Reactor Technology; Nuclear Fuels*

**20070014949** Savannah River National Lab., Aiken, SC, USA, Westinghouse Savannah River Co., Aiken, SC, USA

**Materials Compatibility of Snap Fuel Components During Shipment in 9975 Packaging**

Vorinelker, P. R.; Nov. 2006; 15 pp.; In English

Report No.(s): DE2006-895360; WSRC-ST-12006-00140-REV-1; No Copyright; Avail.: Department of Energy Information Bridge

Materials Science and Technology has evaluated materials compatibility for the SNAP (Systems for Nuclear Auxiliary Power) fuel for containment within a 9975 packaging assembly for a shipping period of one year. The evaluation included consideration for potential for water within the convenience can, corrosion from water, galvanic corrosion, tape degradation, and thermal expansion risk. Based on a review of existing literature and assumed conditions, corrosion and/or degradation of the 304 stainless steel (SS) Primary Containment Vessel (PCV) and the 304 stainless steel convenience cans containing the SNAP fuel is not significant to cause failure during the 1 year time shipping period in the 9975 packaging assembly. However, storage beyond the 1 year shipping period has not been validated.

NTIS

*Compatibility; Containment; Corrosion; Packaging; SNAP; Stainless Steels*

**20070015055** Oak Ridge National Lab., TN USA, Cincinnati Univ., OH, USA

**Assumptions and Criteria for Performing a Feasibility Study of the Conversion of the High Flux Isotope Reactor Core to Use Low-Enriched Uranium Fuel**

Primm, R. T.; Ellis, R. J.; Gehin, J. C.; Moses, D. L.; Binder, J. L.; Feb. 01, 2006; 80 pp.; In English

Report No.(s): DE2006-890007; ORNL/TM-2005/269; No Copyright; Avail.: National Technical Information Service (NTIS)

A computational study will be initiated during fiscal year 2006 to examine the feasibility of converting the High Flux Isotope Reactor from highly enriched uranium fuel to low-enriched uranium. The study will be limited to steady-state, nominal operation, reactor physics and thermal-hydraulic analyses of a uranium-molybdenum alloy that would be substituted for the current fuel powder--U(sub 3)O(sub 8) mixed with aluminum. The purposes of this document are to (1) define the scope of studies to be conducted, (2) define the methodologies to be used to conduct the studies, (3) define the assumptions that serve as input to the methodologies, (4) provide an efficient means for communication with the Department of Energy and American research reactor operators, and (5) expedite review and commentary by those parties.

NTIS

*High Flux Isotope Reactors; Reactor Cores; Uranium*

**20070015817** Naval Research Lab., Washington, DC USA

**OSSE Observations of Galactic 511 keV Positron Annihilation Radiation: Initial Phase 1 Results**

Purcell, W R; Grabelsky, D A\g; Ulmer, M P; Johnson, W N; Kinzer, R L; Kurfess, J D; Strickman, M S; Jung, G V; May 10, 1993; 18 pp.; In English

Report No.(s): AD-A464533; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment (OSSE) on the Compton Gamma-Ray Observatory (GRO) has performed numerous observations of the galactic plane and galactic center region to measure the distribution of galactic 511

keV positron annihilation radiation and to search for time variability of the emission; the initial 511 keV line fluxes for the observations performed during the first 18 months of the GRO mission are presented. The 511 keV line flux for a typical galactic center observation is  $(2.5 \pm 0.3) \times 10^{-1} \text{ gamma sq cm s}^{-1}$ , where the quoted uncertainty represents the 1 sigma statistical uncertainty. No statistically significant time variability of the line flux has been observed; the 3 sigma upper limit to daily variations from the mean is  $3 \times 10^{-4} \text{ gamma sq cm s}^{-1}$ . The distribution of galactic 511 keV positron annihilation radiation implied by the OSSE observations is discussed and compared with observations by other instruments.

DTIC

*Annihilation Reactions; Positron Annihilation; Radiation Dosage*

**20070015826** Stanford Univ., Stanford, CA USA

**Development of a Miniaturized Hadamard Transform Time-of-Flight Mass Spectrometer**

Zare, Richard N; Feb 2007; 27 pp.; In English

Contract(s)/Grant(s): FA9550-04-1-0076

Report No.(s): AD-A464544; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This report details advances in theory and technology for the precise deflection of high kinetic energy ion beams using Bradbury-Nielsen gates (BNGs) and their application to high duty cycle miniaturized mass spectrometry. We have developed methods to fabricate BNGs using template assisted manual weaving and silicon-on-insulator microfabrication. These devices have been characterized using ion beam imaging techniques, and the results compared to mathematical models of the deflection process developed for this purpose. A new vacuum-compatible electronic system has been constructed to allow the deflection of ions using BNGs following an arbitrary digital sequence that minimizes the impact of impedance mismatching within the circuit and improves the precision of deflection. The aforementioned advances have been integrated to develop a new form of time-of-flight mass spectrometry that allows for 100% duty cycle detection of a continuous ion beam. Experiments detailing 100% duty cycle operation are described. The statistical advantages to this form of detection over other forms of mass spectrometry in a shot noise dominant environment are presented.

DTIC

*Ion Beams; Mass Spectrometers; Mass Spectroscopy; Miniaturization; Time of Flight Spectrometers; Transformations (Mathematics)*

**20070016035** Naval Research Lab., Washington, DC USA

**X-ray Observations of Mkn 421 with USA**

Giebels, B; Wood, K S; Bandyopadhyay, R M; Bloom, E; Focke, W; Fritz, G; Godfrey, G; Hertz, P; Kowalski, M P; Lovellette, M N; Ray, P S; Reilly, K; Saz Parkinson, P; Scargle, J; Shabad, G; Wolff, M T; Yentis, D; Jan 2000; 5 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DE-AC03-76SF00515

Report No.(s): AD-A464597; No Copyright; Avail.: CASI: [A01](#), Hardcopy

This paper presents the first AGN detections with the USA X-ray detector on board of ARGOS. We started observing the BL Lac object Mkn421 at the end of January 2000, when it was also observed by the CAT Cerenkov telescope (see Pierre Espigat, these proceedings), and optical telescopes (but the latter are not presented here). Mkn421 was at the beginning of a long period of high activity that lasted for many weeks. Some observations on Mkn421 were also carried out in this period by XTE (see Rita Sambruna, these proceedings).

DTIC

*X Ray Detectors; Active Galactic Nuclei*

**20070016039** Naval Research Lab., Washington, DC USA

**The Pulsed Hard X-Ray Spectrum of PSR B1509-58**

Matz, S M; Ulmer, M P; Grabelsky, D A; Purcell, W R; Grove, J E; Johnson, W N; Kinzer, R L; Kurfess, J D; Strickman, M S; Jung, G V; Jan 1994; 11 pp.; In English

Report No.(s): AD-A464483; No Copyright; Avail.: CASI: [A03](#), Hardcopy

OSSE observed the 150 ms X-ray pulsar PSR B1509-58 in the supernova remnant MSH 15-52 for four weeks in 1992. The pulsed spectrum from 50 keV to 5 MeV is well-fit by a single power law photon spectrum of the form  $(3.14 \pm 0.16) \times 10^{(6)} \times (E/118.5 \text{ keV})^{-(1.68 \pm 0.09)}$  photons  $\text{cm}^{-2} \text{ s}^{-1} \text{ keV}^{-1}$ . This is significantly harder than the Crab pulsar spectrum in this energy range. The Ginga soft X-ray spectrum (2-60 keV) reported by Kawai et

al. Is significantly harder than the observed OSSE spectrum and predicts a flux two times higher than we observe in the ~55 -170 keV energy band. This requires a break to a steeper spectrum somewhere in the intermediate energy range (~ 40 - 80 keV). The spectrum must soften again at higher energies or the pulsar would have easily been detected by EGRET, COS B, and SAS-2.

DTIC

*X Ray Spectra; Pulsars; Supernova Remnants*

## 74 OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

**20070014800** Swedish Defence Research Establishment, Linköping, Sweden

### **Characterization of an Intracavity Optical Parametric Oscillator (Karakterisering av en Optisk Parametrisk Oscillator)**

Sandberg, D.; Sep. 2005; 82 pp.; In English

Report No.(s): PB2007-105523; FOI-R-1737-SE; No Copyright; Avail.: CASI: [A05](#), Hardcopy

The wavelength of laser radiation can be converted by using nonlinear optical crystals. One nonlinear process is parametric oscillation where a fundamental wavelength is converted into two longer wavelengths. In this work the possibilities to build a stable source producing radiation in the 2 micrometers wavelength region was investigated. This radiation can, in further conversion processes, generate longer wavelengths with applications in e.g. laser countermeasures and laser for atmospheric remote sensing. An intracavity Optical Parametric Oscillator (OPO) using the nonlinear crystal KTiOPO<sub>4</sub> (KTP) was designed to cover pulsed Nd: YAG laser radiation operating at 1064 nm wavelength to regions around 2 micrometers. The maximum converted output power achieved for an intracavity OPO configuration was 2.5 W using a Nd: YAG output power of 20 W. An analysis of thermal lensing of the laser rod and the influence from thermal effects on output power from the system was carried out.

NTIS

*Lasers; Optical Properties; Oscillators; Parametric Amplifiers*

**20070014882** Sandia National Labs., Albuquerque, NM USA

### **Tunable Electrochromic Fabry-Perot Filter for Adaptive Optics Applications**

Kammler, D. R.; Yelton, W. G.; Verley, J. C.; Sweatt, W. C.; Heller, E. J.; Oct. 01, 2006; 48 pp.; In English

Report No.(s): DE2006-895983; SAND2006-6577; No Copyright; Avail.: National Technical Information Service (NTIS)

The potential for electrochromic (EC) materials to be incorporated into a Fabry-Perot (FP) filter to allow modest amounts of tuning was evaluated by both experimental methods and modeling. A combination of chemical vapor deposition (CVD), physical vapor deposition (PVD), and electrochemical methods was used to produce an ECFP film stack consisting of an EC WO<sub>(sub 3)</sub>/Ta<sub>(sub 2)</sub>O<sub>(sub 5)</sub>/NiO<sub>(sub x)</sub>H<sub>(sub y)</sub> film stack (with indium-tin-oxide electrodes) sandwiched between two Si<sub>(sub 3)</sub>N<sub>(sub 4)</sub>/SiO<sub>(sub 2)</sub> dielectric reflector stacks. A process to produce a NiO<sub>(sub x)</sub>H<sub>(sub y)</sub> charge storage layer that freed the EC stack from dependence on atmospheric humidity and allowed construction of this complex EC-FP stack was developed. The refractive index (n) and extinction coefficient (k) for each layer in the EC-FP film stack was measured between 300 and 1700 nm. A prototype EC-FP filter was produced that had a transmission at 500 nm of 36%, and a FWHM of 10 nm. A general modeling approach that takes into account the desired pass band location, pass band width, required transmission and EC optical constants in order to estimate the maximum tuning from an EC-FP filter was developed. Modeling shows that minor thickness changes in the prototype stack developed in this project should yield a filter with a transmission at 600 nm of 33% and a FWHM of 9.6 nm, which could be tuned to 598 nm with a FWHM of 12.1 nm and a transmission of 16%.

NTIS

*Adaptive Optics; Electrochromism; Fabry-Perot Interferometers; Tunable Filters*

**20070014942** Brookhaven National Lab., Upton, NY USA, Technische Hochschule, Aachen, Germany

### **Spin Polarized Photoelectron Spectroscopy as a Probe of Magnetic Systems**

Johnson, P. D.; Guentherodt, G.; Oct. 2006; 84 pp.; In English

Report No.(s): DE2006-895869; BNL-77185-2006-BC; No Copyright; Avail.: National Technical Information Service (NTIS)

Spin-polarized photoelectron spectroscopy has developed into a versatile tool for the study of surface and thin film magnetism. In this chapter, we examine the methodology of the technique and its recent application to a number of different problems. We first examine the photoemission process itself followed by a detailed review of spin-polarization measurement techniques and the related experimental requirements. We review studies of spin polarized surface states, interface states and quantum well states followed by studies of the technologically important oxide systems including half-metallic transition metal oxides, ferromagnet/oxide interfaces and the antiferromagnetic cuprates that exhibit high T<sub>c</sub> Superconductivity. We also discuss the application of high-resolution photoemission with spin resolving capabilities to the study of spin dependent self energy effects.

NTIS

*Photoelectron Spectroscopy; Particle Spin; Photoelectric Emission*

**20070014958** Ohio Dept. of Transportation, Columbus, OH, USA

**Comparison of Optical Gradation Analysis Devices to Current Test Methods-Phase One. Final Report**

Rajagopal, A.; Oct. 2006; 33 pp.; In English

Report No.(s): PB2007-107831; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Optical devices for gradation analysis are being developed to deliver accurate gradation results with, less labor, less consistency error, and greater reliability. The goal of this study was to conduct a review and develop comprehensive understanding of the existing technology for gradation analysis, and generate basic data to determine when and where such devices are appropriate from the standpoint of both economics and performance. Following a review of available optical devices, an optical device called Computerized Particle Analyzer (CPA) was selected for laboratory evaluation to determine its suitability for gradation analysis. This device has been designed to examine particles as they freely fall in front of a light source, while a sophisticated camera capable of making 10,000 scans per second captures images. Aggregate samples were collected from 46 different sources in Ohio. These sources included various sizes of limestone and gravel with varying amounts of crushed faces. Gradation tests were first performed according to the standard AASHTO procedure. The samples were then tested in CPA.

NTIS

*Optical Equipment; Technology Utilization*

**20070015067** National Inst. of Environmental Health Sciences, Research Triangle Park, NC, USA

**Current Status of In Vitro Test Methods for Identifying Ocular Corrosives and Severe Irritants: Hen's Egg Test-Chorioallantoic Membrane Test Method. Background Review Document**

Mar. 2006; 248 pp.; In English

Report No.(s): PB2007-107803; NIH-PUB-06-4515; No Copyright; Avail.: Other Sources: [A11](#), Hardcopy

This Background Review Document (BRD) reviews available data and information regarding the validation status of the Hens Egg Test Chorioallantoic Membrane (HET-CAM) test method for identifying ocular corrosives and severe irritants. The test method was reviewed for its ability to predict ocular corrosives and severe/irreversible effects as defined by the U.S. Environmental Protection Agency (EPA) (EPA 1996), the European Union (EU) (EU 2001), and the United Nations (UN) Globally Harmonized System (GHS) of Classification and Labeling of Chemicals (UN 2003). The objectives of this BRD is to describe the current validation status of the HET-CAM test method, including what is known about its accuracy and reliability, the scope of the substances tested, and the availability of a standardized test method protocol.

NTIS

*Chickens; Eggs; Identifying; In Vitro Methods and Tests; Membranes*

**20070015068** National Inst. of Environmental Health Sciences, Research Triangle Park, NC, USA

**Current Status of In Vitro Test Methods for Identifying Ocular Corrosives and Severe Irritants: Isolated Chicken Eye Test Method. Background Review Document**

Mar. 2006; 168 pp.; In English

Report No.(s): PB2007-107804; NIH-PUB-06-4513; No Copyright; Avail.: Other Sources: [A08](#), Hardcopy

This Background Review Document (BRD) reviews available data and information regarding the validation status of the Isolated Chicken Eye (ICE) test method for identifying ocular corrosives and severe irritants. The test method was reviewed for its ability to predict ocular corrosives and severe/irreversible effects as defined by the U.S. Environmental Protection Agency (EPA) (EPA 1996), the European Union (EU) (EU 2001), and the United Nations (UN) Globally Harmonized System (GHS) of Classification and Labeling of Chemicals (UN 2003). The objective of this BRD is to describe the current validation

status of the ICE test method, including what is known about its accuracy and reliability, the scope of the substances tested, and the availability of a standardized test method protocol.

NTIS

*Chickens; Eye (Anatomy); Ice; Identifying; In Vitro Methods and Tests*

**20070015280** Harvard Univ., Cambridge, MA USA

**Development of a Quantum Repeater for Long-Distance Quantum Communication Using Photonic Information Storage**

Lukin, Mikhail; Mar 14, 2007; 17 pp.; In English

Contract(s)/Grant(s): N00014-02-1-0599; Proj-211837-01

Report No.(s): AD-A464029; 133438; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464029>

In this project, we have carried out the pioneering work for long-distance quantum communication using atomic ensembles for photon-state storage and for implementation of quantum repeaters. This work was followed by many groups and is now considered as one of the most promising approaches to overcoming photon losses in long-distance quantum communication. Specific highlights include theoretical proposals for quantum repeaters based on atomic ensembles (Nature, 414, 413, 2001), atom-atom correlations mediated by dark-state polaritons (Phys.Rev.Lett., 88, 243602, 2002), generation of stationary pulses of light (Phys.Rev.Lett, 89, 143602, 2002); experimental demonstrations of atomic memory for correlated photon states (Science, 301, 196, 2003), stationary pulses of light (Nature 426, 638, 2003), shaping quantum pulses via atomic memory (Phys.Rev.Lett. 93, 233602, 2004)), and finally realization of two-node quantum network involving generation and storage of single photon pulses in two remote ensembles (Nature, 438, 837, 2005). Finally, we proposed and analyzed a novel method that uses fixed, minimal physical resources to achieve generation and nested purification of quantum entanglement for quantum communication over arbitrarily long distances. In this method, solid-state single photon emitters with two internal degrees of freedom formed by an electron spin and a nuclear spin are used to build intermediate nodes in a quantum channel (Phys.Rev.Lett. 96,070504, 2006). Recently, we have experimentally demonstrated such a node using Nitrogen-Vacancy centers in room temperature diamond lattice (submitted to Science, 2007).

DTIC

*Data Storage; Photonics; Quantum Communication; Quantum Optics; Repeaters*

**20070015361** National Central Univ., Taoyuan, Taiwan, Province of China

**Automatic Target Recognition for Hyperspectral Imagery Using High-Order Statistics**

Ren, Hsuan; Du, Qian; Wang, Jing; Chang, Chein-I; Jensen, James O; Jensen, Janet L; Oct 2006; 15 pp.; In English

Report No.(s): AD-A464170; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464170>

Due to recent advances in hyperspectral imaging sensors many subtle unknown signal sources that cannot be resolved by multispectral sensors can be now uncovered for target detection, discrimination, and identification. Because the information about such sources is generally not available, automatic target recognition (ATR) presents a great challenge to hyperspectral image analysts. Many approaches developed for ATR are based on second-order statistics in the past years. This paper investigates ATR techniques using high order statistics. For ATR in hyperspectral imagery, most interesting targets usually occur with low probabilities and small population and they generally cannot be described by second-order statistics. Under such circumstances, using high-order statistics to perform target detection have been shown by experiments in this paper to be more effective than using second order statistics. In order to further address a challenging issue in determining the number of signal sources needed to be detected, a recently developed concept of virtual dimensionality (VD) is used to estimate this number. The experiments demonstrate that using high-order statistics-based techniques in conjunction with the VD to perform ATR are indeed very effective.

DTIC

*Detection; Imagery; Statistical Analysis; Target Acquisition; Target Recognition*

**20070015366** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Feature Extraction Using Principal and Independent Component Analysis for Hyperspectral Imagery**

Koo, Robert; Mar 2007; 136 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464185; AFIT/GOR/ENS/07-16; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA464185>

Hyperspectral imagery (HSI) analysis is frequently employed by the Department of Defense for the purpose of classifying objects within an image as a form of target detection. In this research a robust Two-Phase Filtering Independent Component Analysis (ICA) Target Detection Method is proposed and validated. This new method resolves two main challenges encountered when implementing target detection methods using ICA, a high order statistics feature extraction (FE) method. The first challenge is the high computational demand imposed by the large volume of data associated with HSI during the FE process. To alleviate the effort required for ICA data processing, principal component analysis (PCA), a classical second order statistics method, is used for data reduction. Furthermore, the performance of using PCA under classification is compared against recently developed supervised FE techniques. The second challenge arises during the feature selection (FS) phase after the statistically independent components have been extracted. Current ICA target FS techniques have shown to be either unreliable or require significant user-intervention. A reliable FS process is essential in automating the target detection process. This proposed method uses ICA to extract independent features from the retained principal components, and is followed by an unsupervised target FS with a two-phase filtering process using kurtosis and mean silhouette values. This method achieved promising results when tested against a wide range of benchmark images.

DTIC

*Imagery; Pattern Recognition; Principal Components Analysis*

**20070015715** Cincinnati Univ., OH USA

**Control of Penetration and Mixing of an Excited Supersonic Jet Into a Supersonic Cross Stream (Postprint)**

Murugappan, S; Gutmark, E; Carter, C; Oct 2006; 15 pp.; In English

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A464369; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Rayleigh/Mie scattering from flow field ice crystals was used to study mixing and penetration of a forced a supersonic jet in a supersonic Mach-2 cross stream. Instantaneous images--using image planes along side-view and normal end-view to the flow axis--were used to study the dynamical structures in the jet whereas ensemble images provide information regarding the jet trajectory. Standard deviation images reveal information about the large-scale mixing/entrainment. Probability density functions were used to evaluate the mixing along the time-average jet interface. Forced cases indicate the presence of periodic formation of large-scale eddies in the jet/free stream interface. The eddies were bigger in size and more convoluted in the forced cases as compared to the baseline. These provided high penetration of the jet into the free stream. Forced cases also show higher region involved in small scale and/or bulk mixing in both the side- and end-views.

DTIC

*Gas Streams; Jet Control; Mie Scattering; Penetration; Probability Density Functions; Ramjet Engines; Streams; Supersonic Flow; Supersonic Jet Flow*

**20070015725** Naval Research Lab., Washington, DC USA

**Intrinsic Multiple Quantum Well Spatial Light Modulators**

Rabinovich, W S; Bowman, S R; Katzer, D S; Kyono, C S; Feb 27, 1995; 4 pp.; In English

Report No.(s): AD-A464387; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Large improvements are reported in the sensitivity of optically addressed multiple quantum well spatial light modulators. In prior work with these materials the quantum well region has been made semi-insulating. It is shown that this is unnecessary and in fact detrimental to performance. By placing layers containing high trap concentrations at the ends of the structure and leaving the active quantum well layers intrinsic the speed of the device at a given illumination is improved by more than four times, diffraction efficiency is enhanced and spatial resolution is almost the same.

DTIC

*Light Modulators; Quantum Wells*

**20070015841** Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires, Argentina

**New Radio and Optical Study of the Supernova Remnant W44**

Giacani, E B; Dubner, G M; Kassim, N E; Frail, D A; Goss, W M; Winkler, P F; Williams, B F; Apr 1997; 13 pp.; In English

Contract(s)/Grant(s): AST-9315967

Report No.(s): AD-A464584; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present new optical images of the supernova remnant (SNR) W44 in the H-alpha and [S II] lines covering the entire source for the first time. We also report on improved radio image of W44 at 1442.5 MHz, obtained after the reprocessing of existing VLA data. A spectral index  $\alpha$  of -0.4 was derived for the whole source, without indication of significant spectral

variations between 0.3 and 1.4 GHz across the remnant. Accurate multiwavelength comparisons were made based on existing observations of W44 in the different spectral regimes. We find excellent correlation between optical and radio emission along the northwest border of the remnant, suggesting that the optical radiation is originating through radiative cooling of the shocked gas immediately behind the shock front. Some diffuse optical emission is also observed towards the interior of W44, with no clear radio counterpart. We confirm that over most of the source, the bright X-ray emission corresponds with regions of low radio brightness. At the northern border of the remnant, diffuse X-ray emission exactly overlaps the radio and optical radiation. From the study of the immediate environs of W44 we conclude that the remnant is interacting with molecular clouds along the eastern border. Such a scenario is compatible with the filamentary structure of W44, the excitation of OH masers and the apparent lack of optical emission along the eastern border. To the north, an extended atomic cloud surrounds the remnant, although the interaction is not evident in this case.

DTIC

*Astronomy; Electromagnetic Radiation; Hydroxyl Emission; Interstellar Masers; Light Emission; Masers; Optical Properties; Radiation Spectra; Radio Frequencies; Supernova Remnants*

**20070016572** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Fabrication of Extremely Lightweight Mirrors**

Zhang, William W.; [2006]; 1 pp.; In English; Technology Days in the Government 2006, 18-20 Sep. 2006, Albuquerque, NM, USA; No Copyright; Avail.: Other Sources; Abstract Only

Further progress in astronomy requires large (approx. 10m class) space telescopes in all wavelength bands, from IR to X-rays. The enabling of this progress requires optical fabrication technologies that not only can make mirrors that are orders of magnitude less massive than the present ones, but also orders of magnitude less expensive. In the past five years, we have been developing lightweight X-ray mirrors to meet mission requirements of the Constellation-X, which is NASA's next major X-ray observatory scheduled for launch some time in the next decade. In this talk, I will describe in detail a glass forming, or slumping, technique that allows a high-fidelity copying of a mandrel's figure while preserving the microroughness of the float glass surface. In particular, I will address the possibility of applying this technique to making extremely large optical telescopes.

Author

*Spaceborne Telescopes; Fabrication; Mirrors; X Ray Astronomy; Forming Techniques*

**20070016676** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

#### **Measurement of the Non-common Vertex Error of a Double Corner Cube**

Azizi, Alireza; Marcin, Martin; Moore, Douglas; Moser, Steve; Negron, John; Paek, Eung-Gi; Ryan, Daniel; Abramovici, Alex; Best, Paul; Crossfield, Ian; Nemat, Bijan; Neville, Tim; Platt, B.; Wayne, Leonard; August 13, 2006; 11 pp.; In English; SPIE Optics and Photonics, 13-17 Aug. 2006, San Diego, CA, USA; Original contains color illustrations; Copyright;

Avail.: Other Sources

ONLINE: <http://hdl.handle.net/2014/39940>

The Space Interferometry Mission (ESA) requires the control of the optical path of each interferometer with picometer accuracy. Laser metrology gauges are used to measure the path lengths to the fiducial corner cubes at the siderostats. Due to the geometry of ESA a single corner cube does not have sufficient acceptance angle to work with all the gauges. Therefore ESA employs a double corner cube. Current fabrication methods are in fact not capable of producing such a double corner cube with vertices having sufficient commonality. The plan for ESA is to measure the non-commonality of the vertices and correct for the error in orbit. ESA requires that the non-common vertex error (NCVE) of the double corner cube to be less than 6 ( $\mu$ )m. The required accuracy for the knowledge of the NCVE is less than 1 ( $\mu$ )m. This paper explains a method of measuring non-common vertices of a brassboard double corner cube with sub-micron accuracy. The results of such a measurement will be presented.

Author

*Optical Paths; Interferometry; Space Missions; Sensitivity Analysis; Instrument Compensation; Apexes*



75  
**PLASMA PHYSICS**

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**20070014897** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Plasma Environments and Spacecraft Charging for Lunar Programs**

Minow, Joseph I.; Altstatt, Richard L.; Blackwell, William C., Jr.; [2007]; 29 pp.; In English; Space Technology Applications International Forum 2007, 12-15 Feb. 2007, Biarritz, France; Original contains color and black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Space systems interacting with the space plasma environment charge to potentials of a few tens of volts positive in interplanetary space or on the lunar surface in daylight, a few hundred volts negative in the dark lunar plasma wake and in some regions of the Earth's radiation belts, and to multiple kilovolt negative potentials for worst case conditions in the Earth's magnetosphere near geostationary orbit. Good design practices are required to assure that space systems operate successfully in these environments without detrimental effects due to transient currents and insulator failure produced by electrostatic discharges. Cold lunar environments in particular are challenging because detrimental effects of charging are often exacerbated by cold, highly resistive dielectrics which can integrate charge for long periods of time. We will describe the cold plasma and energetic particle environments relevant to lunar missions responsible for surface and bulk charging of space systems and discuss program requirements under development for assuring that systems operate successfully in these environments.

Author

*Spacecraft Charging; Plasma Potentials; Radiation Belts; Geosynchronous Orbits; Earth Magnetosphere; Space Plasmas; Lunar Environment; Energetic Particles; Aerospace Systems*

**20070014910** Lawrence Livermore National Lab., Livermore, CA USA

**Compact High Current Heavy-Ion Injector**

Westenskow, G. A.; Grote, D. P.; Kwan, J. W.; Bieniosek, F.; Aug. 14, 2006; 5 pp.; In English  
Report No.(s): DE2006-895997; UCRL-PROC-220625; No Copyright; Avail.: National Technical Information Service (NTIS)

To provide a compact high-brightness heavy-ion beam source for Heavy Ion Fusion (HIF), we have been experimenting with merging multi-beamlets in an injector which uses an RF plasma source. An array of converging beamlets was used to produce a beam with the envelope radius, convergence, and ellipticity matched to an electrostatic quadrupole (ESQ) channel. Experimental results were in good quantitative agreement with simulation and have demonstrated the feasibility of this concept. The size of a driver-scale injector system using this approach will be several times smaller than one designed using traditional single large-aperture beams. The success of this experiment has possible significant economical and technical impacts on the architecture of HIF drivers.

NTIS

*Heavy Ions; High Current; Injectors; Nuclear Fusion; Linear Accelerators*

**20070014913** Lawrence Livermore National Lab., Livermore, CA USA

**Development and Characterization of a High Magnetic Field Solenoid for Laser Plasma Experiments**

Pollock, B. B.; Froula, D. H.; Davis, P. F.; Ross, J. S.; Divol, L.; May 10, 2006; 6 pp.; In English  
Report No.(s): DE2006-896004; UCRL-PROC-221295; No Copyright; Avail.: National Technical Information Service (NTIS)

An electromagnetic solenoid was developed to study the quenching of nonlocal heat transport in laser-produced gas-jet plasmas by high external magnetic fields. The solenoid, which is driven by a pulsed power system supplying 30 kJ, achieves fields exceeding 10 T. Temporally resolved measurements of the electron temperature profile transverse to a high power laser beam were obtained using Thomson Scattering. A method for optimizing the solenoid design based on the available stored energy is presented.

NTIS

*Laser Plasmas; Lasers; Magnetic Fields; Plasma Diagnostics; Solenoids*

**20070015052** Lawrence Livermore National Lab., Livermore, CA USA

**ESL Startup Workshop**

Cohen, R. H.; Dec. 05, 2005; 131 pp.; In English

Report No.(s): DE2006-890004; UCRL-PROC-217531; No Copyright; Avail.: National Technical Information Service (NTIS)

No abstract available

*Conferences; Modes*

**20070015732** Princeton Univ., NJ USA

**Combustion Enhancement Via Stabilized Piecewise Nonequilibrium Gliding Arc Plasma Discharge (Postprint)**

Ombrello, Timothy; Qin, Xiao; Ju, Yiguang; Gutsol, Alexander; Fridman, Alexander; Carter, Campbell; Jan 2006; 11 pp.; In English

Contract(s)/Grant(s): F49620-04-1-0038

Report No.(s): AD-A464395; AIAA-2005-1194; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A new piecewise nonequilibrium gliding arc plasma discharge integrated with a counterflow flame burner was developed and validated to study the effect of a plasma discharge on the combustion enhancement of methane-air diffusion flames. The results showed that the new system provided a well-defined flame geometry for the understanding of the basic mechanism of the plasma-flame interaction. It was shown that with a plasma discharge of the airstream, up to a 220% increase in the extinction strain rate was possible at low-power inputs. The impacts of thermal and nonthermal mechanisms on the combustion enhancement was examined by direct comparison of measured temperature profiles via Rayleigh scattering thermometry and OH number density profiles via planar laser-induced fluorescence (calibrated with absorption) with detailed numerical simulations at elevated air temperatures and radical addition. It was shown that the predicted extinction limits and temperature and OH distributions of the diffusion flames, with only an increase in air temperature, agreed well with the experimental results.

DTIC

*Arc Discharges; Augmentation; Combustion; Gliding; Nonequilibrium Plasmas*

## 76

### SOLID-STATE PHYSICS

Includes condensed matter physics, crystallography, and superconductivity. For related information see also *33 Electronics and Electrical Engineering*; and *36 Lasers and Masers*.

**20070014830** Purdue Univ., West Lafayette, IN, USA

**Diffusion in Grain Boundary Triple Junctions, and its Effects on the Behavior of Nanostructured Materials. Final Report**

King, A. H.; Dayananda, M. A.; Dec. 2006; 6 pp.; In English

Contract(s)/Grant(s): DE-FG02-01ER45940

Report No.(s): DE2007-896482; No Copyright; Avail.: Department of Energy Information Bridge

The principal goal of this project was to develop a means of studying diffusion in controlled tricrystal specimens that allow access to consistent grain boundary triple junctions (GBTJs).

NTIS

*Diffusion; Grain Boundaries; Nanostructure (Characteristics)*

**20070014854** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Passive Gas-Gap Heat Switch for Adiabatic Demagnetization Refrigerator**

Shirron, P. J., Inventor; Di Pirro, M. J., Inventor; October 20, 2005; 9 pp.; In English

Patent Info.: Filed Filed 10 May 05; US-Patent-Appl-SN-11-126-516

Report No.(s): PB2007-105949; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014854>

A passive gas-gap heat switch for use with a multi-stage continuous adiabatic demagnetization refrigerator (ADR). The passive gas-gap heat switch turns on automatically when the temperature of either side of the switch rises above a threshold value and turns off when the temperature on either side of the switch falls below this threshold value. One of the heat switches in this multistage process must be conductive in the 0.25.degree. K to 0.3.degree. K range. All of the heat switches must be

capable of switching off in a short period of time (1-2 minutes), and when off to have a very low thermal conductance. This arrangement allows cyclic cooling cycles to be used without the need for separate heat switch controls.

Author

*Adiabatic Conditions; Demagnetization; Magnetic Cooling; Magnetic Fields; Refrigerators; Switches*

**20070015130** Universal Energy Systems, Inc., Dayton, OH USA

**Deformation and Recrystallization During Thermomechanical Processing of a Nickel-Base Superalloy Ingot Material**

Semiatin, S L; Weaver, D S; Goetz, R L; Thomas, J P; Turner, T J; Sep 2006; 14 pp.; In English

Contract(s)/Grant(s): F33615-04-D-5235; F33615-03-D-5801

Report No.(s): AD-A463637; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463637>

The deformation response and recrystallization behavior of a coarse, columnar-grain superalloy ingot material, Waspaloy, with a  $\lambda/100$  fiber texture were established. For this purpose, isothermal hot compression tests were performed on cylindrical and doublecone samples at supersolvus temperatures under both monotonic (constant strain rate) and multi-hit conditions. Plastic flow showed a noticeable dependence on test direction relative to the columnar-grain orientation; the observed anisotropy in peak flow stress and flow softening were explained on the basis of the evolution of crystallographic texture during recrystallization. Similarly, anisotropy in dynamic recrystallization kinetics with respect to test direction was interpreted in terms of the effect of initial texture on the plastic work imposed per increment of macroscopic strain. Nevertheless, the broad kinetics for the coarse-grain, ingot material deformed under both monotonic and multi-hit conditions were comparable to those previously measured for fine-grain, wrought Waspaloy. Such an effect was attributed to the beneficial influence of the nucleation of recrystallization at both grain boundaries and carbide particles in the ingot material. In addition, a spatial non-uniformity in recrystallization was found in the ingot material and was interpreted in the context of the grain-boundary character and non-uniform strain at the grain/intragrain scale. A suite of tools being developed to model recrystallization phenomena during the breakdown of superalloy ingots is described. These tools include a mechanistic cellular automata; a mesoscale, mechanism-based model; and the crystal-plasticity finite-element method.

DTIC

*Deformation; Heat Resistant Alloys; Ingots; Nickel Alloys; Recrystallization; Thermodynamics; Thermomechanical Treatment*

**20070015247** Stanford Linear Accelerator Center, CA, USA, Stanford Univ., CA, USA

**Gauge Mediation in Supergravity and Gravitino Dark Matter**

Ibe, M.; Kitano, R.; Nov. 2006; 22 pp.; In English

Report No.(s): DE2006-895806; SLAC-PUB-12189; No Copyright; Avail.: National Technical Information Service (NTIS)

Gravitinos and hidden sector fields often cause a cosmological disaster in supersymmetric models. We find that a model with gravitational gauge mediation solves such a problem quite naturally. The  $(\mu)$ -problem is also absent in the model. Moreover, the abundance of gravitinos explains correct amount of dark matter of the universe. The dark matter abundance can be calculated without detailed information on the thermal history of the universe such as the reheating temperature after inflation.

NTIS

*Dark Matter; Gravitinos; Measuring Instruments; Supergravity*

**20070015718** Arizona State Univ., Tempe, AZ USA

**Using Local Orbitals in DFT to Examine Oligothiophene Conductance Anomalies**

Speyer, Gil; Akis, Richard; Ferry, David K; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464374; No Copyright; Avail.: CASI: [A01](#), Hardcopy

At the heart of a quantitatively accurate metal-molecule-metal conductance calculation, the potential profile must reflect the surface physics between the metal and vacuum. In this work, we employ a local orbital basis and calculate the conductance over a suite of Hamiltonians to examine trends within a molecular system using a rapid, self consistent scattering matrix method. As discussed above, this is justified as the tunneling barriers within the molecule largely determine the device's qualitative behavior. In this manner, the unexpectedly higher conductance experimentally measured on a four-membered oligothiophene, over its three-membered counterpart, is analyzed by calculating the conductance for a range of multi-atom displacements corresponding to a selected vibrational mode.

DTIC

*Anomalies; Molecular Orbitals; Oligomers; Orbitals*

## PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics*, *73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

**20070014918** Brookhaven National Lab., Upton, NY USA

### Lattice QCD at Finite Density

Schmidt, C.; Oct. 2006; 17 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-895868; BNL-77175-2006; No Copyright; Avail.: Department of Energy Information Bridge

I discuss different approaches to finite density lattice QCD. In particular, I focus on the structure of the phase diagram and discuss attempts to determine the location of the critical end-point. Recent results on the transition line as function of the chemical potential ( $T(\text{sub } c)((\mu)(\text{sub } q))$ ) are reviewed. Along the transition line, hadronic fluctuations have been calculated; which can be used to characterize properties of the Quark Gluon plasma and eventually can also help to identify the location of the critical end-point in the QCD phase diagram on the lattice and in heavy ion experiments. Furthermore, I comment on the structure of the phase diagram at large  $(\mu)(\text{sub } q)$ .

NTIS

*Quantum Chromodynamics; Particle Interactions*

**20070014943** Brookhaven National Lab., Upton, NY USA, Iowa State Univ., IA, USA

### QCD Factorization for Heavy Quarkonium Production at Collider Energies

Qiu, J. W.; January 2006; 9 pp.; In English

Contract(s)/Grant(s): DE-AC02-98CH10886

Report No.(s): DE2006-895870; BNL-77186-2006; No Copyright; Avail.: Department of Energy Information Bridge

In this talk, I briefly review several models of the heavy quarkonium production at collider energies, and discuss the status of QCD factorization for these production models.

NTIS

*Factorization; Quantum Chromodynamics; Quarks*

**20070015087** Jefferson (Thomas) National Accelerator Facility, Newport News, VA, USA, Hampton Univ., VA, USA

### Decays of Excited Baryons in the Large $N_c$ Expansion of QCD

Goity, J. L.; Scoccola, N. N.; May 06, 2006; 3 pp.; In English

Report No.(s): DE2006-896226; JLAB-THY-06-581; DOE/ER/40150-4154; No Copyright; Avail.: Department of Energy Information Bridge

The authors present the analysis of the decay widths of excited baryons in the framework of the  $1/N_c$  expansion of QCD. These studies are performed up to order  $1/N_c$  and include both positive and negative parity excited baryons.

NTIS

*Baryons; Quantum Chromodynamics; Particle Decay*

**20070015810** Hokkaido Univ., Sapporo, Japan

### Properties of a GaAs Single Electron Path Switching Node Device Using a Single Quantum Dot for Hexagonal BDD Quantum Circuits

Nakamura, Tatsuya; Abe, Yuji; Kasai, Seiya; Hasegawa, Hideki; Hashizume, Tamotsu; Jan 2006; 5 pp.; In English

Report No.(s): AD-A464522; No Copyright; Avail.: CASI: [A01](#), Hardcopy

A new single electron (SE) binary-decision diagram (BDD) node device having a single quantum dot connected to three nanowire branches through tunnel barriers was fabricated using etched AlGaAs/GaAs nanowires and nanometer-sized Schottky wrap gates (WPGs), and their operation was characterized experimentally, for the hexagonal BDD quantum circuit. Fabricated devices showed clear and steep single electron pass switching by applying only an input voltage signal, which was completely different from switching properties in the previous SE BDD node devices composed of two single electron switches. As the possible switching mechanism, the correlation between the probabilities of tunnelling through a single quantum dot in exit branches was discussed.

DTIC

*Circuits; Electron Trajectories; Gallium Arsenides; Quantum Dots; Quantum Theory; Schottky Diodes; Switching*

## ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**20070016051** Research and Technology Organization, Neuilly-sur-Seine, France

### **NATO RTO Space Science and Technology Advisory Group (SSTAG) Recommendations for Space Research Topics**

February 2007; 66 pp.; In English

Report No.(s): RTO-TM-SPD-002; AC/323(SPD-002)TP/02; Copyright; Avail.: CASI: **C01**, CD-ROM: **A04**, Hardcopy

As NATO and Nations are facing increased global responsibilities for security and defence with smaller forces, the ability to meet objectives will increasingly depend on use of integral, force-enhancing support from space. To respond to this future need, the RTB established a limited-life, RTO Space Science and Technology Advisory Group (SSTAG) to identify and recommend space research topics to the RTB and RTO panels. SSTAG Recommendations for space research topics were defined through a peer review process involving panel members and external colleagues from the extensive RTO Space Expert Consultant (SEC) network. As part of this, an RTA Space Strategy Workshop was held at RTA HQ in June, 2005 that resulted in 29 topics of common national interest. The topics were developed by members of the SEC network through Summer and Fall, 2005. The SSTAG also sought national support for the topics through Fall, 2005. The effort was supplemented by a SSTAG high level view of relevance to NATO Capability Needs. The SSTAG is seeking Panel consideration of the SSTAG Recommendations as new or extended panel technical activities. Each Panel is being requested to identify topics which have potential as technical activities within the Panel; to indicate if the Panel is willing to take a leadership role in any of the topics as a Panel or Inter-Panel technical activity; and to identify on-going activities within the 2006/7 Program of Work that may be addressing technical topics related to the Recommendations.

Author

*North Atlantic Treaty Organization (NATO); Research and Development; Project Planning; Priorities; Space Based Radar; Remote Sensing; Satellite Tracking*

## DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer program documentation see *61 Computer Programming and Software*.

**20070014932** NASA Goddard Space Flight Center, Greenbelt, MD, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **Controlled Vocabularies Boost International Participation and Normalization of Searches**

Olsen, Lola M.; [2006]; 2 pp.; In English; 7th International Conference on Hydrosociences and Engineering (ICHE): Metadata in Hydroscience Mini Symposium, 12 Sep. 2006, Philadelphia, PA, USA; No Copyright; Avail.: CASI: **A01**, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014932>

The Global Change Master Directory's (GCMD) science staff set out to document Earth science data and provide a mechanism for it's discovery in fulfillment of a commitment to NASA's Earth Science program and to the Committee on Earth Observation Satellites' (CEOS) International Directory Network (IDN.) At the time, whether to offer a controlled vocabulary search or a free-text search was resolved with a decision to support both. The feedback from the user community indicated that being asked to independently determine the appropriate 'English' words through a free-text search would be very difficult. The preference was to be 'prompted' for relevant keywords through the use of a hierarchy of well-designed science keywords. The controlled keywords serve to 'normalize' the search through knowledgeable input by metadata providers. Earth science keyword taxonomies were developed, rules for additions, deletions, and modifications were created. Secondary sets of controlled vocabularies for related descriptors such as projects, data centers, instruments, platforms, related data set link types, and locations, along with free-text searches assist users in further refining their search results. Through this robust 'search and refine' capability in the GCMD users are directed to the data and services they seek. The next step in guiding users more directly to the resources they desire is to build a 'reasoning' capability for search through the use of ontologies. Incorporating twelve sets of Earth science keyword taxonomies has boosted the GCMD S ability to help users define and more directly retrieve data of choice.

Derived from text

*Information Retrieval; Earth Sciences; Thesauri; Indexing (Information Science); Taxonomy*

**20070015103** Naval Postgraduate School, Monterey, CA USA

**Design and Implementation of a Prototype Ontology Aided Knowledge Discovery Assistant (OAKDA) Application**

Lee, Ann Y; Powers, Edward C; Dec 2006; 205 pp.; In English; Original contains color illustrations

Report No.(s): AD-A462632; No Copyright; Avail.: CASI: [A10](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA462632>

The World Wide Web (WWW) has become a major source of easily accessible information for students, professionals, researchers and the general public. However, the volume of information available through the Web is so overwhelming that it is not unusual to get tens of thousands of 'hits' when conducting a relatively simple search. Most existing search techniques use brute force based on keyword matches to find related Web pages. While the enormous speed of search engines improves the efficiency of such methods, effectiveness is not improved. The objective of this thesis is to construct and test an ontology-based application to help users identify the most pertinent keywords for a search. By navigating ontologies that describe domains of interest, users are assisted in finding a relevant set of key terms that will aid the search engines in narrowing, widening, or refocusing a Web search. Specifically, the thesis develops an ontology-aided Web search assistant prototype to help users enhance the relevance and precision of the returned results through the use of a context provided by ontologies associated with each search.

DTIC

*Data Mining; Information Retrieval; Internets; Prototypes*

**20070015105** Air Force Research Lab., Rome, NY USA

**Adoption of an Electronic Submission Process for Unclassified Technical Reports**

Rico, Helen M; Hall, Frederick G; Jan 2002; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A462772; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA462772>

In any given year, the Air Force Research Laboratory's Information Directorate publishes an average of 250 technical reports describing the results of scientific research performed for efforts aimed at furthering the Air Force's C4I capabilities. Today's military environment places a premium on the rapid dissemination of information. However, the process used to distribute technical reports has remained heavily manpower-intensive and paper-based, and has changed little over the past 50 years. In this paper, the authors describe a re-invention of the business process used for distribution of technical reports. This new process uses the latest information technology as an enabler to make the process more streamlined and cost-efficient. As a result of implementing this new process, the flow of scientific information is more rapid, Federal Government mandates to reduce the amount of paperwork generated are being met, and significant cost savings are being achieved.

DTIC

*Client Server Systems; Cost Reduction; Electronic Publishing; Military Technology; Research and Development*

**20070015106** Space and Naval Warfare Systems Center, San Diego, CA USA

**Improving Individual and Team Decisions Using Iconic Abstractions of Subjective Knowledge**

Fleming, Robert A; Cowen, Michael B; Jun 2004; 22 pp.; In English; Original contains color illustrations

Report No.(s): AD-A462773; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA462773>

Eighteen military officers made ratings about the suitable location of a mythical refugee camp. They were given 30 information items, 6 items for each of 5 decision criteria. Using a 5-point acceptability scale, they gave a rating for each of the criteria plus an overall acceptability rating. Half of the participants (Text group) saw each item and assigned it to a criterion, and then during the decision phase were shown the items they had assigned to each criterion and asked to make their ratings. The other half of the participants (IOB group) had the additional task of evaluating each item on a 4-point yes-no rating scale. During the decision phase they were not shown the original text items but rather an information object (IOB) representation of the item, (i.e., a small symbol that encapsulated their subjective rating of the item). Half of the participants should have made a Positive recommendation, half a Negative recommendation. The results showed that not a single participant in the Text group made a correct overall assessment, predominately selecting the 'neutral' option. Six of the nine IOB participants made the correct overall assessment. Both groups took significantly longer to process information and make ratings when the preponderance of the information was positive in content versus negative in content. Results are discussed in terms of the increased confidence the IOB participants had in the accuracy of their ratings and the increased time that was needed to assess positive information that endorses commitment to an action.

DTIC

*Decision Making; Symbols*

**20070015108** Naval War Coll., Newport, RI USA

**Hezbollah: Operational Art in Fourth Generation Warfare**

Carron, Ryan T; Oct 23, 2006; 25 pp.; In English

Report No.(s): AD-A463338; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463338>

Fourth generation warfare, or irregular warfare involving nonstate actors, is becoming the new threat upon which the study of operational art should be applied. By applying the design elements from Joint Publication 3-0 to both Hezbollah and Israel in the Second Lebanon War, a real world case study can be made to these tenets. This paper starts with an examination of Hezbollah and the events precipitating the capture of the two Israeli reservists to find the motivation for their actions. By looking at their potential strategic objectives and desired end-state, a regressive analysis will be applied to this nonstate actor to support an operational planning construct. A select number of operational design elements will then be applied to an analysis of Hezbollah's actions. This same methodology will also be focused on Israel's response to this nonstate threat. At this snapshot in time, a conclusion will be derived as to whether the conventional forces of Israel or the irregular militia of Hezbollah has better applied operational art through these design elements. Finally, lessons learned will be derived for future operations involving both traditional and fourth generation warfare threats.

DTIC

*Damage; Israel; Lebanon; Warfare*

**20070015131** Naval War Coll., Newport, RI USA

**It's the Message, Stupid: The Rise, Power and Implication of Information and Technology in 21st Century Warfare**

Hauk, Keith B; Oct 23, 2006; 22 pp.; In English

Report No.(s): AD-A463639; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463639>

Some theorists claim that technology has so altered the levels of war -- the strategic, the operational, and the tactical -- to the point that the differences between them are no longer significant. As numerous observers have pointed out, long-held principles on the formulation and conduct of war, almost all of which are grounded in the Industrial or pre-Industrial Age, chafe against new realities attendant to the Information Age and the current operational environment. During another era in the evolution of warfare, Clausewitz observed that 'very few of the new manifestations in war can be attributed to new inventions or departures in ideas...they result mainly from the transformation of society and new social conditions.' What is interesting about his 19th century formulation is that now, at the cusp of the Information Age, we arguably find ourselves at a point that Clausewitz could scarcely have imagined. That is a point at which both the impact of new technology (i.e., the Internet, modern communications, precision weaponry, and WMD) and societal transformation (i.e., globalization and the rise of nonstate transnational actors) are simultaneously driving changes in the conceptualization of warfare. Clausewitz did not have it wrong. What he could not have foreseen in the early 19th century was the unique historical intersection of epic technological change and societal transformation away from the nation-state as a defining construct, both as a means of political identity and as the principal protagonist on both sides of conflict. As part of that epic technological change, he further could not have foreseen the near-instantaneous movement of information across traditional national boundaries as well as the proliferation of that information such that it has a profound political effect. The impacts of technological innovation have reduced, but not eliminated or forced change to, the distinctions between the tactical, operational, or strategic levels of war.

DTIC

*Information Systems; Messages; Warfare*

**20070015163** Library of Congress, Washington, DC USA

**Sharing Law Enforcement and Intelligence Information: The Congressional Role**

Best Jr , Richard A; Feb 13, 2007; 19 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463801; CRS-RL33873; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463801>

Almost all assessments of the attacks of September 11, 2001, have concluded that U.S. intelligence and law enforcement agencies had failed to share information that might have provided advance warning of the plot. This realization led Congress to approve provisions in the USA PATRIOT Act (P.L. 107-56) and subsequent legislation that removed barriers to information sharing between intelligence and law enforcement agencies, and mandated exchanges of information relating to terrorist threats. Most experts agreed that statutory changes, albeit difficult to enact, were essential to change the approaches taken by executive branch agencies. The barriers that existed prior to September 2001 had a long history based on a determination to prevent government spying on U.S. persons. This had led to the establishment of high statutory barriers to the sharing of law

enforcement and intelligence information. The statutes laid the foundation of the so-called wall between intelligence and law enforcement that was buttressed by regulations, Justice Department policies, and guidance from the judicial branch.

DTIC

*Intelligence; Law (Jurisprudence)*

**20070015167** Mitre Corp., Bedford, MA USA

**Team Decision Making in Time-Sensitive Environments**

Boiney, Lindsley; Jun 2005; 24 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463813; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463813>

Many critical Command and Control decisions, such as Time-Sensitive Targeting, must be made collaboratively due to the amount of information to be processed and the level of complexity. This research addresses the challenges of technology-supported human collaboration. We have conducted a blend of field observation, expert interviews, and chat analysis at several joint, time-sensitive exercises and experiments. We find operator teams perform critical functions as part of the human-technology 'cognitive functional system.' For example, they: 1) validate information, and determine where to get more if needed; 2) engage in collaborative sensemaking - handling ambiguous or conflicting information; 3) establish trust and credibility with one another; 4) maintain sufficient team awareness to enable effective coordination, even when not co-located; 5) judge who should - and should not - receive information, balancing the need for sharing against the danger of cognitive overload; 6) select appropriate communication modalities for sharing information of varying importance, time-sensitivity, and intended audience; 7) cue other team members to important information, emerging events, or changing priorities. Our results reveal how challenging these functions can be for operators bombarded with information, how existing technology supports or hinders key activities, and how teams adapt their processes or technologies to meet real time demands.

DTIC

*Data Processing; Decision Making; Sensitivity; Situational Awareness; Targets*

**20070015170** Texas Univ., Arlington, TX USA

**The Generalized Weapon Target Assignment Problem**

Rosenberger, Jay M; Hwang, Hee S; Pallerla, Ratna P; Yucel, Adnan; Wilson, Ron L; Brungardt, Ed G; Jun 2005; 34 pp.; In English

Report No.(s): AD-A463819; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463819>

Dynamic command and control and battle management functions require fast and effective decision aids to provide optimal allocation of resources (object/sensor pairing, weapon/target assignment) for effective engagement and real-time battle damage assessment. The basic Weapon Target Assignment (WTA) problem considers the assignment of a set of platforms/weapons to a set of targets such that the overall expected effect is maximized. In the present study, we extend the basic WTA problem by allowing for multiple target assignments per platform, subject to the number of weapons available and their effectiveness. We formulate the problem as a linear integer programming problem and investigate two solution methods. The first method is a greedy approach based on the sequential application of the auction algorithm that was generalized for assigning  $n$  assets/resources to  $m$  targets. The second method is built on a branch-and-bound framework that enumerates feasible tours of assets/resources a process that can become computationally intensive with increasing number of sources and targets but will find an optimal solution. We provide results of Monte Carlo experiments and provide comparative evaluation of the two solution methods. Finally, we extend the brand-and bound technique to assigning multiple platforms per target and thereby demonstrate its utility for collaborative asset planning. While this study focuses on weapon target pairing for illustration purposes, the methods and results herein are readily applicable to sensor tasking and similar resource allocation problems.

DTIC

*Algorithms; Command and Control; Integers; Linear Programming; Nonlinear Programming; Optimization; Real Time Operation; Targets*

**20070015186** Johns Hopkins Univ., Laurel, MD USA

**Managing Dynamic Collaborative Action Teams in a Net-Centric Environment**

Salamacha, Christine O; Briscoe, N R; Forsythe, Steven L; Jun 2005; 21 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463853; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463853>



The U.S. Department of Defense (DoD) wants to improve Command and Control (C2) by leveraging advances in computation, networking, and information technologies. Agility is increasingly becoming recognized as the most critical characteristic of a transformed force, with network-centricity being understood as the key to achieving agility easily. (Alberts and Hays 2003, 126) The DoD Net-Centric Data Strategy outlines a vision for managing data in a net-centric environment that includes the concepts of Communities of Interest (COIs) and collaborative groups. While collaborative groups and teams are not new concepts, new technologies will transform collaborative C2 and how warfighters interact in the same way that the internal combustion engine combined with the concept of the horseless carriage to transform how we traveled. The technological capabilities envisioned for the Global Information Grid (GIG) will literally enable anyone to engage anyone else in a decision-making process irrespective of distance, time, organization and organizational structure. This paper applies the term Dynamic Collaborative Action Team (DCAT) to a dynamic and to some degree ad-hoc grouping of organizations or personnel for a specific mission or operational task irrespective of command echelon. The GIG environment will enable a DCAT to utilize new data and include members outside routine organizational and command structures. To do so effectively, the DCAT will require a management framework that accommodates its dynamic membership and processes. This paper describes a ubiquitous framework for the effective management of DCATs. Operational examples are provided to illustrate how DCATs would be employed to conduct net-centric C2 and how the DCAT concept may close the seams between the national, strategic and operational echelons of command and shape future C2 Policy for a net-centric environment.

DTIC

*Command and Control; Data Management; Decision Making*

**20070015195** Bolt, Beranek, and Newman, Inc., Cambridge, MA USA

**Flexible Data Entry for Information Warning and Response Systems**

Mulvehill, Alice M; Reilly, James; Krisler, Brian; Jun 2005; 10 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463878; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463878>

The need to collect data that can provide warnings to avert crisis situations is paramount to many modern military and civil response systems. These systems allow the end user to report a variety of anomalies about the world. The U.S. Air Force's Integrated Information Management System (IIMS) has been developed to support the collection and interpretation of data that may be indicative of potential chemical or biological attacks. Data-entry forms are generally provided to end-users for description of incidents of interest. Since all possible data types cannot be realized in the design process, it would be useful to provide forms that can adapt to the data being collected. Tracker is a tool that allows a user to define and use one or more XML-based templates (forms) to support problems such as crisis-action mission planning. Tracker provides users with a suite of tools that allow them to easily add or modify fields in a given template or instance. Since this feature is the type of capability that the IIMS developers wanted for their system, an experiment was conducted linking Tracker to IIMS. In this paper we present the results of this experiment.

DTIC

*Data Systems; Decision Support Systems; Information Systems; Multisensor Fusion; Templates; Warning Systems*

**20070015199** QinetiQ Ltd., Malvern, UK

**Extending the NEC Concept**

Alston, Anthony; Jun 2005; 12 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463886; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463886>

The concepts for NEC, which are very closely aligned with the NCW tenets and framework, have been generated over the past two years and are now being used to investigate future military capability. In the main these investigations have been concerned with command and control. However, of late some inquiries have originated from sources whose systems are totally automated and are at the one of the ends of a sensor to shooter chain. The current NEC Themes, the encapsulation of the NEC concept, and the published NEC Benefits Chain, have been unable to fully support these inquiries. Whilst the lower levels of the NEC Themes directly supported the inquiry, those of better networking and better information sharing, the higher order themes, particularly Shared Understanding had little applicability to the inquirers. This was due to the very human/cognitive nature of these themes. A new Theme, concerned with the equivalent of sharing understanding between automated machines, is added to the existing NEC Themes and the NEC Benefits Chain is totally re-written to include the concepts of Individual Machine understanding and sharing it between many machines.

DTIC

*Networks; Systems Engineering*

**20070015202** Ministry of Defence (Army), London, UK

**Developing Coherent, Concise and Comprehensive User Requirements Using the MoD Architectural Framework (MODAF)**

Bailey, Chris W; Garbutt, Richard M; Jun 2005; 38 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463889; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463889>

Articulating user requirements is arguably one of the most difficult and yet critical challenges in any Information System Project. Within the British Army, the Directorate of Command and Battlespace Management (Army) has been developing its user requirement methodology and practice over the last few years and now uses the Ministry of Defence Architectural Framework (MODAF) as a corner stone of its approach. This paper explains the methodology that has been developed to overcome some of the difficulties associated with user requirement engineering for Command and Battlespace Management IS. The specific difficulties are: 1) How to bridge the gap between users who may not know what they want and industry who may not understand the intricacies of the military business to be supported. 2) How to articulate URs in a manner concise and digestible enough for users to review effectively, yet comprehensive enough for industry to fully understand the requirement and the military business effected by the system. 3) How to ensure a User Requirement Document (URD) is consistent and coherent with URDs for other IS within the System of Systems. The approach taken revolves around use of the MODAF framework, instantiated using the Mood Transformation Tool Set.

DTIC

*Information Systems; User Requirements*

**20070015220** Naval War Coll., Newport, RI USA

**Leadership and the Principles of War**

Parvin, Scott A; Critz, M; May 16, 2005; 24 pp.; In English

Report No.(s): AD-A463919; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463919>

Leadership has always been the foundation of military discipline, decision-making, and victory. This paper ties together leadership and the principles of war through mental models and their applications to revolutions in military affairs, specifically network centric warfare. In doing so this paper explores, via academic thought and real-world examples, some the pitfalls of wrongful applications of mental models as they apply to the principles of war. In light of the dynamic changes network centric warfare proposes to bring to the battlefield, this paper also offers a balanced and sensible approach to operational and strategic leaders alike in the examination and restructuring of our enduring bedrock of military doctrine. Two principles of war, mass and unity of command, are scrutinized under the above criteria, and the concept of will is introduced as an integral part of leadership and argued to be included in future principles of war.

DTIC

*Decision Making; Leadership; Warfare*

**20070015234** Naval Health Research Center, San Diego, CA USA

**MSAT Lead Investigator Support**

Garland, Frank; Sep 2006; 20 pp.; In English

Contract(s)/Grant(s): MIPR; 5MSNCM5123

Report No.(s): AD-A463938; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463938>

Medical Situational Awareness in the Theater (MSAT) will evaluate existing technologies that can provide enhanced operational medical situational awareness to Combatant Commanders. Presently, Combatant Commanders lack timely, complete, actionable health information for operational decision-making, thereby putting troops at unnecessary risk to illness or injury and jeopardizing force strength and morale. Current stovepipe information systems do not provide timely trend analysis, access to clinical care, or immediate warning alerts that identify risks. Rather, these disparate systems require intensive human manipulation, which causes systems to be poorly used. The approach will be to develop and enact proper integration and configuration to fuse current and emerging technologies and apply artificial intelligence and computerized decision support systems to transform collected, scattered data into timely, actionable information and knowledge. The timely analysis of the disparate data in existing service medical, environmental and personnel databases and the reporting of results will allow protective measures to be implemented and factored into the medical and operational status of deployed Joint Forces. The ACTD will evaluate and exploit applicable commercial products, technologies including: fusion applications;

artificial intelligence capabilities; web-enabling technologies; sensor and point-of-use data capture technologies; and technologies for the capture and analysis of physiological changes.

DTIC

*Data Bases; Decision Support Systems; Military Personnel; MSAT; Multisensor Fusion*

**20070015242** Research Inst. for Communication, Information Processing and Ergonomics, Wachtberg-Werthhoven, Germany

**Integration of the MIP Command and Control Information Exchange Data Model into National Systems**

Schmitt, Michael; Jun 2005; 47 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463953; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463953>

Interoperability of command and control information systems gains an ever-increasing importance. The aim of the Multilateral Interoperability Programme (MIP) is to achieve international interoperability in order to support land component commanders in joint and combined operations. For that purpose, MIP defines the Command and Control Information Exchange Data Model (C2IEDM) and the Data Exchange Mechanism (DEM). However, when implementing the MIP Solution, it is not sufficient to simply add new interfaces to existing systems. Instead, far-reaching modifications to the core of national C2ISs have to be made to ensure true semantic interoperability. In this paper, we address several interoperability and implementation issues of the MIP C2IEDM. We point out that a shared tactical picture only becomes reality if the commanders are fully aware of the extent of interoperability that is given by their national C2ISs. Moreover, the subtle problems of coupling a geographic information system (GIS) with the MIP solution are discussed. On the data base level, we show that the co-existence of a proprietary national data model and the C2IEDM results in systems that are extremely hard to maintain. To hide away the complexity of the C2IEDM from C2 applications, we propose a data access stack that provides a canonical, business objects view on the data model.

DTIC

*Command and Control; Data Management; Interoperability*

**20070015243** Naval War Coll., Newport, RI USA

**Embedded Media - A Force Multiplier or Force Divider**

Sipes, John A; May 16, 2006; 25 pp.; In English

Report No.(s): AD-A463961; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463961>

The American public has a right to know how its nation's treasures are expended. The reinvigoration of the embedded media program during Operation IRAQI FREEDOM (OIF) was implemented to accomplish just this mission. Embedded media participated in unprecedented numbers during OIF. Some 692 embedded media had the unique experience to live, work, sleep, and even die among the U.S. forces operating in Iraq. Some had preconceived agendas about how they were going to exploit the terrible horrors they were about to encounter in an effort to degrade the military leadership, dissuade the civilian leadership, or perhaps dismantle the public will as was arguably successful during Vietnam. The majority, however, volunteered to recount the actual events as they happened and bring them home to living rooms across the globe. Their intention was to display the facts in real time as they happened and allow the public to decide upon the veracity. The presence of media on the battlefield, however, poses unique challenges to both the tactical commander as well as the operational commander. The intent of this paper is to compare and contrast the embedded media's impact on the tactical and operational commander.

DTIC

*Dividers; Embedding; Military Technology; News Media*

**20070015245** Naval War Coll., Newport, RI USA

**Information Operation's Planners: Training and Education without a Plan**

Hill, Jeremy R; Feb 10, 2005; 23 pp.; In English

Report No.(s): AD-A463967; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463967>

Combatant Commanders need a mix of Information Operations (IO) planners and capability specialists under their command to maintain the ability to dominate the full range of military operations. The difference between the two 'types' of IO professionals should be based on their experience level. IO Planners must know extremely in-depth knowledge of the

adversary, their psyche, network of connections, strengths, weaknesses, and ways of influencing each. Arguably, they are not alone in the planning cell and are supported by personnel from every office code within the command with additional possible support from inter-agency, coalition, and non-governmental organization representatives. The planners are expected to be able to articulate their intent, direction, restrictions, measures of effectiveness, and timeliness for the planning and employment of IO capabilities and related activities within their area of responsibility. To provide that understanding of the adversary, granularity and innovation in their plan, and ability to integrate their plan into the overall theater strategy or operation, their education and training levels need to meet a joint IO standard which has not been set by the Combatant Commanders. Professional Military Education must serve as a change agent for the military grappling with the information age. The educated force the U.S. military develops and invests in today will significantly increase its chances of maintaining the information edge in the future.

DTIC

*Education; Military Operations; Military Personnel; Qualifications; Warfare*

**20070015256** Norwegian Defence Research Establishment, Kjeller, Norway

**Ad hoc Organization of Distributed Picture Compilation and Support for Situation Awareness in Network Based Defence - An Exploratory Experiment**

Hafnor, Hilde; Normark, Runar; Jun 2005; 41 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463982; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463982>

Network Based Defense (NBD), adapted from the US concept of Network Centric Warfare (NCW), is currently one of the primary strategic directions for the Norwegian Armed Forces. NBD have accented the importance of having good situation awareness, not only on the individual level, but on the team level as well. The foundation of shared situation awareness is increased access to and sharing of information in the information infrastructure. Our assertion is that the concept of ad hoc organization of information flow is an important capability in this context. This paper reports the results from an exploratory experiment conducted during the NATO exercise Battle Griffin in February/March 2005. The experiment was a part of the Norwegian Armed Forces Concept Development & Experimentation (CDE) program. The experiment presented here explored ad hoc organization of information flow applied to the distributed compilation of a common operational picture (COP). An additional aim was to test new ways of collaboration (peer-to-peer horizontal collaboration) between military units on the tactical command and control (C2)-level. The main discussion in this paper focuses on how new technology and new ways of collaboration affects the situation awareness of decision makers, both at individual and team level.

DTIC

*Images; Situational Awareness*

**20070015278** Naval Research Lab., Washington, DC USA

**Horizontal Integration based upon Decentralized Data Fusion (DDF), NetCentric Architecture (NCA) , and Analysis Collaboration Tools (ACT)**

Gardner, Sheldon B; Jun 2005; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464026; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464026>

The major focus in the joint-services area today is on Horizontal Integration (HI) rapidly fusing and exploiting the data from different collection systems to speed the flow of correlated intelligence to war fighters, both for situational awareness and targeting. In this paper we discuss several technologies potentially useful in HI. They are Decentralized Data Fusion (DDF), NetCentric Architecture (NCA), and Analysis Collaboration Tools (ACT). DDF, NCA, and ACT could provide pathfinders and enablers for future implementation of HI across current 'stovepipe' collection and analysis systems. HI will ultimately require effective command and control of air, ground, naval, and space-based intelligence collection and dissemination systems. This control will be achieved through net-centric information management that includes dynamic links between a 'global' database and multiple locally maintained databases that contain data obtained from component stovepipe systems. The links between communication nodes will allow global information to be updated automatically with information from distributed assets. The motivation for providing connectivity and automated information sharing among distributed platforms/nodes is to increase the amount of information available at each node. The technology enablers for HI include, but are not limited to, the following: ' Net-Centric Architecture (NCA)- A network architecture that gives component platforms access to multi-level security information and communications over a two-way encrypted TCP/IP connection allowing net-centric control and utilization ' Decentralized Data Fusion (DDF)-The DDF framework includes a proposed solution to the data fusion problem called Covariance Intersection (CI), as well as a solution to the information corruption problem called Covariance Union (CU). '

Analysis Collaboration Tool (ACT)-NRL has developed an analysis collaboration tool (ACT) to be used for virtual collaboration in intelligence support.

DTIC

*Data Acquisition; Multisensor Fusion; Warfare*

**20070015296** Space and Naval Warfare Systems Center, San Diego, CA USA

**SSC San Diego Command History Calendar Year 2006**

Mar 2007; 71 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464049; SSC/SD-TD-3213; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464049>

The Space and Naval Warfare Systems Center San Diego (SSC San Diego) is a full-spectrum research, development, test and evaluation, engineering and fleet support center serving the U.S. Navy, Marine Corps, and other Department of Defense and national sponsors within its mission, leadership assignments, and prescribed functions. SSC San Diego reports directly to the Commander, Space and Naval Warfare Systems Command (SPAWAR). SSC San Diego's formal mission is 'to be the Navy's full-spectrum research, development, test and evaluation, engineering and fleet support center for command, control and communication systems and ocean surveillance and the integration of those systems which overarch multiplatforms'

DTIC

*Command and Control; Military Operations; Organizations*

**20070015303** Federal Aviation Administration, Washington, DC USA

**Index of International Publications in Aerospace Medicine**

Antunano, Melchor J; Wade, Katherine; Jan 2007; 65 pp.; In English

Report No.(s): AD-A464057; DOT/FAA/AM-07/2; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464057>

The 3rd edition of the Index of International Publications in Aerospace Medicine is a comprehensive listing of international publications in clinical aerospace medicine, operational aerospace medicine, aerospace physiology, environmental medicine/physiology, diving medicine/physiology, aerospace human factors, as well as other topics directly or indirectly related to aerospace medicine. The Index is divided into six major sections: I) Open Publications in General Aerospace Medicine, II) Government Publications in General Aerospace Medicine, III) Publications in Other Topics Related to Aerospace Medicine and Aerospace Human Factors IV) Proceedings From Scientific Meetings in Aerospace Medicine and Psychology, V) Journals, Newsletters, and Bulletins in Aerospace Medicine and Aerospace Human Factors, and VI) On-line Databases Containing Bibliographic, Regulatory, and Safety Information in Aerospace Medicine and Related Disciplines.

DTIC

*Accident Investigation; Aerospace Medicine; Bibliographies; Diving (Underwater); Human Factors Engineering*

**20070015337** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Automatic Generation of Social Network Data from Electronic-Mail Communications**

Yee, Jason; Mills, Robert F; Peterson, Gilbert L; Bartczak, Summer E; Jun 2005; 43 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464107; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464107>

Most organizations have formal and informal elements. Formal structures are usually documented in organizational charts showing chain of command, levels of authority, and personnel resources. The actual effectiveness of the organization or specific individuals may actually depend on informal structures and internal communication networks. These are by definition personality-dependent and may provide significant insight into how work actually gets done within the organization. Effective leaders will want insight into these informal structures for various reasons. Inefficient decision-making or staffing processes may result in unnecessary or redundant communications, chokepoints, or single points of failure, each of which can either delay decisions or degrade the quality of those decisions. Further, sudden changes in the informal structures may indicate underlying stresses within the organization, interpersonal conflicts, or behavioral problems that may significantly disrupt the mission effectiveness or morale of the organization. Documenting these informal structures and networks can be achieved through a variety of means, often through personal interviews or direct observation, both of which are difficult and time consuming. In this paper, we describe a method of automatically generating social network data using electronic mail

messaging logs. Performance is demonstrated using three months of real data from a medium sized organization.  
DTIC

*Data Mining; Data Processing; Data Transmission; Electronic Mail*

**20070015342** Naval Research Lab., Washington, DC USA

**Moving Map Composer -- Personal Computer (MMCPC) Version 1.0 Training Manual Developed for the Finnish Air Force**

Trenchard, Michael E; Myrick, Stephanie A; Layne, Geary; Lohrenz, Maura C; Mar 2, 2007; 23 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464114; NRL/FR/7440--07-10125; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464114>

This document is the training manual for the Naval Research Laboratory (NRL) Moving Map Composer - Personal Computer (MMCPC) System, Version 1.0, developed for the Finnish Air Force (FiAF). Training was conducted in August 2005, immediately following the Acceptance Test Procedures (ATP) in Halli, Finland at Patria Aviation.

DTIC

*Acceptability; Computer Programs; Education; Manuals; Microcomputers; Personal Computers*

**20070015344** Naval Postgraduate School, Monterey, CA USA

**Deep Versus Broad Methods for Automatic Extraction of Intelligence Information From Text**

Rowe, Neil C; Wintrode, Jonathan; Sparks, Jason; Vorrath, Jonathan; Lear, Matthew; Jun 2005; 42 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464116; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464116>

Extraction of intelligence from text data is increasingly becoming automated as software and network technology increases in speed and scope. However, enormous amounts of text data are often available and one must carefully design a data mining strategy to obtain the relevant nuggets of gold from the mountains of useless dross. Two strategies can be tried. A deep approach is to use a few strong clues to find reasonable sentence candidates, then apply linguistic restrictions to find and extract key information (if any) surrounding the candidates. A broad approach is to focus on large numbers of weaker clues such as specific words whose implications can be combined to rate sentences and present those of high likelihood of relevance. In the work reported here, we tested the deep approach on military intelligence reports about enemy positions, which were relatively short text extracts, and we tested the broad approach on news stories from the World Wide Web involving terrorism, which presented a large volume of text information.

DTIC

*Extraction; Information Retrieval; Intelligence; Natural Language (Computers); Texts*

**20070015352** ITT Industries, Inc., Utica, NY USA

**Grid Technology and Information Management for Command and Control**

Spetka, Scott E; Ramseyer, George O; Linderman, Richard W; Jun 2005; 34 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464154; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464154>

Over the next few years, the Command and Control (C2) community will face increased demands for processing data as increasing numbers of data sources are deployed. It is expected that skilled analysts will continue to play an important role in gleaning useful information from imagery and other sources that are by and large produced as digital multimedia. Using current information systems would require significant increases in the numbers of analysts needed to manage the increased workload that is expected. Because the number of analysts can be expected to remain fairly constant over the next few years, scalable and extensible C2 processing technology will be required to achieve productivity gains needed to keep up with increasing demands. Two complementary information systems, a Distributed Processing (DP) system and an Information Management (IM) system, form the basis for a new architecture that can meet this requirement. A combined system (DPIM) that addresses the performance and the scalability required for future C2 systems is introduced in this paper.

DTIC

*Command and Control; Information Management; Information Systems*

**20070015353** Space and Naval Warfare Systems Command, San Diego, CA USA

**Dynamic Targeting in the Information Age**

Gizzi, Jr , Nicholas; Quinn, Paul W; Jun 2005; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464159; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464159>

This paper presents a list of operational deficiencies facing military planners in the era of dynamic targeting and provides a discussion of potential solutions identifying technical issues needing to be resolved in order to meet operational needs within the information age. The paper outlines and discusses a notional solution enabling real-time re-tasking and reallocation of airborne assets through utilization of information integration within an enterprise solution. The enterprise framework is designed to support a collaborative Distributed Command & Control construct that utilizes: efficient spectrum management; policy-driven approaches; generation of rule-based solutions within the context of a users request and constraints; adaptive protocol management; and knowledge-based processing to provide war fighters a real-time re-targeting capability. Technical issues such as: communications and network architectures; seamless, secure, reliable data-linking and networking; limited throughput capacity; efficient management of links & networks; and quality of service (QoS) responses in constraint- driven environments are highlighted and discussed. Experimental data is presented that demonstrates how operationally a secure real-time retargeting capability can be achieved through the enterprise framework, web enabled technologies, collaborative software applications, spectrum management techniques, quality of service (QoS) enforcement algorithms, and prioritization & optimization of network scheduling and data linked information that re-assigns aircraft to prosecute time sensitive high-value targets of opportunity.

DTIC

*Command and Control; Knowledge Based Systems*

**20070015364** George Mason Univ., Fairfax, VA USA

**On Finding Effective Courses of Action in a Complex Situation Using Evolutionary Algorithms**

Haider, Sajjad; Levis, Alexander H; Jun 2005; 22 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-03-1-0033; F30602-01-C-0065

Report No.(s): AD-A464180; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464180>

This paper proposes an Evolutionary Algorithm (EA) based approach for finding effective courses of action (COAs) in a complex uncertain situation. The complex situation is modeled using a probabilistic modeling and reasoning framework, referred to as Timed Influence Nets (TINs). The TIN-based framework helps a system modeler in connecting a set of actionable events and a set of desired effects through chains of cause and effect relationships. Once a TIN is built, the optimization task confronted by the modeler is to identify a course of action that would increase the likelihood of achieving the desired effects over a pre-specified time interval. The paper uses Evolutionary Algorithms to accomplish this task. The proposed approach generates multiple COAs that are close enough in terms of achieving the desired effect. The purpose of generating multiple COAs is to give several alternatives to a decision maker. Moreover, the alternate COAs could be generalized based on the relationships that exist among the actions and their execution timings. While determining an effective course of action in a given situation, a system modeler has to consider several temporal/causal constraints that are present in a problem domain. The paper also proposes a constraint specification language that would help a system modeler in specifying these constraints.

DTIC

*Algorithms; Computer Aided Design; Models*

**20070015373** Northwestern Univ., Evanston, IL USA

**STRAW - An Integrated Mobility and Traffic Model for VANETs**

Choffnes, David R; Bustamante, Fabian E; Jun 2005; 45 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464198; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464198>

Ad-hoc wireless communication among highly dynamic, mobile nodes in a urban network is a critical capability for a wide range of important applications including automated vehicles, real-time traffic monitoring, and battleground communication. When evaluating application performance through simulation, a realistic mobility model for vehicular ad-hoc networks (VANETs) is critical for accurate results. This technical report discusses the implementation of STRAW, a new mobility model for VANETs in which nodes move according to a realistic vehicular traffic model on roads defined by real street map data. The challenge is to create a traffic model that accounts for individual vehicle motion without incurring

significant overhead relative to the cost of performing the wireless network simulation. We identify essential and optional techniques for modeling vehicular motion that can be integrated into any wireless network simulator. We then detail choices we made in implementing STRAW.

DTIC

*Collisions; Communication Networks; Mobility; Models; Motion; Simulators; Systems Integration; Traffic; Wireless Communication*

**20070015378** Military Academy, West Point, NY USA

**Reliability of Information-Fueled Services in Network-Centric Operations**

Tortorella, M; Driscoll, P J; Jun 2005; 38 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464213; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464213>

The Network-Centric Operations Conceptual Framework (NCO-CF) contains many factors pertaining to the use of information in NCO. Information plays such a central role, however, that the importance of high-quality information must not be overlooked. Information that is of poor quality (even in an informal sense) is at best distracting and at worst catastrophic to NCO. In addition, a key quality attribute for information is that consumers of the information must be able to access it reliably. The highest quality information is useless if it cannot be seen so that it can be acted upon. This paper discusses aspects of service reliability for NCO information distribution services that commanders and warfighters use to obtain information. A framework for thinking about these problems and several examples from recent case studies are discussed.

DTIC

*Information Systems; Reliability; Warfare*

**20070015381** Binary Consulting, Inc., Bethesda, MD USA

**Flowing Focused and Relevant Information to the Edge through Semantic Channels**

Damashek, Robert; Anderson, Derek; Jun 2005; 25 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464216; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464216>

The Department of Defense (DoD) Global Information Grid (GIG) Enterprise Service and Net-Centric Data Strategies envision a shared market of information services across the Enterprise. The authors believe that this vision lacks an essential means for adding situational context to the services and data. Without this context, shared information in the GIG will inevitably become, like that of today's World Wide Web, increasingly difficult to research, analyze and make accessible to commanders and decision makers. The GIG information explosion will also become increasingly expensive to support in terms of bandwidth and computing capacity. The authors propose extending GIG capabilities with Semantic Channels that provide the needed context for discovery and analysis. The authors are exploring how COTS software and a standardized categorization framework can be combined with GIG service and metadata registries to yield a near-term GIG Semantic Channel solution. Initial results show significant reduction in information dissemination complexity for GIG consumers without limiting the ability to explore related information. Future steps include exploring how GIG Semantic Channels can simplify information dissemination, the insertion of caching, bandwidth compression, and synchronization technologies to efficiently and effectively extend the GIG information space to tactical edge commanders and operators.

DTIC

*Computer Programs; Information Transfer; Internets*

**20070015404** Pacific Science and Engineering Group, Inc., San Diego, CA USA

**Intelligent Aided Communication (iaC) in a Command and Control Environment**

Moore, Ronald A; Jun 2005; 41 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W31P4Q-04-C-R287

Report No.(s): AD-A464256; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464256>

During the past several decades many important incremental improvements have been made in command and control (C2) and decision making theories, practices, and supporting technologies; however, true innovation has often been lacking. Major problems remain that hinder revolutionary improvements to military C2 concepts and practices. Two particularly troublesome problems are information overload and a focus on individuals/small teams versus larger groups within an information environment. To address these and related problems, Pacific Science & Engineering Group (PSE) is developing a new



human-centered concept referred to as intelligent aided Communication (iaC)[copyrighted]. The iaC concept facilitates more efficient and effective communication and collaboration among users and systems by selectively employing context-aware user profiles (e.g., profiles based on C2 roles and responsibilities, information requirements, user preferences, etc.) and software agents to manage many of the mundane tasks associated with information exchange and alerting that warfighters perform manually today. Similarly, other iaC agents use this same context awareness and user profiles approach to tailor information organization and presentation for the individual warfighter. This paper and presentation will describe the iaC concept in more detail and outline how iaC can form the foundation for more sophisticated, larger-scale efforts to develop intelligent command centers and technologies.

DTIC

*Command and Control; Data Processing; Decision Theory*

**20070015411** Defence Research and Development Canada, Valcartier, Quebec Canada

**Capturing and Modeling Domain Knowledge Using Natural Language Processing Techniques**

Auger, Alain; Jun 2005; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464268; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464268>

Command and control (C2) and the decision making domain are seriously threatened, facing information overload and uncertainty issues. To make sense out of the flood of information, military have to create new ways of processing sensor and intelligence information, and of providing the results to commanders. Initiated in 2004 at Defense Research and Development Canada (DRDC), the SACOT knowledge engineering research project is currently investigating, developing and validating innovative natural language processing (NLP) approaches as scientific means to capture knowledge objects contained in domain-specific electronic texts and turn them rapidly into broad domain ontologies to be used in third-party applications. Ontologies are key elements required to enable next generation of decision support and knowledge exploitation systems with new semantic capabilities. Major impediments to classic development of ontologies are that it is a time and budget consuming operation. It is also largely dependant on Subject Matter Experts (SME) own limitations. Exhaustive elicitation of knowledge objects of a domain requires the application of NLP extraction techniques over textual data. This paper illustrates how recent advances in NLP techniques are implemented in the SACOT framework to automate elicitation of knowledge objects from unstructured texts and to support efficiently SMEs in ontology engineering tasks.

DTIC

*Command and Control; Information Management; Models; Natural Language (Computers); Natural Language Processing*

**20070015412** Defence Research and Development Canada, Valcartier, Quebec Canada

**Capturing and Modeling Domain Knowledge Using Natural Language Processing Techniques**

Auger, Alain; Jun 2005; 25 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464269; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464269>

PROBLEM SPACE: (1) Command and control (C2) and decision-making domains are seriously threatened, facing information overload and uncertainty issues; (2) Military have to create new ways of processing sensor and intelligence information; (3) Without new means to elicit knowledge from multiple information and intelligence sources, decision-makers will have to deal with very limited knowledge and increasing levels of uncertainty in operations; (4) How can we better capture and represent knowledge objects contained in sources? \* METADATA \* TAXONOMIES \* ONTOLOGIES

DTIC

*Command and Control; Metadata; Natural Language Processing; Taxonomy*

**20070015425** Naval Research Lab., Washington, DC USA

**Achieving Database Security Through Data Replication: The Sintra Prototype**

Kang, Myong H; Froscher, Judith N; McDermott, John; Costich, Oliver; Peyton, Rodney; Jan 1994; 12 pp.; In English

Report No.(s): AD-A464289; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464289>

There are several proposed approaches for multilevel secure (MLS) database systems which protect classified information. The SINTRA database system, which is currently being prototyped at the Naval Research Laboratory, is a multilevel trusted database system based on a replicated data approach. This approach uses physical separation of classified data as a protection measure. Each database contains data at a given security level and replicas of all data at lower security

levels. Project goals include good performance and full database capability. For practical reasons (e.g., ease of evaluation, portability) the SINTRA database system uses as many readily-available commercial components as possible. In this paper, security constraints and the rationale for the SINTRA prototype are described. We also present the structure and function of each component of the SINTRA prototype: the global scheduler, the query preprocessor, and the user interface. A brief description of the SINTRA recovery mechanism is also presented.

DTIC

*Data Bases; Prototypes; Security*

**20070015698** Geological Survey, Reston, VA USA

**Guidelines for Coding and Entering Ground-Water Data into the Ground-Water Site Inventory Data Base, Version 4.6, U.S. Geological Survey, Washington Water Science Center**

Lane, R C; Jan 2006; 117 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463996; USGS-OPEN-FILE-2006-1371; No Copyright; Avail.: CASI: [A06](#), Hardcopy

This report establishes and documents the procedures used by the U.S. Geological Survey, Washington Water Science Center, to code and enter ground-water data into the Ground-Water Site Inventory database of the U.S. Geological Survey's Ground Water Site Inventory System. These guidelines are consistent with Version 4.6 of the system, but will be updated as each new version becomes available. This report establishes and documents a formal and consistent set of procedures, practices, and standards for coding and entering ground-water data into the U.S. Geological Survey (USGS) Washington Water Science Center (WAWSC) Ground-Water Site Inventory (GWSI) database. Some definitions, standards, and practices in this document vary from those in the National Water Information System (NWIS) User's Manual (U.S. Geological Survey, 2005a). However, this report takes precedence over the NWIS User's Manual and is to be used by the WAWSC.

DTIC

*Coding; Data Bases; Geological Surveys; Ground Water; Inventories; Water*

**20070015724** Naval Research Lab., Washington, DC USA

**A Study of Inference Problems in Distributed Databases**

Chang, LiWu; Moskowitz, Ira S; Jan 2002; 15 pp.; In English

Report No.(s): AD-A464386; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Often, database managers must decide which non-sensitive data to release. This is referred to as data sanitization or data downgrading. Issues surrounding downgrading are of particular importance to network architectures which utilize a multiple single level approach for keeping sensitive data away from the generic user. In a distributed environment, data may be distributed among different data sites. Therefore, before data is downgraded, database managers must take into account other data that users may have access to.

DTIC

*Data Bases; Inference*

**20070015726** Naval Postgraduate School, Monterey, CA USA

**Model-based Communication Networks and VIRT: Filtering Information by Value to Improve Collaborative Decision-Making**

Hayes-Roth, Rick; Apr 2005; 36 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464388; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Command-control and other distributed, collaborative systems should achieve the best possible results with resources available. We should measure these systems in terms of the quality of decisions made. Better decisions lead to better outcomes, because superior choices are made about what to do, with what assets, where and when. Just as we measure manufacturing processes in terms of value added at each stage, we want each processing step in distributed collaborative operations to maximize the ratio of added value to cost. Both computerized agents and human personnel receive information from others, process it, and then produce additional information for others downstream in the operational processes. This paper shows that current architectures do not promote high productivity. Specifically, most current approaches encourage an increase in information supply and exchange per se, producing glut rather than value. This paper explains how we can significantly increase the productivity of each operator and the success of overall missions. The approach, called VIRT, treats collaborators as participants with shared models. These models determine which information is high value and for whom. The architecture

gives priority to conveying high value information. Similarly, low value bits are filtered out, saving resources and optimizing value attained.

DTIC

*Communication Networks; Decision Making; Information Management*

**20070015770** Mitre Corp., Bedford, MA USA

**Net-Centric Information Management**

Renner, Scott; Jun 2005; 47 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464442; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Information sharing is a key tenet of network-centric warfare (NCW). Information sharing succeeds when the right information is provided to the right people at the right time and place so that they can make the right decisions. This will not occur without an information management policy and process that is fitted to the needs of NCW -- one that is flexible, seamless, and complete. In this paper we describe the essential architecture of a net-centric information management process, one that is based on the information and data management strategy of the US Air Force. NCW is about deriving combat power from distributed interacting entities with significantly improved access to information [1]. This improvement is derived in part from better communication networks, things built with cables, radio links, and TCP/IP, things that deliver data bits from one networking participant to another. A more important factor in this improvement is the participants ability to find the data they need and to understand that data when they receive it. In the terms of the DoD Net-Centric Data Strategy [2], data must be visible, accessible, understandable, trusted, interoperable, and made available in response to user needs. These things will not occur without an information management policy and process that is fitted to the needs of NCW, which imposes additional demands on the activities of information management. In this paper we describe the essential architecture of a netcentric information management process from the viewpoint of governance: what activities must be performed, and the roles/responsibilities of the people and organizations that perform them.

DTIC

*Combat; Information Management; Information Systems; Warfare*

**20070015773** Naval War Coll., Newport, RI USA

**Coalition Interoperability: Not Another Technological Solution**

Trepka, John C; Feb 14, 2005; 27 pp.; In English

Report No.(s): AD-A464448; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Coalition interoperability has been an issue for some time. One can look back through history from WWI to present and determine that coalitions are the norm and not the exception. There are numerous articles on how technical solutions are available to increase interoperability. However, coalition interoperability continues to be a problem. If the operational commander understands the scope of interoperability, the limiting factors of interoperability and the current operational trends to achieve interoperability one can conclude that technology, by itself, will not solve interoperability. However, technology as a key contributor to the achievement of interoperability; the operational commander must balance between technology and information to gain an acceptable level of interoperability. Several options are available that do not specifically address technology. The operational commander can begin to forecast how future operations will take place. Specifically, how the GWOT and Network Centric Warfare might change the nature of multinational operations and establish a coalition component as part of the JTF structure. The operational commander can transition to a coalition information network to change the paradigm in the U.S. military from a U.S. only information organization to truly a coalition-oriented force. Finally, the operational commander can continue to focus on combined training designed to increase the information aspects of interoperability as operational objectives. These recommendations recognize that technology will contribute to interoperability but will not provide the commander the final solution.

DTIC

*Interoperability; Military Operations; Warfare*

**20070015776** Naval War Coll., Newport, RI USA

**Command and Control in a Network Centric Warfare World: Preserving the Operational Echelon of Command**

Parker, Elton C; Feb 14, 2005; 32 pp.; In English

Report No.(s): AD-A464453; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Joint Vision 2020 (JV 2020) is designed around the premise that modern and emerging technologies, particularly information-related advances, should make possible a new level of battlespace awareness in the joint operations arena.

Underpinning a variety of technological advances is information superiority the ability to detect, collect, process and disseminate an uninterrupted flow of information, while exploiting or denying an adversary's ability to do the same. The goal of JV 2020 seeks to achieve Full Spectrum Dominance a joint force persuasive in peace, decisive in war, preeminent in any form of conflict. If we are to truly achieve this goal of full spectrum dominance by establishing and maintaining information superiority, then the organizational echelons in the command and control structure must be maximized to use this superiority, not minimized to hamper it. Network Centric Warfare (NCW) is one of the key tenets to meet these demands of increased information flow. Proponents of the ongoing Revolution in Military Affairs (RMA), spawned from and running parallel to the Revolution in Business Affairs (RBA), have recognized in NCW the need to restructure certain organizational paradigms for maximum effectiveness in the anticipation of achieving JV 2020 goals. According to these groups, much of the organizational evolution in the military should center around the use of a networked command and control system which, when implemented, will reduce and consolidate staff structure, allow for decentralized execution, and increase the commander's control over a more encompassing sector of the 2020 battlespace. How and more importantly, at which levels do we best utilize this potentially world-altering tool to maximize its effectiveness?

DTIC

*Command and Control; Warfare*

**20070015777** Science Applications International Corp., Arlington, VA USA

**Command and Control Information Management Strategy (CIMS) provided by an Information Integration Framework**

Odenwood, Juan A; Mar 17, 2005; 36 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464455; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Access and availability to information is the key to for future command and control with improved access to information as an objective of the DoD's net-centric initiatives. However, net-centric initiatives are being implemented, piecemeal and slowly, through the DoD Data Strategy currently focused at the community of interest level (COI). In order to improve the speed of transformation, take advantage of net-centric concepts, and to manage information for decision-makers, an information management strategy and a information integration framework to implement that strategy is required. This paper proposes a C2 Information Integration Framework (C2IIF) that provides management of data strategies, value of information, and Communities of Interest (COIs) at the information level and within the context of portfolio oversight. It permits capabilities alignment to meet transformation objectives assures sound management of the Department's IT investment decisions. Through this framework, DoD can improve information sharing with a repeatable, analytical process. Additionally, since legacy applications are included as part of the framework, the strategy provides the means to migrate and evaluate legacy applications and data within the net-centric environment.

DTIC

*Command and Control; Information Management; Information Systems; Management Planning; Warfare*

**20070015819** Naval War Coll., Newport, RI USA

**The Zero Effect: The Impact of Network-Centric Warfare on Operational Planning**

Andrews, II, Nicholas E; Feb 14, 2005; 22 pp.; In English

Report No.(s): AD-A464535; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The strength of a networked force is its ability to collect, understand, disseminate, and act on information faster than the opponent; allowing plans to be adjusted in real time and creating an agile force with which the slower enemy would have a hard time competing. Implicit in this is one critical assumption: the opposing forces will act in some way and friendly assets will observe this act. Quicker reaction to the enemy, enabled by the networking of combat units and shared awareness, represents a decisive advantage&once the enemy is engaged. While this is obviously a goal worth pursuing, it is more applicable at the tactical level of war than at the operational level. The ultimate goal of network-centric warfare should be the ability to modify an already established operational plan in near real-time, not to construct one. Parallel planning and execution is inherently reactive and is of great use at the tactical level but should not be used as the framework to plan at the operational level.

DTIC

*Command and Control; Information Systems; Military Operations; Operational Problems; Planning; Warfare*

**20070015833** Naval War Coll., Newport, RI USA

**Operational Net Assessment: A Framework for Social Network Analysis and Requirements for Critical Debate**

Hannan, Michael J; Feb 14, 2005; 28 pp.; In English

Report No.(s): AD-A464562; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Operational Net Assessment (ONA) is critical to the new Standing Joint Force Headquarters (SJFHQ) concept. SJFHQs were designed by the U.S. Joint Forces Command (USJFCOM) to provide Regional Combatant Commanders in-depth analysis for a specific adversary or situation within their area of responsibility. This paper does not seek to debunk the ONA process, nor antagonize the SJFHQ concept. The author desires to provide insight into perceived weaknesses in existing doctrine and promote issues for further discussion within the Joint Intelligence Community. The collaborative ONA process as designed by JFCOM is subjective. The lack of a formal vetting process to review information applied for analysis is dangerous. Current network modeling tools, the cornerstone of ONA's analytical construct, have limitations that must be recognized as tenuous assumptions. Product output must be sufficiently analyzed in concert with operational planners and scaled to mission requirements to support the Commander's Intent. The author has drawn from current literature on the ONA template and reviewed the construct to create a 'truth in lending' approach. The goal is not simply to identify the present limitations of ONA, but provide recommendations and areas for improvement. For ONA to be relevant, its level of confidence must be clearly understood by the warfighter.

DTIC

*Decision Support Systems; Intelligence; Military Operations; Network Analysis; Networks*

**20070015852** Naval Research Lab., Washington, DC USA

**Privacy-Preserving Collaborative Data Mining**

Zhan, Zhijun; Chang, LiWu; Jan 2003; 9 pp.; In English

Report No.(s): AD-A464602; XB-NRL/MR/5540; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Privacy-preserving data mining is an important issue in the areas of data mining and security. In this paper, we study how to conduct association rule mining, one of the core data mining techniques, on private data in the following scenario: Multiple parties, each having a private data set, want to jointly conduct association rule mining without disclosing their private data to other parties. Because of the interactive nature among parties, developing a secure framework to achieve such a computation is both challenging and desirable. In this paper, we present a secure framework for multiple parties to conduct privacy-preserving association rule mining.

DTIC

*Data Mining; Information Retrieval; Privacy*

**20070016004** Barcroft Research Inst., Falls Church, VA USA

**The Challenges Associated with Achieving Interoperability in Support of Net-Centric Operations**

Starr, Stuart H; Jun 2005; 57 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463978; No Copyright; Avail.: CASI: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463978>

Recently, John Stenbit, former ASD(NII), articulated his views on the keys to achieving effective Net-Centric Operations (NCO). He called for the creation of a ubiquitous, secure, robust, trusted, protected and routinely used wide bandwidth net that is populated with the information and information services that our forces need. Furthermore, he observed that we must move from a set of monopoly suppliers of information to an information marketplace; from a push-oriented dissemination process to a pull-oriented one; and from an interoperability approach based upon applications standards to one based upon data standards (where an unanticipated user can find, access, and use data, anywhere, anytime). This vision requires us to critically reassess the nature of the interoperability problem. To illuminate the issue, this paper addresses three inter-related dimensions of the interoperability problem. First, it characterizes the nature of the interoperability issue. Second, it identifies key longer-term trends and derives interoperability implications. These trends include potential changes in the areas of geopolitics, national security, strategic vision, institutional initiatives, systems, technology, and testbeds. Finally, it identifies and discusses residual interoperability challenges that the community must address in five areas: institutional, program management, architectures and standards, operational, and systems. Emphasis is placed on interoperability among C4I systems in the context of joint, interagency, multinational (JIM+) net-centric operations, where the plus refers to additional participants such as international organizations (e.g., the United Nations), non-governmental organizations (NGOs) (e.g., Doctors Without Borders), and contractors.

DTIC

*Interoperability; Information Systems; Security; Bandwidth*

**20070016008** Defence Science Technology Lab., Farnborough, UK

**Towards Quantifying the Benefits of NEC**

Court, Georgia; Parr, Alison; Jun 2005; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463984; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463984>

The UK places Network Enabled Capability (NEC) as one of its highest priorities for future investment in research, acquisition and people. A recent Defense White Paper states that the continued transformation of UK forces is dependent on exploiting the benefits of NEC. Analysis and experimentation has a key role in helping UK MOD to identify: 1) where will NEC deliver most benefit to defense; 2) what can be traded off to pay for it; 3) what changes are required to processes, equipment, training etc, to deliver the desired transformation. Analytical support is being provided in three main ways: 1) Knowledge-mining previous work on quantifying the value of information. NEC as a coherent concept is new, but many of its elements have been under analysis for the last few years. 2) Influencing ongoing studies and experiments to include NEC options in their analysis; 3) Providing decision support to the MOD acquisition communities from a benefits-led perspective. This activity is helping the MOD to identify the high level benefits that could be achieved in delivering NEC. This paper provides examples of the types of benefits that are being identified and quantified and the methods that have been used in deriving them.

DTIC

*Budgeting; Information; Education*

**20070016010** Library of Congress, Washington, DC USA

**Countries of the World and International Organizations: Sources of Information**

Torreon, Barbara S; Jan 8, 2007; 24 pp.; In English; Original contains color illustrations

Report No.(s): AD-A463784; CRS-96-816; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463784>

This report provides a selection of materials for locating information on foreign countries and international organizations. In the general information section, it presents sources giving an overview of politics, economics, and recent history. A specialized information section cites sources on human rights, immigration, international organizations, military strengths, terrorism, and other topics. Included are titles of some of the most frequently consulted bibliographic sources that are available for use in many libraries. Electronic information on foreign countries is also provided, via the Internet, by agencies of the federal government, international organizations, and related sources. Included is a list of foreign chanceries located in Washington, DC. This report will be updated periodically through the year as new materials become available.

DTIC

*Information Systems; Information Retrieval*

**20070016054** Maryland Univ., College Park, MD USA

**TREC-2006 at Maryland: Blog, Enterprise, Legal and QA Tracks**

Oard, Douglas; Elsayed, Tamer; Wang, Jianqiang; Wu, Yejun; Zhang, Pengyi; Abels, Eileen; Lin, Jimmy; Soergel, Dagbert; Jan 2006; 17 pp.; In English

Report No.(s): AD-A463747; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: <http://hdl.handle.net/100.2/ADA463747>

In TREC 2006, teams from the University of Maryland participated in the Blog track, the Expert Search task of the Enterprise track, the Complex Interactive Question Answering task of the Question Answering track, and the Legal track. This paper reports our results.

DTIC

*Information Retrieval; Data Retrieval; Metadata*

**20070016574** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Letting The NASA Press Engine Work For You**

Weaver, Kimberly; [2006]; 1 pp.; In English; HEAD Conference, 4-7 Oct. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

You have an amazing result based on NASA data or a NASA Mission; you have written your seminal paper and submitted it to your favorite journal. You believe it has press potential and maybe you've even gotten help from your PR folks in writing a press release. Now you would really like NASA to issue this as a press release. But how do you do that? This presentation

will illustrate the steps required to engage NASA in helping promote your story. What are NASA's requirements for newsworthiness? Should your news be released as a web feature story or in the local media? Does your news rise to the level of a full-blown press conference or will it be a media teleconference? How do you obtain approval for a NASA press event? Once your result is scheduled to be issued as a press release, how can you improve your chances of getting the best possible coverage for your story? I will discuss the NASA press process and suggest how to consider factors like timing, working with your collaborating institutions in an efficient way, and not letting the cat out of the bag until the press event.

Author

*News; Teleconferencing; Conferences; NASA Programs*

## 88

### SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

**20070014864** NASA, Washington, DC, USA

#### **Managing Space Technology Development at NASA**

Moore, Christopher L.; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

NASA uses a structured process for managing projects that develop advanced space technologies and transition them into the designs of flight systems. The four-part process consists of formulation, approval, implementation, and transition. In the formulation phase, technology needs are derived from mission concept studies, various technical approaches for meeting the technology needs are identified, technical performance goals called Key Performance Parameters (KPPs) are established, and a project plan is developed. Prior to project approval, an Independent Formulation Review is conducted to ensure that the project objectives are aligned with the mission needs, and that the project is well planned to meet the objectives. In the implementation phase, the technology development project matures the technology, and progress towards the KPPs is evaluated in periodic status reviews. Technology Readiness Levels (TRLs) are used throughout the project lifecycle to assess the progress of technology maturation. In the transition phase, technologies that are successful in achieving the required level of maturity are transitioned to a customer for further development, are used in system designs, or are thoroughly documented for resumption of development at a later date. The customer or end-user of the technology is involved in all phases of the technology development process.

Author

*Technology Assessment; Aerospace Engineering; Project Planning; NASA Programs*

**20070014868** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **The Role of Ring Current on Slot Region Penetration**

Fok, Mei-Ching; Elkington, Scot; [2006]; 1 pp.; In English; 2006 Spring AGU meeting: Coupled Dynamics of the Inner Magnetosphere, 23-26 May 2006, Baltimore, MD, USA; No Copyright; Avail.: Other Sources; Abstract Only

During magnetic quiet times, the inner belt, slot region and the outer belt are well defined regions. However, during some major storms, outer belt particles penetrate inward and significantly fill the slot region. In some extreme events, the outer belt particles travel through the slot and create a new belt in the inner region that persists from months to years. In this paper, we examine the role of the ring current on this radiation belt penetration into the slot region. The storm-time intensification of the ring current produces strong magnetic depression in the inner magnetosphere. This perturbation and its fluctuation enhance the radial transport and diffusion of the outer radiation belt particles. We perform kinetic and test-particle calculations to quantitatively assess the effects of the ring current field on filling of the slot region. Simulation results during major storms will be presented and discussed.

Author

*Inner Radiation Belt; Ring Currents; Penetration; Outer Radiation Belt; Magnetospheres*

**20070015999** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Community Coordinated Modeling Center Support of Science Needs for Integrated Data Environment**

Kuznetsova, M. M.; Hesse, M.; Rastatter, L.; Maddox, M.; [2007]; 1 pp.; In English; 2006 Cedar Workshop, 19-23 Jun. 2006, Santa Fe, NM, USA; No Copyright; Avail.: Other Sources; Abstract Only

Space science models are essential component of integrated data environment. Space science models are indispensable tools to facilitate effective use of wide variety of distributed scientific sources and to place multi-point local measurements

into global context. The Community Coordinated Modeling Center (CCMC) hosts a set of state-of-the-art space science models ranging from the solar atmosphere to the Earth's upper atmosphere. The majority of models residing at CCMC are comprehensive computationally intensive physics-based models. To allow the models to be driven by data relevant to particular events, the CCMC developed an online data file generation tool that automatically downloads data from data providers and transforms them to required format. CCMC provides a tailored web-based visualization interface for the model output, as well as the capability to download simulations output in portable standard format with comprehensive metadata and user-friendly model output analysis library of routines that can be called from any C supporting language. CCMC is developing data interpolation tools that enable to present model output in the same format as observations. CCMC invite community comments and suggestions to better address science needs for the integrated data environment.

Author

*Aerospace Sciences; Models; Data Integration; Earth Atmosphere*

**20070016022** NASA Langley Research Center, Hampton, VA, USA

**Mars Science Laboratory: Entry, Descent, and Landing System Performance**

Way, David W.; Powell, Richard W.; Chen, Allen; SanMartin, A. Miguel; Burkhart, P. Daniel; Mendeck, Gavin F.; January 09, 2007; 39 pp.; In English; 2007 IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 857464.02.07.07

Report No.(s): Paper-1467; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016022>

In 2010, the Mars Science Laboratory (MSL) mission will pioneer the next generation of robotic Entry, Descent, and Landing (EDL) systems, by delivering the largest and most capable rover to date to the surface of Mars. To do so, MSL will fly a guided lifting entry at a lift-to-drag ratio in excess of that ever flown at Mars, deploy the largest parachute ever at Mars, and perform a novel Sky Crane maneuver. Through improved altitude capability, increased latitude coverage, and more accurate payload delivery, MSL is allowing the science community to consider the exploration of previously inaccessible regions of the planet. The MSL EDL system is a new EDL architecture based on Viking heritage technologies and designed to meet the challenges of landing increasing massive payloads on Mars. In accordance with level-1 requirements, the MSL EDL system is being designed to land an 850 kg rover to altitudes as high as 1 km above the Mars Orbiter Laser Altimeter defined areoid within 10 km of the desired landing site. Accordingly, MSL will enter the largest entry mass, fly the largest 70 degree sphere-cone aeroshell, generate the largest hypersonic lift-to-drag ratio, and deploy the largest Disk-Gap-Band supersonic parachute of any previous mission to Mars. Major EDL events include a hypersonic guided entry, supersonic parachute deploy and inflation, subsonic heatshield jettison, terminal descent sensor acquisition, powered descent initiation, sky crane terminal descent, rover touchdown detection, and descent stage flyaway. Key performance metrics, derived from level-1 requirements and tracked by the EDL design team to indicate performance capability and timeline margins, include altitude and range at parachute deploy, time on radar, and propellant use. The MSL EDL system, which will continue to develop over the next three years, will enable a notable extension in the advancement of Mars surface science by delivering more science capability than ever before to the surface of Mars. This paper describes the current MSL EDL system performance as predicted by end-to-end EDL simulations, highlights the sensitivity of this baseline performance to several key environmental assumptions, and discusses some of the challenges faced in delivering such an unprecedented rover payload to the surface of Mars.

Author

*Descent; Landing Aids; Viking Mars Program; Mars Global Surveyor; Payloads; Mars Missions; Mars Surface*

**20070016550** NASA Johnson Space Center, Houston, TX, USA

**Comparison of Meteoroid Flux Models for Near Earth Space**

Drolshagen, G.; Liou, J.-C.; Dikarev, V.; Landgraf, M.; Krag, H.; Kuiper, W.; [2007]; 1 pp.; In English; Meteoroids 2007, 11-15 Jun. 2007, Barcelona, Spain; Copyright; Avail.: Other Sources; Abstract Only

Over the last decade several new models for the sporadic interplanetary meteoroid flux have been developed. These include the Meteoroid Engineering Model (MEM), the Divine-Staubach model and the Interplanetary Meteoroid Engineering Model (IMEM). They typically cover mass ranges from 10-12 g (or lower) to 1 g and are applicable for model specific sun distance ranges between 0.2 A.U. and 10 A.U. Near 1 A.U. averaged fluxes (over direction and velocities) for all these models are tuned to the well established interplanetary model by Gr<sup>n</sup> et. al. However, in many respects these models differ considerably. Examples are the velocity and directional distributions and the assumed meteoroid sources. In this paper flux predictions by the various models to Earth orbiting spacecraft are compared. Main differences are presented and analysed. The



persisting differences even for near Earth space can be seen as surprising in view of the numerous ground based (optical, radar) and in-situ (captured IDPs, in-situ detectors and analysis of retrieved hardware) measurements and simulations. Remaining uncertainties and potential additional studies to overcome the existing model discrepancies are discussed.

Author

*Meteoroid Concentration; Sporadic Meteoroids; Earth Orbits; Simulation*

## 89

### ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

**20070015070** Stanford Linear Accelerator Center, CA, USA

#### **Galactic Variable Sky with EGRET and GLAST**

Digel, S. W.; Nov. 01, 2006; 9 pp.; In English

Report No.(s): DE2006-896170; SLAC-PUB-12218; No Copyright; Avail.: Department of Energy Information Bridge

The characteristics of the largely-unidentified Galactic sources of gamma rays that were detected by EGRET are reviewed. Proposed source populations that may have the correct spatial, spectral, luminosity, and variability properties to be the origins of the EGRET sources are also presented. Finally, the prospects for studying Galactic gamma-ray sources with the GLAST LAT are reviewed.

NTIS

*Galaxies; Gamma Ray Observatory; Gamma Ray Telescopes; Gamma Rays*

**20070015072** Stanford Linear Accelerator Center, CA, USA, National Central Univ., Chung-Li, Taiwan, Province of China, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA, Arizona State Univ., Tempe, AZ USA

#### **Search for Small Trans-Neptunian Object by the TAOS Project**

Chen, W. P.; Alcock, C.; Axelrod, T.; Bianco, F. B.; Byun, Y. I.; Dec. 01, 2006; 4 pp.; In English

Report No.(s): DE2006-896172; SLAC-PUB-12216; No Copyright; Avail.: National Technical Information Service (NTIS)

The Taiwan-America Occultation Survey (TAOS) aims to determine the number of small icy bodies in the outer reach of the Solar System by means of stellar occultation. An array of 4 robotic small (D=0.5 m), wide-field (f/1.9) telescopes have been installed at Lulin Observatory in Taiwan to simultaneously monitor some thousand of stars for such rare occultation events. Because a typical occultation event by a TNO a few km across will last for only a fraction of a second, fast photometry is necessary. A special CCD readout scheme has been devised to allow for stellar photometry taken a few times per second. Effective analysis pipelines have been developed to process stellar light curves and to correlate any possible flux changes among all telescopes. A few billion photometric measurements have been collected since the routine survey began in early 2005. Our preliminary result of a very low detection rate suggests a deficit of small TNOs down to a few km size, consistent with the extrapolation of some recent studies of larger (30-100 km) TNOs.

NTIS

*Surveys; Taiwan; Trans-Neptunian Objects*

**20070015099** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Detection of a Hot Binary Companion of eta Carinae**

Sonneborn, G.; Iping, R. C.; Gull, T. R.; Massa, D.; Hillier, D. J.; [2006]; 1 pp.; In English; IAU Symposium No. 240, 'Binary Stars as Critical Tools and Tests in Contemporary Astrophysics', 14-25 Aug. 2006, Prague, Czech Republic; Copyright;

Avail.: Other Sources; Abstract Only

A hot companion of eta Carinae has been detected using high resolution spectra (905 - 1 180 Angstroms) obtained with the Far Ultraviolet Spectroscopic Explorer (FUSE) satellite. Observations were obtained at two epochs of the 2024-day orbit: 2003 June during ingress to the 2003.5 X-ray eclipse and 2004 April several months after egress. These data show that essentially all the far-UV flux from eta Car shortward of Lyman alpha disappeared at least two days before the start of the X-ray eclipse (2003 June 29), implying that the hot companion, eta Car B was also eclipsed by the dense wind or extended atmosphere of eta Car A. Analysis of the far-UV spectrum shows that eta Car B is a luminous hot star. N II 1084-1086 emission disappears at the same time as the far-UV continuum, indicating that this feature originates from eta Car B itself or in close proximity to it. The strong N II emission also raises the possibility that the companion star is nitrogen rich. The observed FUV

flux levels and spectral features, combined with the timing of their disappearance, are consistent with eta Carinae being a massive binary system.

Author

*Hot Stars; Detection; Binary Stars; Astronomy*

**20070015262** Naval Observatory, Flagstaff, AZ USA

**Trigonometric Parallaxes of Central Stars of Planetary Nebulae**

Harris, Hugh C; Dahn, Conrad C; Canzian, Blaise; Guetter, Harry H; Leggett, S K; Levine, Stephen E; Luginbuhl, Christian B; Monet, Alice K; Monet, David G; Pier, Jeffrey R; Feb 2007; 9 pp.; In English

Report No.(s): AD-A463999; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA463999>

Trigonometric parallaxes of 16 nearby planetary nebulae are presented, including reduced errors for seven objects with previous initial results and results for six new objects. The median error in the parallax is 0.42 mas, and 12 nebulae have parallax errors of less than 20%. The parallax for PHL 932 is found here to be smaller than was measured by Hipparcos, and this peculiar object is discussed. Comparisons are made with other distance estimates. The distances determined from these parallaxes tend to be intermediate between some short distance estimates and other long estimates; they are somewhat smaller than those estimated from spectra of the central stars. Proper motions and tangential velocities are presented. No astrometric perturbations from unresolved close companions are detected.

DTIC

*Measurement; Nebulae; Parallax; Planetary Nebulae; Trigonometric Functions*

**20070015263** Los Alamos National Lab., NM USA

**A Catalog of Spectroscopically Selected Close Binary Systems from the Sloan Digital Sky Survey Data Release Four**

Silvestri, Nicole M; Eisenstein, Daniel J; McGehee, Peregrine; Smith, J A; Harris, Hugh C; Kleinman, Scot J; Krzesinski, Jurek; Neilsen, Jr, Eric H; Schneider, Donald P; Jan 2006; 14 pp.; In English

Report No.(s): AD-A464001; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464001>

We present a spectroscopic sample of 747 detached close binary systems from the Sloan Digital Sky Survey (SDSS) Fourth Data Release. The majority of these binaries consist of a white dwarf primary and a low-mass secondary (typically M dwarf) companion. We have determined the temperature and gravity for 496 of the white dwarf primaries and the spectral type and magnetic activity properties for 661 of the low-mass secondaries. We have estimated the distances for each of the white dwarf main-sequence star binaries and used white dwarf evolutionary grids to establish the age of each binary system from the white dwarf cooling times. With respect to a spectroscopically identified sample of ~8000 isolated M dwarf stars in the SDSS, the M dwarf secondaries show enhanced activity with a higher active fraction at a given spectral type. The white dwarf temperatures and gravities are similar to the distribution of ~1900 DA white dwarfs from the SDSS. The ages of the binaries in this study range from ~0.5 Myr to nearly 3 Gyr (average age ~0.20 Gyr).

DTIC

*Binary Stars; Catalogs (Publications); Digital Data; Sky; Sky Surveys (Astronomy); Spectroscopy; Surveys*

**20070015365** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Narrow-band Imagery with the Goddard Fabry-Perot: Probing the Epoch of Active Accretion for PMS Stars**

Woodgate, Bruce E.; Grady, C.; Endres, M.; Williger, G.; March 25, 2006; 1 pp.; In English; American Astronomical Society 208th Meeting, 4-8 Jun. 2006, Calgary, Alberta, Canada; Copyright; Avail.: Other Sources; Abstract Only

The STIS coronagraphic imaging sample of I<sup>+</sup>M S stars was surveyed with the Goddard Fabry-Perot (GFP) interferometer to determine what fraction of the stars drive jets, whether there is any difference in behavior for a group of intermediate-mass stars as compared with T Tauri stars, and to search for evolutionary effects. Compared to broad band imaging, the GFP achieves an emission-line nebulosity-to-star contrast gain of between 500 and 3000. To date, we have detected jets associated with classical T Tauri stars spanning a factor of 280 in mass accretion rate in approximately 50% of the STIS coronagraphic imaging sample. We also detected jets or Herbig-HARO knots associated with 5 Herbig Ae stars, all younger than 8 Myr, for a detection fraction which is smaller than the T Tauri survey.

Derived from text

*Fabry-Perot Interferometers; T Tauri Stars; Herbig-Haro Objects; Stellar Mass*

**20070015442** Naval Research Lab., Washington, DC USA

**Near-Infrared K-Band Imaging of a Sample of Ultra-Steep-Spectrum Radio Sources Selected at 74 MHz**

Jarvis, Matt J; Cruz, Maria J; Cohen, Aaron S; Roettgering, Huub J; Kassim, Namir E; Jan 2004; 12 pp.; In English

Contract(s)/Grant(s): NAG-W-2116

Report No.(s): AD-A464314; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464314>

In this paper we present near-infrared K-band imaging of a sample of ultra-steep-spectrum (USS) radio sources selected at 74 MHz. The dual selection criteria of low frequency and USS mean that we should be sensitive to the highest-redshift ( $z \approx 5$ ) radio galaxies. We have obtained K-band magnitudes for all of the objects in our sample of 26 and discuss the properties of each. There is a pronounced bias in this sample towards fainter magnitudes and thus higher redshifts when compared to complete unfiltered samples such as the 7CRS of Willott et al., implying that the steep-spectrum technique is still viable at 74 MHz. However, there are more bright ( $K \approx 17$ ) sources in the 74-MHz sample than in a similar sample selected at 151 MHz, namely 6C\*. This is principally due to the additional selection criterion of a small angular size for the radio sources in 6C\*; four of the six sources in the 74-MHz USS sample with  $K \approx 17$  have angular sizes  $\leq 15$  arcsec (the angular size cut-off of 6C\*). We find that the distribution of K-band magnitudes from a sample selected at 74 MHz is statistically indistinguishable from the 6C\* sample, when similar angular size filtering is applied to the 74-MHz sample.

DTIC

*Extremely High Frequencies; Imaging Techniques; Near Infrared Radiation; Spectra*

**20070015444** Naval Research Lab., Washington, DC USA

**Does the Crab Have a Shell**

Frail, D A; Kassim, N E; Cornwell, T J; Goss, W M; Dec 1, 1995; 6 pp.; In English

Report No.(s): AD-A464317; No Copyright; Avail.: CASI: [A02](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464317>

We present deep images of a region around the Crab Nebula made with the VLA, utilizing new imaging and deconvolution algorithms in a search for a faint radio shell. The existence of a high-velocity, hydrogen-rich envelope has been predicted to account for the low total mass and kinetic energy of the observed nebula. No radio emission was detected from an extended source outside the Crab Nebula. Our limits on surface brightness are sufficiently low to rule out the existence of a shell around the Crab whose brightness is at least 2 orders of magnitude below that of SN 1006, the faintest historical shell-type supernova remnant. We consider models for the progenitor star and the presupernova environment and conclude that if a fast, outer shock exists, then it has a sharply reduced efficiency at accelerating relativistic particles from the kinetic energy of the blast wave. We also looked for a steepening of the spectral index along the boundary of the Crab Nebula itself, the signature of an outer shock. However, contrary to previous claims, no such steepening was found. The absence of any evidence at radio wavelengths that either the Crab Nebula or a hypothetical shell is interacting with the ambient medium leads to an interpretation that the supernova of A.D. 1054 was a peculiar low-energy event.

DTIC

*Crabs; Electromagnetic Radiation; Radio Frequencies; Radio Waves; Supernovae*

**20070015730** Minnesota Univ., Minneapolis, MN USA

**1051 Ergs: The Evolution of Shell Supernova Remnants**

Jones, T W; Rudnick, Lawrence; Jun, Byung-Il; Borkowski, Kazimierz J; Dubner, Gloria; Frail, Dale A; Kang, Hyesung; Kassim, Namir E; McCray, Richard; Nov 15, 1997; 28 pp.; In English

Report No.(s): AD-A464393; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Although the title points only to classical, shell SNR structures, the workshop also considered dynamical issues involving X-ray filled composite remnants and pulsar-driven shells, such as that in the Crab Nebula. Approximately 75 observers, theorists, and numerical simulators with wide-ranging interests attended the workshop. An even larger community helped through extensive on-line debates prior to the meeting to focus issues and galvanize discussion. In order to deflect thinking away from traditional patterns, the workshop was organized around chronological sessions for 'very young,' 'young,' 'mature,' and 'old' remnants, with the implicit recognition that these labels are often difficult to apply. Special sessions were devoted to related issues in plerions and thermal X-ray composites. Controversy and debate were encouraged. Each session also addressed some underlying, general physical themes: How are supernova remnant (SNR) dynamics and structures modified by the character of the circumstellar medium (CSM) and the interstellar medium (ISM), and vice versa? How are magnetic fields generated in SNRs and how do magnetic fields influence SNRs? Where and how are cosmic rays (electrons and ions) produced in SNRs, and how does their presence influence or reveal SNR dynamics? How does SNR blast energy partition into

various components over time, and what controls conversion between components? In lieu of a proceedings volume, we present here a synopsis of the workshop in the form of brief summaries of the workshop sessions. The sharpest impressions from the workshop were the crucial and under appreciated roles that environments have on SNR appearance and dynamics and the critical need for broad-based studies to understand these beautiful but enigmatic objects.

DTIC

*Interstellar Matter; Stellar Evolution; Supernova Remnants; Supernovae*

**20070015734** Naval Research Lab., Washington, DC USA

**OSSE observations of positron annihilation in the galactic plane**

Kinzer, R L; Purcell, W R; Johnson, W N; Kurfess, J D; Jung, G; Skibo, J; Jan 1996; 5 pp.; In English

Report No.(s): AD-A464397; No Copyright; Avail.: CASI: [A01](#), Hardcopy

OSSE has measured the galactic longitude distribution of both the 511 keV annihilation line radiation and the three-photon positronium continuum within ~40 degrees of the center. They have similar shapes, with a composite longitude distribution well represented by an ~11 degrees FWHM Gaussian central bulge together with a possible broad disk component comprising as much as 15% of the integral flux between 40 degrees and 320 degrees longitude. Contributions from one or more discrete source(s) at or near the center with total annihilation radiation (line plus continuum) intensities of up to  $\sim 4 \times 10^{10}(\text{exp } -4)$  photons  $\text{cm}^{-2} \text{sec}^{-1}$  (2 sigma upper limit) are compatible with the observed distribution. The best estimate of the positronium fraction is 0.97 plus or minus 0.03. No evidence for variation in the positronium fraction is observed.

DTIC

*Annihilation Reactions; Galaxies; Positron Annihilation; Positrons*

**20070015745** Naval Research Lab., Washington, DC USA

**A New Supernova Remnant Over the Galactic Centre**

Kassim, N E; Frail, D A; Jan 1996; 8 pp.; In English

Report No.(s): AD-A464413; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Improved images and a newly determined spectrum - from 80 MHz to 15 GHz - have clarified the nature of the radio source GO.33 +0.04 at the Galactic Centre. Its non-thermal spectral index and its shell-like morphology favour an interpretation that it is a supernova remnant. Furthermore, the absorption characteristics of the continuum spectrum at the lowest frequencies and its elongation along the plane suggest that, like Sgr A East, it is in physical proximity to the Galactic Centre.

DTIC

*Galaxies; Morphology; Supernova Remnants; Supernovae*

**20070015746** Naval Research Lab., Washington, DC USA

**The Radio Spectral Index and Expansion of 3C 58**

Bietenholz, M F; Kassim, N E; Weiler, K W; Oct 20, 2001; 8 pp.; In English

Report No.(s): AD-A464414; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We present new observations of the plerionic supernova remnant 3C 58 with the VLA at 74 and 327 MHz. In addition, we re-reduced earlier observations at 1.4 and 4.9 GHz taken in 1973 and 1984. Comparing these various images, we find that (1) the remnant has a flat and relatively uniform spectral-index distribution, (2) any expansion of the remnant with time is significantly less than that expected for uniform, undecelerated expansion since the generally accepted explosion date in 1181 A.D., and (3) there is no evidence for a nonthermal synchrotron-emission shell generated by a supernova shock wave, with any such emission having a surface brightness of less than  $1 \times 10^{10}(\text{to the } -21\text{st power}) \text{ W m}^{-2}(\text{to the } -2\text{nd power}) \text{ Hz}^{-1}(\text{to the } -1\text{st power}) \text{ sr}^{-1}$  at 327 MHz.

DTIC

*Continuums; Radio Astronomy; Spectra; Supernova Remnants; Supernovae*

**20070015747** Naval Research Lab., Washington, DC USA

**Multifrequency Very Long Baseline Array Observations of the Compact Double B2 2050+36: Constraints on Interstellar Scattering Revisited**

Lazio, T J; Fey, A L; Oct 20, 2001; 10 pp.; In English

Report No.(s): AD-A464415; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We present multifrequency observations with the Very Long Baseline Array of the compact double radio source B2

2050+36. Our observations are at 0.33, 0.61, 1.67, 2.3, and 8.4 GHz, with the 0.61 GHz observations forming the third epoch of observation of this source at that frequency. At 0.61 GHz, the structure of B2 2050+36 is dominated by two components 56 mas apart. Within the uncertainties of the various measurements, this separation has remained unchanged for the past 16 yr. Any differential image wander caused by refractive interstellar scattering is less than 4 mas. Both the lack of differential image wander and the frequency dependence of the angular diameter of B2 2050+36 below 1 GHz indicate that the electron density power spectrum along this line of sight has a spectral index near the Kolmogorov value, with a value of 4 being highly unlikely. We conclude that diffractive scattering dominates along this line of sight; results in the literature indicate that this conclusion also holds true for the line of sight to the pulsar PSR B2020+28. Comparison of our 1.67 GHz observations with those obtained 21 yr previously place a limit on the projected linear separation velocity of the two components of c.

DTIC

*Frequencies; Interstellar Matter; Scattering*

**20070015748** Naval Research Lab., Washington, DC USA

**Low-Frequency VLA Observations of Abell 754: Evidence for a Cluster Radio Halo and Possible Radio Relics**

Kassim, N E; Clarke, T E; Ensslin, T A; Cohen, A S; Neumann, D M; Oct 1, 2001; 7 pp.; In English

Report No.(s): AD-A464416; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We present 74 and 330 MHz VLA observations of Abell 754. Diffuse, halo-like emission is detected from the center of the cluster at both frequencies. At 330 MHz, the resolution of 90' distinguishes this extended emission from previously known point sources. In addition to the halo, and at a much lower level, outlying steep-spectrum emission regions straddle the cluster center and are seen only at 74 MHz. The location, morphology, and spectrum of this emission are all highly suggestive of at least one, and possibly two, cluster radio relics. Easily obtained higher resolution, higher sensitivity VLA observations at both frequencies are required to confirm the extended nature of the halo-like emission and the 74 MHz relic detections. However, since there is prior evidence that this cluster is or has recently been in the process of a major merger event, the possible discovery of relics in this system is of great interest in light of recent observational and theoretical evidence in favor of a merger-relic connection. We discuss the possible role that the merger shock waves, which are seen in the X-ray emission, may have played in the formation of the halo and radio relics in A754.

DTIC

*Halos; Low Frequencies; Very Large Array (VLA)*

**20070015750** Naval Research Lab., Washington, DC USA

**Detection of Sagittarius A\* at 330 MHz With the Very Large Array**

Nord, Michael E; Lazio, T J; Kassim, Namir E; Goss, W M; Duric, N; Jan 20, 2004; 5 pp.; In English

Report No.(s): AD-A464418; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The central radio-bright region of our Galaxy, known as the Sagittarius Complex, is composed of three major components: the supernova remnant (SNR) Sgr A East, the Sgr A West H II region, and Sgr A\*, recently established as our Galaxy's central massive black hole (e.g., Ghez et al. 2000; Eckart et al. 2002). Models attempting to explain the emission from Sgr A\* fall into three broad classes. Emission is modeled as arising from thermal sources, such as a low-temperature accretion disk, from nonthermal sources such as a jet (e.g., Melia & Falcke 2001 and references therein), or from a mixture of the two. Such models are constrained primarily by the observed spectrum of Sgr A\*, but large gaps in frequency coverage exist. For this reason, filling in such gaps, as with the recent near-IR detections (Ghez et al. 2004; Genzel et al. 2003), and extending the range of frequencies over which the source is observed is important in order to place additional observational constraints on these models.

DTIC

*Near Infrared Radiation; Sagittarius Constellation; Supernova Remnants; Very Large Array (VLA)*

**20070015759** Naval Research Lab., Washington, DC USA

**High-Resolution, Wide-Field Imaging of the Galactic Center Region at 330 MHz**

Nord, Michael E; Lazio, T J; Kassim, Namir E; Hyman, S D; LaRosa, T N; Brogan, C L; Duric, N; Oct 2004; 26 pp.; In English

Report No.(s): AD-A464429; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present a wide-field, subarcminute-resolution VLA image of the Galactic center region at 330 MHz. With a resolution of  $-7' \times 12'$  and an rms noise of 1.6 mJy beam (exp -1), this image represents a significant increase in resolution and sensitivity over the previously published VLA image at this frequency. The improved sensitivity has more than tripled the census of

small-diameter sources in the region, has resulted in the detection of two new nonthermal filaments (NTFs), 18 NTF candidates, and 30 pulsar candidates, reveals previously known extended sources in greater detail, and has resulted in the first detection of Sagittarius A\* in this frequency range.

DTIC

*Algorithms; Detection; High Resolution; Images; Imaging Techniques*

**20070015760** Naval Research Lab., Washington, DC USA

**Evidence for Thermal Absorption Inside Cassiopeia A**

Kassim, N E; Perley, R A; Dwarakanath, K S; Erickson, W C; Dec 10, 1995; 11 pp.; In English

Report No.(s): AD-A464430; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Subarcminute resolution images of Cas A at 74 and 333 MHz are presented. Comparison with each other and with higher frequency observations indicates that the spectral index of its nonthermal emission flattens below 333 MHz and that the effect is confined toward the central 19 of the source and is maximum at its center. The source of the flattening is unknown, although we show that the data are consistent with absorption by ionized gas inside the radio shell. Such a component may be related to unshocked ejecta still freely expanding within the boundaries of the reverse shock as delineated by X-ray observations.

DTIC

*Absorption; Cassiopeia A; Constellations; Thermal Absorption; Thermodynamic Properties*

**20070015761** Naval Research Lab., Washington, DC USA

**X-Ray Observations of Supernova Remnants as Distance Indicators**

Kassim, Namir E; Hertz, Paul; Van Dyk, Schuyler D; Weiler, Kurt W; Jun 1, 1994; 4 pp.; In English

Report No.(s): AD-A464431; No Copyright; Avail.: CASI: [A01](#), Hardcopy

SNRs are important in Galactic astrophysics because they are the major source of energy input to the interstellar medium, serve as the site of cosmic-ray acceleration and play a role in triggering star formation. Unlike H-II regions, whose distances can be constrained kinematically, Galactic SNRs have poorly determined distances. Of the currently known 180 Galactic remnants, only 15% have distance determinations and only a limited subset of these are likely to be reliable. Most methods of establishing distances to SNRs are either difficult and uncertain or are too inexact to be useful. We describe how soft X-ray observations, such as those made by the German X-ray observatory ROSAT, can be used to estimate distances to many shell-type SNRs. We have already applied this procedure to G326.3--1.8, and we apply it here to a number of SNRs with independently established distances in order to test the procedure's validity.

DTIC

*Distance Measuring Equipment; Supernova Remnants; Supernovae; X Ray Astronomy; X Rays*

**20070015762** Naval Research Lab., Washington, DC USA

**Radio Imaging of Two Supernova Remnants Containing Pulsars**

Frail, D A; Kassim, N E; Weiler, K W; Mar 1994; 11 pp.; In English

Report No.(s): AD-A464432; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The supernova remnants G 5.4 - 1.2 and G 8.7 - 0.1 each have a 15,000 yr old pulsar projected along their outside edges. If these are true pulsar-supernova remnant associations then the implied pulsar transverse motions for PSR1757-24 and PSR 1800-21 are excessively large (1500-2500 km s<sup>-1</sup>). We present new radio observations made at the VLA in the continuum at 327 MHz and the H I line at 1420 MHz to address this issue. For G 5.4-1.2 we better constrain the true extent of the remnant and its shape. We also derive an H I absorption distance and the spectral index distribution across the bright western side of the remnant. All the available evidence suggests that G 5.4-1.2 and PSR 1757-24 are associated. Our deep 327 MHz image of G 8.7 - 0.1 reveals faint extensions of the remnant but no new emission is seen near PSR 1800 - 21. A possible new supernova remnant is also discovered north of G 8.7 - 0.1. Several difficulties are presented for the proposed association between G 8.7 - 0.1 and PSR 1800 - 21, the most serious of which are the lack of a pulsar-powered nebula and the discrepant distance estimates for the pulsar and supernova remnant. We conclude that PSR 1800 - 21 is a foreground object, unrelated to G 8.7-0.1.

DTIC

*Images; Imaging Techniques; Pulsars; Radio Astronomy; Supernova Remnants; Supernovae*

**20070015763** Naval Research Lab., Washington, DC USA

**Subarcminute Resolution Imaging of Radio Sources at 74 MHz with the Very Large Array**

Kassim, N E; Perley, R A; Erickson, W C; Dwarakanath, K S; Dec 1993; 12 pp.; In English

Report No.(s): AD-A464433; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A new observing system operating at 74 MHz and providing an angular resolution of 20' is currently being tested at the VLA. The system comprises a prime-focus dipole feed and amplifier installed on eight of the VLA's 25 m antennas. Although the system is of low efficiency, it works well for imaging strong sources ( $S \sim \sqrt{\lambda}$  200 Jy) on long baselines ( $\sqrt{\lambda}$  5 km) since self-calibration has sufficient signal to noise to remove phase errors on the short time scales ( $\sim 10$  s) characteristic of ionospheric variations. We present maps of a few strong, well known radio sources imaged in most cases with unprecedented angular resolution. For weaker sources, the ionospheric phase variations do not allow the increased integration times required for successful self-calibration. In order to overcome this, we have developed a procedure of dual-frequency ionospheric phase referencing utilizing simultaneous observations at 74 and 330 MHz to 'unwind' the effects of the ionosphere before self-calibration. We will discuss the procedure, which should be applicable to any future low frequency ( $\sim 100$  MHz), long baseline ( $\sqrt{\lambda}$  5 km), ground-based interferometer which can obtain simultaneous, higher frequency measurements, and show examples of its application.

DTIC

*Images; Imaging Techniques; Resolution; Very Large Array (VLA)*

**20070015765** Naval Research Lab., Washington, DC USA

**ROSAT Observations of the Composite Supernova Remnant G326.3-1.8**

Kassim, Namir E; Hertz, Paul; Weiler, Kurt W; Dec 20, 1993; 7 pp.; In English

Report No.(s): AD-A464436; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We have observed X-ray emission from the radio-defined composite (shell plus filled-center plerion) Galactic supernova remnant (SNR) 0326.3 - 1.8 with the ROSAT position sensitive proportional counter (PSPC). The derived distance falls within the range of a variety of previous but poor and uncertain distance estimates and is consistent with the only reliable lower limit of  $D \sim 1.5$  kpc. Evidence exists in the literature from both optical and radio studies that would place the SNR significantly further than this lower limit. Higher quality radio absorption measurements are warranted to confirm our distance determination. This result, along with other recent ROSAT studies of SNRs, implies that improved distance estimates may be established for the large number of extended shell-type SNRs with very poor distance estimates which fall within ROSAT's all-sky survey. No X-ray analog to the plerionic radio emission appears on our ROSAT image, but our exposure is not sufficient to establish a stringent limit on any filled-center nonthermal X-ray emission.

DTIC

*ROSAT Mission; Satellite Imagery; Supernova Remnants; Supernovae*

**20070015766** Naval Research Lab., Washington, DC USA

**A New Look at the 'Jet' in the CTB 37A/B Supernova Remnant Complex**

Kassim, Namir E; Baum, Stefi A; Weiler, Kurt W; Jun 10, 1991; 7 pp.; In English

Report No.(s): AD-A464437; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Very Large Array observations of the unusual southern Galactic supernova remnant (SNR) complex near  $l = 348$  degrees,  $b = 0$  degrees at wavelengths of 6, 20, and 90 cm are presented. Derived continuum spectra and observed morphologies indicate that G348.5+0.1 (CTB 37A) does not have a 'jet' as reported by previous observers but is instead superposed on a second, previously unidentified SNR lying along the line of sight. This new SNR is designated G348.5-0.0 according to the usual convention. Other observers have also noted a faint, flat spectrum bridge of emission possibly connecting the G348.5+0.1/G348.5-0.0 superposition with a third nearby remnant G348.7+0.3 (CTB 37B). However, a connection appears unlikely, and we suggest that the 'bridge' merely consists of faint emission which has 'leaked' from the southeastern side of G348.7+0.3 and has no relation to the G348.5+0.1/G348.5-0.0 superposition. These new data also reveal a remarkable region of 'blown-out' emission from the southwestern part of G348.5+0.1 which most likely reflects the presence of large-scale density inhomogeneities in the interstellar medium into which the SNR shell is expanding.

DTIC

*Nebulae; Supernova Remnants; Supernovae*

**20070015767** Naval Research Lab., Washington, DC USA

**W30 Revealed: Separation and Analysis of Thermal and Nonthermal Emission in a Galactic Complex**

Kassim, Namir E; Weiler, Kurt W; Sep 1, 1990; 14 pp.; In English

Report No.(s): AD-A464438; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present new VLA observations of the W30 Galactic complex at 90 and 20 cm. By combining these data with existing radio continuum and recombination line observations extending from wavelengths of 10 m to 3 cm, we are able to do the

following: (1) We can improve estimates of the spectra and physical properties of H II regions in the complex. For thermal sources which are optically thick at 90 cm, we derive improved emission measures and filling factors, and for those which are optically thin, we set new upper limits to their emission measures. (2) We can derive improved estimates of the spectrum and physical properties of the supernova remnant (SNR) G8.7-0.1 associated with the W30 complex. Our 90 cm observations show that the nonthermal emission from the SNR is much larger than previously realized. The newly determined spectral index  $\alpha = -0.5$  is typical of shell-type SNRs. Relating G8.74-0.1 to H II regions in the W30 complex yields an improved distance estimate for the SNR of  $\sim 6$  plus or minus 1 kpc. At this distance G8.7 - 0.1 is one of the largest known Galactic SNRs, with a physical size of 80 pc, and certainly one of the most distant, low-surface brightness SNRs known in the Milky Way. (3) We can show that the low-frequency turnover in the spectrum of G8.7 - 0.1 is due to absorption by localized thermal gas associated with one or more of the H II regions near the W30 complex and does not require absorption by a distributed ionized component of the ISM. (4) We can show that, with this new distance and larger extent, G8.7 - 0.1 may be associated with the very young pulsar, PSR 1800 - 21.

DTIC

*Emission; Galaxies; Nonthermal Radiation; Thermal Analysis; Thermal Emission*

**20070015783** Naval Research Lab., Washington, DC USA

**Evidence for Shock Acceleration in the Binary Pulsar System PSR B1259-63**

Grove, J E; Tavani, M; Purcell, W R; Johnson, W N; Kurfess, J D; Strockman, M S; Arons, J; Jan 1995; 10 pp.; In English  
Contract(s)/Grant(s): NAG5-2234(MT); NAGW 2413(JA)

Report No.(s): AD-A464473; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The PSR B1259-63 system (Johnston et al. 1992, 1994) was observed near periastron by the Compton Gamma-Ray Observatory in January 1994. This system contains a rapidly rotating pulsar and a Be star in a highly eccentric binary orbit. We report the discovery by the OSSE instrument of unpulsed emission with a hard power-law spectrum between 50 and 200 keV from the direction of this system. Neither diffuse galactic background emission nor nearby X-ray binaries contribute significant to the detected flux. Our results are particularly important for the theory of interaction of pulsars with gaseous environments. We interpret the hard X-ray emission as synchrotron radiation from relativistic particles of the PSR B1259-63 wind being shocked and accelerated within the binary. Our results indicate, for the first time in a binary pulsar, that shock acceleration can increase the original energy of pulsar wind particles by a factor  $\sim$  but similar to 10, despite the high synchrotron and inverse Compton cooling rates near periastron. The derived shock properties (efficiency, radiation spectrum, timescale) are relevant for a broad class of high-energy astrophysical sources characterized by shocked relativistic plasmas subject to strong radiative cooling.

DTIC

*Compton Effect; Electron Scattering; Pulsars; Synchrotron Radiation*

**20070015789** Naval Research Lab., Washington, DC USA

**Structure in Small Molecular Clouds: Pedestals and Clumping**

Magnani, Loris; Carpenter, John M; Blitz, Leo; Kassim, Namir E; Nath, Biman B; Aug 1990; 23 pp.; In English

Report No.(s): AD-A464485; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Observations of wings or pedestals from three regions in high-latitude molecular clouds are presented in order to determine the morphology and physical conditions of the gas responsible for this phenomenon. High-sensitivity spectra along 10-25 lines of sight in each region show extended emission in addition to the typical narrow Gaussian emission from cold clumps. The pedestal profiles resemble the wings seen in CO and other molecules in low-luminosity molecular outflow regions such as B335. In the case of the bipolar outflows, the energy required to drive the outflow comes from a young stellar object; in contrast, it is virtually certain that the small molecular clouds studied in this paper do not contain any low-mass star formation sites. The data indicate that the pedestal emission is optically thick. Large velocity gradient and LTE analyses data indicate that the narrow-line emission is produced by cold clumps of size 0.2 pc and density several times, while the pedestal emission is produced by gas with perhaps an order of magnitude less density. Adjacent spectra often reveal a pedestal which increases in antenna temperature until it resembles a narrow Gaussian line typical of clump emission. This change in spectral shape occurs over length scales of a few hundredths of a parsec and may represent the transition region between a dense clump and its less dense outer region.

DTIC

*Molecular Clouds; Molecular Properties*



**20070015790** Naval Research Lab., Washington, DC USA

**Improved Estimates of Galactic H II Region Emission Measures and Filling Factors: Low-Frequency VLA Observations Near Sharpless 53**

Kassim, Namir E; Weiler, Kurt W; Erickson, William C; Wilson, T L; Mar 1, 1989; 11 pp.; In English  
Report No.(s): AD-A464486; No Copyright; Avail.: CASI: [A03](#), Hardcopy

VLA observations at 20 and 90 cm of five distant Galactic H II regions in an area including the Sharpless S53 complex have been used to measure their effective sizes and optically thick continuum flux densities. These data have been combined with shorter wavelength, optically thin flux density measurements and electron temperature estimates to determine accurate emission measures where previous results gave only lower limits. Our analysis indicates that existing lower limits to the emission measures often underestimate the true values by more than an order of magnitude. Filling factors for the ionized gas in these H II regions have also been determined and values ranging from 0.03 to 0.50 indicate significant clumping. If these clumps are embedded in a lower density but more widely distributed ionized component, even our much higher emission measures are still lower limits to the true values for the clumps.

DTIC

*Estimates; Flux Density; H II Regions; Low Frequencies; Measurement; Very Large Array (VLA)*

**20070015792** Naval Research Lab., Washington, DC USA

**Low-Frequency Observations of Galactic Supernova Remnants and the Distribution of Low-Density Ionized Gas in the Interstellar Medium**

Kassim, Namir E; Dec 15, 1989; 11 pp.; In English  
Report No.(s): AD-A464488; No Copyright; Avail.: CASI: [A03](#), Hardcopy

New long-wavelength observations of Galactic supernova remnants (SNRs) at 30.9 and 57.5 MHz are used to derive detailed low-frequency radio spectra for 32 SNRs. Of these, approximately two-thirds show turnovers at low frequencies, implying the presence of a widespread, but inhomogeneous, ionized absorbing medium along the lines of sight. These observations are combined with other low-frequency data to derive free-free optical depths toward 47 SNRs and to constrain the physical properties of the ionized gas responsible for the absorption. Three generally accepted ionized components of the interstellar medium (ISM) which absorb low-frequency radio emission are (1) H II regions; (2) extended H II region envelopes (EHs); and (3) the warm ionized medium (WIM).

DTIC

*Interstellar Gas; Interstellar Matter; Interstellar Space; Ionized Gases; Low Frequencies; Rarefied Gases; Supernova Remnants; Supernovae*

**20070015793** Naval Research Lab., Washington, DC USA

**On the Enhanced Interstellar Scattering Toward B1849+005**

Lazio, T J; Oct 1, 2004; 15 pp.; In English  
Report No.(s): AD-A464489; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper reports new Very Large Array (VLA) and Very Long Baseline Array (VLBA) observations of the extragalactic source B1849+005 at frequencies between 0.33 and 15 GHz and the reanalysis of archival VLA observations at 0.33, 1.5, and 4.9 GHz. The structure of this source is complex, confirming previous suggestions, but interstellar scattering dominates the structure of the central component at least to 15 GHz. An analysis of the phase structure functions of the interferometric visibilities shows the density fluctuations along this line of sight to be anisotropic (axial ratio = 1.3) with a frequency-independent position angle and having an inner scale of roughly a few hundred kilometers. The anisotropies occur on length scales of order 10 (to the 15th power) cm ( $D/5$  kpc), which within the context of certain magnetohydrodynamic turbulence theories indicates the length scale on which the kinetic and magnetic energy densities are comparable. A conservative upper limit on the velocity of the scattering material is 1800 km s<sup>-1</sup>, based on the lack of changes in the shapes of the 0.33 GHz images. In the 0.33 GHz field of view, there are a number of other sources that might also be heavily scattered, which would suggest that there are large changes in the scattering strength on lines of sight separated by a degree or less. Both B1849+005 and PSR B1849+00 are highly scattered, and they are separated by only 13'. If the lines of sight are affected by the same 'clump' of scattering material, it must be at least 2.3 kpc distant. However, a detailed attempt to account for the scattering observables toward these sources (angular broadening of the extragalactic source, pulse broadening of the pulsar, and upper limits on the angular broadening of the pulsar) does not produce a self-consistent set of parameters for a clump that can reproduce all three measured scattering observables.

DTIC

*Interstellar Space; Scattering*

**20070015794** Northwestern Univ., Evanston, IL USA

**Nonthermal Emission from the Arches Cluster (G0.121+0.017) and the Origin of gamma-Ray Emission from 3EG J1746-2851**

Yusef-Zadeh, F; Nord, M; Wardle, M; Law, C; Lang, C; Lazio, T J; Jun 20, 2003; 5 pp.; In English

Report No.(s): AD-A464490; No Copyright; Avail.: CASI: [A01](#), Hardcopy

High-resolution Very Large Array observations of the Arches cluster near the Galactic center show evidence of continuum emission at  $\gamma = 3.6, 6, 20,$  and  $90$  cm. The continuum emission at  $\gamma = 90$  cm is particularly striking because thermal sources generally become optically thick at longer wavelengths and fall off in brightness, whereas nonthermal sources increase in brightness. It is argued that the radio emission from this unique source has compact and diffuse components produced by thermal and nonthermal processes, respectively. Compact sources within the cluster arise from stellar winds of mass-losing stars, whereas diffuse emission is likely to be due to colliding wind shocks of the cluster flow that generate relativistic particles that are due to diffuse shock acceleration. We also discuss the possibility that gamma-ray emission from 3EG J1746-2851, located within  $3.3'$  of the Arches cluster results from the inverse Compton scattering of the radiation field of the cluster.

DTIC

*Arches; Emission; Gamma Rays; Nonthermal Radiation*

**20070015795** Naval Research Lab., Washington, DC USA

**Hard X Rays from Supernova 1993J**

Leising, M D; Kurfess, J D; Clayton, D D; Grabelsky, D A; Grove, J E; Johnson, W N; Jung, G V; Kinzer, R L; Kroeger, R A; Purcell, W R; Strickman, M S; The, L -S; Ulmer, M P; Jan 1994; 12 pp.; In English

Report No.(s): AD-A464493; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment (OSSE) on the Compton Observatory observed SN 1993J during three intervals centered approximately 12, 30, and 108 days after its outburst. Hard X-ray emission was detected in the first two of these intervals. No emission was seen in the third observation or in two earlier observations in 1991 and 1992. The coincidence of the observed excess with the outburst of SN 1993J and the consistency of the spectra and time evolution with those seen at lower energies by ROSAT and ASCA argue that the observed emission is indeed from SN 1993J. It is probably due the interaction of the fast supernova ejecta with circumstellar material. The luminosity,  $5 \times 10^{40}$  erg s $^{-1}$  (50-150 keV) in the first interval, is significantly larger than predicted. Extrapolating the spectrum to a few keV accounts for most or all of the observed emission at low energy. The observed high temperature,  $10^9$  K, is easily obtained in the shocked circumstellar matter, but a surprisingly high density is required there to give the observed luminosity and little or no additional X-ray emission from denser shocked supernova ejecta is allowed. The hard emission might also be explained in terms of the shocked supernova ejecta itself with unexpectedly high temperature.

DTIC

*Supernovae; X Rays*

**20070015801** Naval Research Lab., Washington, DC USA

**Implications of the Diffuse Galactic Continuum**

Skibo, J G; Ramaty, R; Purcell, W R; Jan 1996; 5 pp.; In English

Report No.(s): AD-A464507; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Observations made with Ginga, OSSE and COMPTEL provide evidence that the diffuse Galactic continuum emission extends down to  $-10$  keV, and that the spectrum steepens below about several hundred keV. If this emission is electron bremsstrahlung, then a very large power ( $\sim 10^{43}$  erg s $^{-1}$ ) is required to maintain the electrons against energy losses to the interstellar medium. This exceeds by an order of magnitude the total power provided by Galactic supernovae. We suggest that this power might be derived from the gravitational potential released on the passage of the ISM through Galactic spiral arm compressions. Alternatively, the hard X-ray Galactic continuum could be the superposition of unresolved point sources such as accreting neutron stars or black holes.

DTIC

*Black Holes (Astronomy); Continuums; Interstellar Matter; Neutron Stars; X Rays*

**20070015804** George Mason Univ., Fairfax, VA USA

**OSSE Observations of Blazars**

McNaron-Brown, K; Grove, J E; Johnson, W N; Kinzer, R L; Kroeger, R A; Kurfess, J D; Grabelsky, D A; Purcell, W R; Jung, G V; Cameron, R A; Jan 1994; 6 pp.; In English

Report No.(s): AD-A464511; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment (OSSE) on the Compton Gamma Ray Observatory has observed four of the active galactic nuclei detected by EGRET (Fichtel et al. 1993) at photon energies above 100 MeV; namely, 3C 273, 3C 279, MRK 421 and PKS 0528+134. These sources show blazar properties at other wavelengths. Only 3C 273 and 3C 279 were detected with high significance in the OSSE energy range, 0.05 - 10 MeV. However, not all of the OSSE observations were contemporaneous with the EGRET detections. The OSSE exposures varied from 10 weeks on 3C 273 (in 8 separate viewing periods) to 3 weeks on PKS 0528+134. When combined with contemporaneous COMPTEL observations of these sources, we find strong evidence for spectral softening between the hard X-ray and medium energy gamma-ray bands in 3 of the 4 sources. Constraints provided by the OSSE observations on models of blazar emissions are discussed.

DTIC

*Blazars; Experiment Design; Galaxies; Scintillation; Spectrometers*

**20070015845** Naval Research Lab., Washington, DC USA

**X-ray Bursts in Neutron Star and Black Hole Binaries from USA and RXTE Data: Detections and Upper Limits**

Tourneir, D; Raffauf, E; Bloom, E D; Focke, W; Giebels, B; Godfrey, G; Saz Parkinson, P M; Reilly, K T; Wood, K S; Ray, P S; Wolff, M T; Bandyopadhyay, R M; Lovellette, M N; Scargle, Jeffrey D; Jan 2003; 25 pp.; In English

Contract(s)/Grant(s): DE-AC03-76-SF00515

Report No.(s): AD-A464589; No Copyright; Avail.: CASI: [A03](#), Hardcopy

Narayan and Heyl (2002) have developed a theoretical framework to convert suitable upper limits on type I X-ray bursts from accreting black hole candidates (BHCs) into evidence for an event horizon. However, no appropriate observational limit exists in the literature. In this paper we survey 2101.2 ks of data from the Unconventional Stellar Aspect (USA) X-ray timing experiment and 5142 ks of data from the Rossi X-ray Timing Explorer (RXTE) experiment to obtain a formal constraint of this type. 1122 ks of neutron star data yield a population averaged mean burst rate of  $1.69 \times 10^5$  bursts  $s^{-1}$  while 6081 ks of BHC data yield a 95% confidence level upper limit of  $4.9 \times 10^7$  bursts  $s^{-1}$ . This is the first published limit of this type for Black Hole Candidates. Applying the theoretical framework of Narayan and Heyl (2002) we calculate regions of unstable luminosity where the neutron stars are expected to burst and the BHCs would be expected to burst if they had a surface. In this unstable luminosity region 464 ks of neutron star data yield an averaged mean burst rate of  $4.1 \times 10^5$  bursts  $s^{-1}$  and 1512 ks of BHC data yield a 95% confidence level upper limit of  $2.0 \times 10^6$  bursts  $s^{-1}$ , and a limit of  $\sqrt{g}$   $10 \sigma$  that BHCs do not burst with a rate similar to the rate of neutron stars in these unstable regions. This gives further evidence that BHCs do not have surfaces unless there is some new physics occurring on their surface.

DTIC

*Black Holes (Astronomy); Neutron Stars; X Ray Timing Explorer; X Rays*

**20070015854** Naval Research Lab., Washington, DC USA

**Search for Protoplanetary and Debris Disks Around Millisecond Pulsars**

Foster, R S; Fischer, J; Oct 6, 1995; 5 pp.; In English

Report No.(s): AD-A464604; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The identification of planetary companions around the nearby millisecond radio pulsar PSR B1257+12 implies that planetary formation has occurred in the past evolutionary history of this system. If planetary formation is common around millisecond pulsars and if it occurs by coalescence of small dust particles within a protoplanetary disk, as is thought to have occurred during the formation of the solar system, then it may be possible to detect the presence of protoplanetary dust or a remnant debris disk via thermal infrared emission. We summarize an attempt to detect this emission via a series of 10  $\mu$ m observations made toward PSR B 1257+12 and four other nearby millisecond pulsars using the National Aeronautics and Space Administration (NASA) Infrared Telescope Facility (IRTF) 3 m telescope and the facility bolometer. We also present a simple model for thermal emission from a protoplanetary disk containing grains heated from the pulsar spin-down luminosity. Further, we describe upcoming space-based far-infrared observations that can substantially improve observational limits from the emission of dust that may radiate in the two order of magnitude gap between ground-based accessible mid-infrared and millimeter spectral regions.

DTIC

*Debris; Dust; Observatories; Protoplanetary Disks; Pulsars*

**20070015858** Naval Research Lab., Washington, DC USA

**ASTROCAM: An Offner Re-imaging 1024 x 1024 InSb Camera for Near-Infrared Astrometry on the USNO 1.55-m Telescope**

Fischer, Jacqueline; Vrba, Frederick; Toomey, Douglas; Lucke, Robert; Wang, Shu-i; Henden, Arne; Robichaud, Joseph; Onaka, Peter; Hicks, Brian; Harris, Fred; Jan 2003; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464610; No Copyright; Avail.: CASI: [A03](#), Hardcopy

In order to extend the US Naval Observatory (USNO) small-angle astrometric capabilities to near infrared wavelengths we have designed and manufactured a 1024 x 1024 InSb re-imaging infrared camera equipped with an array selected from the InSb ALADDIN (Advanced Large Area Detector Development in InSb) development program and broadband and narrowband 0.8 - 3.8 um filters. Since the USNO 1.55-m telescope is optimized for observations at visible wavelengths with an oversized secondary mirror and sky baffles, the straylight rejection capabilities of the ASTROCAM Lyot stop and baffles are of critical importance for its sensitivity and flat-fielding capabilities.

DTIC

*Astrometry; Cameras; Field of View; Imaging Techniques; Infrared Imagery; Near Infrared Radiation; Telescopes*

**20070015863** Naval Research Lab., Washington, DC USA

**Compton Observatory OSSE Studies of Supernovae and Novae**

Leising, M D; Clayton, D D; The, L -S; Johnson, W N; Kurfess, J D; Kinzer, R L; Kroeger, R A; Strickman, M S; Grove, J E; Grabelsky, D A; Purcell, W R; Ulmer, M P; Cameron, R A; Jung, G V; Jan 1995; 11 pp.; In English

Report No.(s): AD-A464618; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A primary objective of the Compton Observatory is the direct study of explosive nucleosynthesis in supernovae and classical novae. We have been fortunate in that three rare events have coincided, relatively speaking, with the Compton Observatory launch. Supernova 1987A, roughly a once per century event, was only 4 years old at launch and so the gamma-ray flux from <sup>57</sup>Co decay was not much past its peak value. Supernova 1991T, a SN Ia which exploded within a few days of launch, is a once in a decade event. It offers as good a chance as we could reasonably expect to detect the <sup>56</sup>Ni and <sup>56</sup>Co decays which are supposed to be responsible for the impressive SN Ia display. Nova Cygni 1992, also a once in a decade event, might be our best chance to detect gamma-rays from <sup>22</sup>Na, a unique nucleosynthesis byproduct of the explosive hydrogen burning thought to power classical novae.

DTIC

*Novae; Observatories; Supernovae*

**20070015864** Naval Research Lab., Washington, DC USA

**OSSE Spectral Observations of GX 339-4 and CYG X-1**

Grabelsky, D A; Matz, S M; Purcell, W R; Ulmer, M P; Johnson, W N; Kinzer, R L; Kroeger, R A; Kurfess, J D; Strickman, M S; Grove, J E; Cameron, R A; Jung, G V; Leising, M D; Jan 1993; 6 pp.; In English

Report No.(s): AD-A464622; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment on the Compton Gamma Ray Observatory has carried out spectral and timing observations of Galactic black-hole candidates GX 339-4 and Cyg X-1. GX 339-4 was observed as a target of opportunity in 1991 September, in response to the outburst reported by BATSE and SIGMA. The source was detected from 50 to 400 keV, at a level relative to the Crab of 30%. During a follow-up observation made in 1991 November, the intensity of the source below 100 keV had dropped by nearly two orders of magnitude, and it was no longer detected above 100 keV. The observations of Cyg X-1 were made during three different observing periods between 1991 June and November. The OSSE time-averaged spectrum of Cyg X-1 is about 10 times brighter than that of GX 339-4, but remarkably similar in shape over the energy range in which both are detected. No significant emission is seen above about 1 MeV, and there is no evidence for any bumps or narrow lines near 0.511 MeV. The spectra of both sources are described reasonably well by a Comptonization model.

DTIC

*Black Holes (Astronomy); Cygnus Constellation; Spectra*

**20070015868** Ohio State Univ., Columbus, OH USA

**Stellar Iron Abundances at the Galactic Center**

Ramirez, Solange V; Sellgren, K; Carr, John S; Balachandran, Suchitra C; Blum, Robert; Terndrup, Donald M; Steed, Adam; Jul 1, 2000; 17 pp.; In English

Contract(s)/Grant(s): AST-9619230; AST-8947990

Report No.(s): AD-A464635; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present measurements of [Fe/H] for six M supergiant stars and three giant stars within 2.5 pc of the Galactic center (GC) and one M supergiant star within 30 pc of the GC. The results are based on high-resolution K-band spectra, taken with CSHELL at the NASA Infrared Telescope Facility. We determine the iron abundance by detailed abundance analysis, performed with the spectral synthesis program MOOG. The mean [Fe/H] of the GC stars is determined to be near solar, [Fe/H]=+0.12 +/- 0.22. Our analysis is a differential analysis, as we have observed and applied the same analysis technique to 11 cool, luminous stars in the solar neighborhood with similar temperatures and luminosities as the GC stars. The mean [Fe/H] of the solar neighborhood comparison stars, [Fe/H] = 0.03 +/- 0.16, is similar to that of the GC stars. The width of the GC [Fe/H] distribution is found to be narrower than the width of the [Fe/H] distribution of Baade's window in the bulge but consistent with the width of the [Fe/H] distribution of giant and supergiant stars in the solar neighborhood.

DTIC

*Iron; Metallicity*

**20070015928** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Extragalactic Backgrounds in the Far UV and Exploring Star Formation at High Redshifts with Gamma-ray Observations**

Stecker, Floyd W.; October 09, 2006; 1 pp.; In English; At the Edge of the Universe OCs of the Deep 06 Conference, 7-14 Oct. 2006, Sintra, Portugal; No Copyright; Avail.: Other Sources; Abstract Only

The determination of the intergalactic photon densities from the FIR to the UV which is produced by stellar emission and dust reradiation at various redshifts can provide an independent measure of the star formation history of the universe. Using recent Spitzer and GALEX data in conjunction with other observational inputs, Stecker, Malkan and Scully have calculated the intergalactic photon density as a function of both energy and redshift for  $0 < z < 6$  for photon energies from 0.003 eV to the Lyman limit cutoff at 13.6 eV in a  $\Lambda$ CDM universe with  $\Omega_{\Lambda} = 0.7$  and  $\Omega_m = 0.3$ . Their results are based on backwards evolution models for galaxies which were developed by Malkan and Stecker previously. The calculated background SEDs at  $z = 0$  are in good agreement with the present observational data and limits. The calculated intergalactic photon densities as a function of redshift were used to predict to extend the absorption of high energy  $\gamma$ -rays in intergalactic space from sources such as blazars and quasars, this absorption being produced by interactions the  $\gamma$ -rays with the intergalactic FIR-UV photons having the calculated densities. The results are in excellent agreement with absorption features found in the low gamma-ray spectra of Mkn 421, Mkn 501 at,  $z = 0.03$  and PKS

Author

*Gamma Ray Spectra; Star Formation; Photon Density; Ultraviolet Radiation; Red Shift; Quasars; Far Infrared Radiation*

**20070015929** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Deep X-ray and UV Surveys of Galaxies with Chandra, XMM-Newton, and GALEX**

Hornschemeier, Ann; August 18, 2006; 1 pp.; In English; At the Edge of the Universe, 9-13 Oct. 2006, Sintra, Portugal; No Copyright; Avail.: Other Sources; Abstract Only

Only with the deepest Chandra surveys has X-ray emission from normal and star forming galaxies (as opposed to AGN, which dominate the X-ray sky) been accessible at cosmologically interesting distances. The X-ray emission from accreting binaries provide a critical glimpse into the binary phase of stellar evolution and studies of the hot gas reservoir constrain past star formation. UV studies provide important, sensitive diagnostics of the young star forming populations and provide the most mature means for studying galaxies at  $2 < z < 4$ . This talk will review current progress on studying X-ray emission in concert with UV emission from normal/star-forming galaxies at higher redshift. We will also report on our new, deep surveys with GALEX and XMM-Newton in the nearby Coma cluster. These studies are relevant to DEEP06 as Coma is the nearest rich cluster of galaxies and provides an important benchmark for high-redshift studies in the X-ray and UV wavebands. The 30 ks GALEX (note: similar depth to the GALEX Deep Imaging Survey) and the 110 ks XMM observations provide extremely deep coverage of a Coma outskirts field, allowing the construction of the UV and X-ray luminosity function of galaxies and important constraints on star formation scaling relations such as the X-ray-Star Formation Rate correlation and the X-ray/Stellar Mass correlation. We will discuss what we learn from these deep observations of Coma, including the recently established suppression of the X-ray emission from galaxies in the Coma outskirts that is likely associated with lower levels of past star formation and/or the results of tidal gas stripping.

Author

*X Ray Sources; Stellar Evolution; Galactic Clusters; Galaxies; Imaging Techniques; Star Formation; Ultraviolet Radiation; Emission*

**20070015946** Naval Research Lab., Washington, DC USA

**Evidence for Residual Material in Accretion Disk Gaps: CO Fundamental Emission from the T Tauri Spectroscopic Binary DQ Tauri**

Carr, John S; Mathieu, Robert D; Najita, Joan R; Apr 10, 2001; 8 pp.; In English

Report No.(s): AD-A464631; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We present the discovery of CO fundamental rovibrational emission from the classical T Tauri spectroscopic binary DQ Tau. The high-resolution infrared echelle spectra reveal emission lines from both the  $\gamma = 1$  and  $\gamma = 2$  vibrational levels with line widths of roughly 70 km s(exp -1). The average CO excitation temperature is approximately 1200 K. We model the spectra as arising from gas in Keplerian rotation about the center of mass of the binary. The disk model requires gas with an average surface density of  $5 \times 10^{-4}$  g sq cm that extends outward to 0.5 plus or minus 0.1 AU and inward to at least 0.1 AU from the center of mass. The radial extent for the emitting gas is close to the predicted size of the gap in the DQ Tau accretion disk that is expected to be dynamically cleared by the binary. We interpret these results, and previous modeling of DQ Tau's spectral energy distribution, as evidence for a small amount ( $\sim 10^{-10}$  M circle dot solar of diffuse material residing within the optically thin disk gap. Thus, dynamical clearing has not been completely efficient in the DQ Tau binary. We suggest that the material is associated with a flow from the circumbinary disk which feeds the ongoing accretion at the stellar surfaces.

DTIC

*Accretion Disks; Binary Stars; Spectroscopy; T Tauri Stars; Taurus Constellation*

**20070015987** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Correlated Temporal and Spectral Variability in Neutron Star and Black Hole X-Ray Binaries**

Swank, J.; May 09, 2006; 1 pp.; In English; International Astronomy Meeting, 19-24 Jun. 2006, Sicily, Italy; No Copyright; Avail.: Other Sources; Abstract Only

The variability of neutron star and black hole X-ray sources has several dimensions, because of the roles played by different important time-scales. The variations on time scales of hours, weeks, and months, ranging from 50% to orders of magnitude, arise out of changes in the flow in the disk. The most important driving forces for those changes are probably various possible instabilities in the disk, though there may be effects with other dominant causes. The changes in the rate of flow appear to be associated with changes in the flow's configuration, as the accreting material approaches the compact object, for there are generally correlated changes in both the X-ray spectra and the character of the faster temporal variability. There has been a lot of progress in tracking these correlations, both for Z and Atoll neutron star low-mass X-ray binaries, and for black hole binaries. I will discuss these correlations and what they tell us about the physical states of the systems.

Author

*Black Holes (Astronomy); Correlation; Neutron Stars; X Ray Binaries; X Ray Sources; X Ray Spectra*

**20070016014** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Suzaku Observation of Two Ultraluminous X-Ray Sources in NGC 1313**

Mizuno, T.; Miyawaki, R.; Ebisawa, K.; Kubota, A.; Miyamoto, M.; Winter, L.; Ueda, Y.; Isobe, N.; Dewangan, G.; Done, C.; Griffiths, R. E.; Haba, Y.; Kokubun, M.; Kotoku J.; Makishima, K.; Matsushita, K.; Mushotzky, R. F.; Namiki, M.; Petre, R.; Takahashi, H.; Tamagaw, T.; Terashima, Y.; [2001]; 23 pp.; In English; Copyright; Avail.: CASI: [A03](#), Hardcopy

A study was made of two ultraluminous X-ray sources (ULXs) in the nearby face-on, late-type Sb galaxy NGC 1313 using data from Suzaku, the 5th Japanese X-ray satellite. Within the 90 ks observation, both sources named X-1 and X-2 exhibited luminosity change by about 50%. The 0.4-10 keV X-ray luminosity was measured to be  $2.5 \times 10^{40}$  erg per second and  $5.8 \times 10^{39}$  erg per second for X-1 and X-2, respectively, requiring a black hole of 50-200 solar mass in order not to exceed the Eddington limit. For X-1: the spectrum exhibited a strong power-law component with a high energy cutoff which is thought to arise from strong Comptonization by a disk corona, suggesting the source was in a very high state. Absorption line features with equivalent widths of 40-80 eV found at 7.0 keV and 7.8 keV in the X-1 spectrum support the presence of a highly ionized plasma and a high mass accretion rate on the system. Oxygen abundance of the NGC 1313 circumstellar matter toward X-1 was found to be subsolar, viz.  $O/H = (5.0 \text{ plus or minus } 1.0) \times 10^{-4}$ . The spectrum of X-2 in fainter phase is best represented by a multicolor disk blackbody model with  $T(\text{sub in}) = 1.2-1.3$  keV and becomes flatter as the flux increases; the source is interpreted to be in a slim disk state.

Author

*Galaxies; Luminosity; X Ray Sources; Black Holes (Astronomy); Accretion Disks*

**20070016052** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**INTEGRAL Observations of the Enigmatic Be Stars ( $\gamma$ ) Cassiopeiae and HD 110432**

Sturmer, S. J.; Shrader, C. R.; [2007]; 23 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NCC5-637; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016052>

We present the results of a hard X-ray study of the Be stars  $\gamma$  Cassiopeiae and HD 110432 based on observations made with the INTEGRAL observatory. These stars are known to be moderately strong, X-ray sources ( $L_{\text{sub x}}$  approx. equal to  $= 10^{\text{sup } 32}$ - $10^{\text{sup } 33}$  erg per second). These values are at the extreme high end of the known luminosity distribution for active coronal systems, but several orders of magnitude below typical X-ray binaries. The hard X-ray spectra for these systems are quite similar. They can be well fitted by either optically thin thermal plasma models with  $kT = 12.5 - 14$  keV or a cutoff powerlaw + gaussian line model with photon indices in the 1.3 - 1.5 range and a line energy of 6.7 keV. The 20-50 keV light curves show no evidence for flaring and no significant evidence for periodic variability. It has been proposed that the X-ray emission is due to either accretion onto a white dwarf companion or magnetic activity near the surface of the Be star. We discuss in detail the pros and cons of each scenario towards explaining our spectral and temporal results. Given that both thermal and nonthermal models fit the data equally well, we cannot use the spectra to delineate between these two scenarios. Recent observations indicate that  $\gamma$  Cas has a approx. 1 solar mass companion in a 203.59 day orbit. This is consistent with the white dwarf - Be star binary model but the lack of periodic modulation of the flux on this timescale calls this conclusion into question. On the other hand the lack of flaring activity may rule against the magnetic activity model. We discuss advances in observations and theory that need to be made to resolve the origin of these systems.

Author

*Cassiopeia Constellation; Observatories; X Ray Astronomy; White Dwarf Stars; X Ray Binaries*

**20070016551** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Onset Phase of 'Soft' X-ray Transients**

Swank, Jean Hebb; Shaposhnikov, N.; Shrader, C. R.; Rupen, M. P.; Beckmann, V.; Markwardt, C. B.; Smith, D. A.; [2006];

1 pp.; In English; High Energy Astrophysics Division Meeting, 4-7 Oct. 2007, San Francisco, CA, USA; Copyright;

Avail.: Other Sources; Abstract Only

Transient outbursts of black holes and neutron stars in X-ray binaries with low-mass companions start with a flickering hard power-law flux that contains a low frequency quasi-periodic oscillation (QPO). The frequency of the QPO may reflect the outer boundary of the coronal emission and its inward motion toward the compact object. It has also been proposed that the hard flux is related to the base of a radio emitting outflow or compact jet. We had detailed observations of the beginning of the 2005 outburst of GRO J165.5-40 with RXTE, INTEGRAL, the VLA and ROTSE. We use the X-ray, radio, and optical results in the context of these models to address their applicability to the onset of the outburst and to specify the physical parameters. Decline of the radio flux as both the power-law and disk flux increased constrains the amount of synchrotron self-Compton emission. Values are compared to those of other black hole and neutron star transients. We are glad to acknowledge support by a NASA INTEGRAL Guest Observer Grant and by the UTE project, NRAO, and ROTSE.

Author

*X Ray Binaries; Black Holes (Astronomy); Coronas; X Ray Optics; Neutron Stars; X Ray Timing Explorer*

**20070016556** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Broadband X-ray Spectroscopy of the ADC Source 4U 1822-37 with Suzaku**

Cottam, J.; White, N.; [2006]; 1 pp.; In English; The Extreme Universe in the Suzaku Era, 3-10 Dec. 2006, Kyoto, Japan; No

Copyright; Avail.: Other Sources; Abstract Only

We will present the broadband spectra of the low mass x-ray binary 4U 1822-37, recently observed with Suzaku. 4U 1822-37 is the canonical accretion disk corona (ADC) source where the compact object is obscured by an extended corona that intercepts and scatters the central continuum emission, some of which is then reprocessed in the outer regions of the accretion disk. 4U 1822-37 therefore serves as an important link between x-ray binaries and AGN. The broadband x-ray spectra from the Suzaku XIS and HXD provide a unique opportunity to probe the physical conditions in the corona and the accretion disk for this important accretion geometry.

Author

*Accretion Disks; Broadband; X Ray Spectroscopy; Solar Corona; X Ray Binaries*

**20070016569** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A Suzaku Observation of the Neutral Fe-line Emission from RCW 86**

Ueno, Masaru; Sato, Rie; Kataoka, Jun; Bamba, Aya; Harrus, Ilana; Hiraga, Junko; Hughes, John P.; Kilbourne, Caroline A.; Koyama, Katsuji; Kokubun, Motohide; Nakajima, Hiroshi; Ozaki, Masanobu; Petre, Robert; Takahashi, Tadayuki; Tanaka, Takaaki; Tomida, Hiroshi; Yamaguchi, Hiroya; [2007]; 6 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NNG05GP87G; Copyright; Avail.: CASI: A02, Hardcopy

The newly operational X-ray satellite Suzaku observed the supernova remnant (SNR) RCW 86 in February 2006 to study the nature of the 6.4 keV emission line first detected with the Advanced Satellite for Cosmology and Astronomy (ASCA). The new data confirms the existence of the line, localizing it for the first time inside a low temperature emission region and not at the locus of the continuum hard X-ray emission. We also report the first detection of a 7.1 keV line that we interpret as the K(beta) emission from neutral or low-ionized iron. The Fe-K line features are consistent with a non-equilibrium plasma of Fe-rich ejecta with  $n(\text{sub } e)$  less than or approx. equal to  $10(\text{exp } 9)/\text{cu cm s}$  and  $kT(\text{sub } e) \leq 1 \text{ keV}$ . We found a sign that Fe K(alpha) line is intrinsically broadened 47 (35-57) eV (99% error region). Cr-K line is also marginally detected, which is supporting the ejecta origin for the Fe-K line. By showing that the hard continuum above 3 keV has different spatial distribution from the Fe-K line, we confirmed it to be synchrotron X-ray emission.

Author

*Iron; K Lines; Supernova Remnants; X Rays; Time Temperature Parameter*

**20070016575** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Gamma-ray Observations with Swift and their Impact on the TeV Community**

Krimm, Hans; August 31, 2006; 1 pp.; In English; TeV Particle Astrophysics Workshop, 28-31 Aug. 2006, Madison, WI, USA

Contract(s)/Grant(s): NCC5-637; No Copyright; Avail.: Other Sources; Abstract Only

The Swift gamma-ray burst explorer was launched on Nov. 20, 2004 from Cape Canaveral, Florida. The first instrument onboard became fully operational less than a month later. Since that time the Burst Alert Telescope (BAT) on Swift has detected more than 150 gamma-ray bursts (GRBs), most of which have also been observed within two minutes by the Swift narrow-field instruments: the X-Ray Telescope (XRT) and the Ultra-Violet and Optical Telescope (UVOT). Swift trigger notices are distributed worldwide within seconds of the trigger through the Gamma-ray burst Coordinates Network (GCN) and a substantial fraction of GRBs have been followed up by ground and space-based telescopes, ranging in wavelength from radio to TeV. Results have included the first rapid localization of a short GRB and further validation of the theory that short and long bursts have different origins; detailed observations of the power-law decay of burst afterglows leading to an improved understanding of the fireball and afterglow models; and detection of the most distant GRB ever found. Swift is also a sensitive X-ray observatory with capabilities to monitor galactic and extragalactic transients on a daily basis, carry out the first all-sky hard X-ray survey since HEAO-1, and study in detail the spectra of X-ray transients. The talk will emphasize the connection between Swift/BAT GRB observations and source monitoring and TeV observations.

Author

*Gamma Ray Bursts; Swift Observatory; X Ray Telescopes; HEAO 1; Coordinates*

**20070016599** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Prospects for GLAST**

McEnery, Julie; [2006]; 1 pp.; In English; 5th Stomlo Symposium, 3-8 Dec. 2006, Caberra, Australia; No Copyright;

Avail.: Other Sources; Abstract Only

The Gamma-ray Large Area Space Telescope (GLAST), scheduled for launch in late 007, is a satellite based observatory to study the high energy gamma-ray sky. There are two instruments on GLAST: the Large Area Telescope (LAT) which provides coverage from 20 MeV to over 300 GeV, and the GLAST Burst Monitor (GBM) which provides supportive observations of transients from 8 keV to 30 MeV. GLAST will provide well beyond those achieved by the highly successful EGRET instrument on the Compton Gamma-Ray Observatory, with dramatic improvements in sensitivity, angular resolution and energy range. The very large field of view will make it possible to observe approx. 20% of the sky at any instant, and the entire sky on timescale of a few hours. This talk includes a description of the instruments, the opportunities for guest investigators, and the mission status.

Author

*Gamma Ray Telescopes; Gamma Ray Observatory; Satellite Instruments*



**20070016603** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**[Ti II] and [Ni II] Emission from the Strontium Filament of eta Carinae**

Bautista, M. A.; Hartman, H.; Gull, T. R.; Smith, N.; Lodders, K.; June 12, 2007; 14 pp.; In English

Contract(s)/Grant(s): NAS5-26555; NNG04G157A; HF-01166.01A

Report No.(s): astro-ph/0606275-v1; Copyright; Avail.: CASI: [A03](#), Hardcopy

We study the nature of the [Ti II] and [Ni II] emission from the so-called strontium filament found in the ejecta of eta Carinae. To this purpose we employ multilevel models of the Ti II and Ni II systems which are used to investigate the physical condition of the filament and the excitation mechanisms of the observed lines. For the Ti II ion, for which no atomic data was previously available, we carry out ab initio calculations of radiative transition rates and electron impact excitation rate coefficients. It is found that the observed spectrum is consistent with the lines being excited in a mostly neutral region with an electron density of the order of  $10(\text{exp } 7)$  per cubic centimeter and a temperature around 6000 K. In analyzing three observations with different slit orientations recorded between March 2000 and November 2001 we find line ratios that change among various observations, in a way consistent with changes of up to an order of magnitude in the strength of the continuum radiation field. These changes result from different samplings of the extended filament, due to the different slit orientations used for each observation, and yield clues on the spatial extent and optical depth of the filament. The observed emission indicates a large Ti/Ni abundance ratio relative to solar abundances. It is suggested that the observed high Ti/Ni ratio in gas is caused by dust-gas fractionation processes and does not reflect the absolute Ti/Ni ratio in the ejecta of eta Carinae. We study the condensation chemistry of Ti, Ni and Fe within the filament and suggest that the observed gas phase overabundance of Ti is likely the result of selective photo-evaporation of Ti-bearing grains. Some mechanisms for such a scenario are proposed.

Author

*Strontium; Ejecta; Filaments; Titanium; Nickel; Star Formation; Mathematical Models*

**20070016613** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Gamma Ray Burst Discoveries with the Swift Mission**

Gehrels, Neil; Dec. 15, 2006; 1 pp.; In English; 2006 Texas Symposium, 11-15 Dec. 2006, Melbourne, Australia; No Copyright; Avail.: Other Sources; Abstract Only

Gamma-ray bursts are among the most fascinating occurrences in the cosmos. They are thought to be the birth cries of black holes throughout the universe. There has been tremendous recent progress in our understanding of bursts with the new data from the Swift mission. Swift was launched in November 2004 and is an international multiwavelength observatory designed to determine the origin of bursts and use them to probe the early Universe. The two years of findings from the mission will be presented. A huge step forward has been made in our understanding of the mysterious short GRBs. High redshift bursts have been detected from enormous explosions early in the universe. GRBs have been found with giant X-ray flares occurring in their afterglow. These, and other topics, will be discussed.

Author

*Gamma Ray Bursts; Swift Observatory; Space Missions; Black Holes (Astronomy)*

**20070016642** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A Stellar-mass Black Hole in the Ultra-luminous X-ray Source M82 X-1**

Okajima, Takashi; Ebisawa, Ken; Kawaguchi, Toshihiro; [2007]; 13 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NNG04GB78A; Copyright; Avail.: CASI: [A03](#), Hardcopy

We have analyzed the archival XMM-Newton data of the archetypal Ultra-Luminous X-ray Source (ULX) M82 X-1 with an LO5 ksec exposure when the source was in the steady state. Thanks to the high photon statistics from the large effective area and long exposure, we were able to discriminate different X-ray continuum spectral models. Neither the standard accretion disk model (where the radial dependency of the disk effective temperature is  $T(r)$  proportional to  $r(\text{sup } -3/4)$ ) nor a power-law model gives a satisfactory fit. In fact, observed curvature of the M82 X-1 spectrum was just between those of the two models. When the exponent of the radial dependence ( $p$  in  $T(r)$  proportional to  $r(\text{sup } -P)$ ) of the disk temperature is allowed to be free, we obtained  $p = 0.61$  (sup +0.03)(sub -0.02). Such a reduction of  $p$  from the standard value  $3/4$  under extremely high mass accretion rates is predicted from the accretion disk theory as a consequence of the radial energy advection. Thus, the accretion disk in M82 X-1 is considered to be in the Slim disk state, where an optically thick Advection Dominant Accretion Flow (ADAF) is taking place. We have applied a theoretical slim disk spectral model to M82 X-1, and estimated the black hole mass approximately equal to 19 - 32 solar mass. We conclude that M82 X-1 is a stellar black hole

which has been produced through evolution of an extremely massive star, shining at a several times the super-Eddington luminosity.

Author

*Accretion Disks; Black Holes (Astronomy); Continuum Modeling; Stellar Mass; X Ray Sources; Stellar Luminosity*

**20070016644** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Swift/BAT and RXTE Observations of the Peculiar X-ray Binary 4U 2206+54 - Disappearance of the 9.6 Day Modulation**

Corbet, R. H. D.; Markwardt, C.; Tueller, J.; [2007]; 13 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Observations of the high-mass X-ray binary 4U 2206+54 with the Swift Burst Alert Telescope (BAT) do not show modulation at the previously reported period of 9.6 days found from observations made with the Rossi X-ray Timing Explorer (RXTE) All-Sky Monitor (ASM). Instead, the strongest peak in the power spectrum of the BAT light curve occurs at a period of 19.25 $\pm$ 0.08 days, twice the period found with the RXTE ASM. The maximum of the folded BAT light curve is also delayed compared to the maximum of the folded ASM light curve. The most recent ASM data folded on twice the 9.6 day period show 'similar morphology to the folded BAT light curve. This suggests that the apparent period doubling is a recent secular change rather than an energy-dependent effect. The 9.6 day period is thus not a permanent strong feature of the light curve. We suggest that the orbital period of 4U 2206+54 may be twice the previously proposed value.

Author

*X Ray Binaries; Swift Observatory; Period Doubling; Light Curve; X Ray Timing Explorer; Power Spectra*

**20070016647** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Polar Summer MLT Plasma Environment as seen by the DROPPS Sounding Rockets**

Assis, Michael P.; Goldberg, Richard A.; Webb, Phillip; Pesnell, W. Dean; Voss, Henry D.; [2006]; 1 pp.; In English; The Polar Summer MLT Plasma Environment as Seen by the Drops Sounding Rockets, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

During early July, 1999, the DROPPS (Distribution and Role of Particles in the Polar Summer Mesosphere) campaign launched two rocket payloads whose purpose was to study the polar summer MLT (mesosphere and lower thermosphere), particularly PMSEs (polar mesospheric summer echoes) and PMCs (polar mesospheric clouds). The rockets were launched from the And(\o)ya Rocket Range in Norway the nights of the 5th and 14th of July. Both payloads included a front-mounted PID (Particle Impact Detector) consisting of charge and mass telescopes to measure aerosol and dust mass distributions. Ice particles of nanometer size are believed to be responsible for PMSEs through the process of electron scavenging. Evidence for this process is suggested, for example, by the presence of an electron 'biteout' simultaneously measured by several instruments at an altitude of  $\sim$ 82-87 km during the first DROPPS launch. This presentation will characterize similarities and differences between both flights as seen by the charge and mass telescopes, starting at launch until the loss of data on the downleg of each flight. Various stages of the flights will be considered in detail, such as the PMSE layer and the apogee at 117 km, as well as the calibration of the data before launch.

Author

*Payloads; Mesosphere; Sounding Rockets; Thermosphere; Noctilucent Clouds; Launching*

**20070016658** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Binary Black Holes, Gravitational Waves, and Numerical Relativity**

Centrella, Joan; [2006]; 1 pp.; In English; Physics-Astronomy Colloquium, 15-17 Oct. 2006, Seattle, WA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The final merger of two black holes releases a tremendous amount of energy and is one of the brightest sources in the gravitational wave sky. Observing these sources with gravitational wave detectors requires that we know the radiation waveforms they emit. Since these mergers take place in regions of extreme gravity, we need to solve Einstein's equations of general relativity on a computer in order to calculate these waveforms. For more than 30 years, scientists have tried to compute these waveforms using the methods of numerical relativity. The resulting computer codes have been plagued by instabilities, causing them to crash well before the black holes in the binary could complete even a single orbit. This situation has changed dramatically in the past year, with a series of amazing breakthroughs. This talk will take you on this quest for the holy grail of numerical relativity, showing how a spacetime is constructed on a computer to build a simulation laboratory for binary black hole mergers. We will focus on the recent advances that are revealing these waveforms, and the dramatic new potential for

discoveries that arises when these sources will be observed by LISA and LIGO.

Author

*Black Holes (Astronomy); Gravitational Waves; Relativity; Numerical Analysis*

**20070016659** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Prospects for Pulsar Studies with the GLAST Large Area Telescope**

Harding, Alice K.; Oct. 4, 2006; 1 pp.; In English; High Energy Astrophysics Division (HEAD) Meeting, 4-6 Oct. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Large Area Telescope (LAT) on the Gamma-ray Large Area Space Telescope (GLAST) will have unprecedented sensitivity and energy resolution for gamma-rays in the range of 30 MeV to 200 GeV. GLAST is therefore expected to provide major advances in the understanding of high-energy emission from rotation-powered pulsars. As the only presently known galactic GeV source class, pulsars will be one of the most important sources for study with GLAST. The main science goals of the LAT for pulsar studies include an increase in the number of detected radio-loud and radio-quiet gamma ray pulsars, including millisecond pulsars, giving much better statistics for elucidating population characteristics, measurement of the high-energy spectrum and the shape of spectral cutoffs and determining pulse profiles for a variety of pulsars of different age. Further, measurement of phase-resolved spectra and energy dependent pulse profiles of the brighter pulsars should allow detailed tests of magnetospheric particle acceleration and radiation mechanisms, by comparing data with theoretical models that have been developed. Additionally, the LAT will have the sensitivity to allow blind pulsation searches of nearly all unidentified EGRET sources, to possibly uncover more radio-quiet Geminga-like pulsars.

Author

*Telescopes; Gamma Ray Telescopes; Pulsars; Gamma Ray Astronomy*

**20070016660** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Binary Black Hole Mergers and Recoil Kicks**

Centrella, Joan; Baker, J.; Choi, D.; Koppitz, M.; vanMeter, J.; Miller, C.; October 4, 2006; 1 pp.; In English; High Energy Astrophysics Division (HEAD) Meeting, 4-7 Oct. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

Recent developments in numerical relativity have made it possible to follow reliably the coalescence of two black holes from near the innermost stable circular orbit to final ringdown. This opens up a wide variety of exciting astrophysical applications of these simulations. Chief among these is the net kick received when two unequal mass or spinning black holes merge. The magnitude of this kick has bearing on the production and growth of supermassive black holes during the epoch of structure formation, and on the retention of black holes in stellar clusters. Here we report the first accurate numerical calculation of this kick, for two nonspinning black holes in a 1.5:1 mass ratio, which is expected based on analytic considerations to give a significant fraction of the maximum possible recoil. We have performed multiple runs with different initial separations, orbital angular momenta, resolutions, extraction radii, and gauges. The full range of our kick speeds is 86-116 kilometers per second, and the most reliable runs give kicks between 86 and 97 kilometers per second. This is intermediate between the estimates from two recent post-Newtonian analyses and suggests that at redshifts  $z$  greater than 10, halos with masses less than  $10(\exp 9) M(\text{sub SUN})$  will have difficulty retaining coalesced black holes after major mergers.

Author

*Black Holes (Astronomy); Astrophysics; Supermassive Stars; Circular Orbits*

**20070016661** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Modelling Gravitational Radiation from Binary Black Holes**

Centrella, Joan; October 4, 2006; 1 pp.; In English; High Energy Astrophysics Division (HEAD) Meeting, 4-7 Oct. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The final merger and coalescence of binary black holes is a key source of strong gravitational waves for the LISA mission. Observing these systems will allow us to probe the formation of cosmic structure to high redshifts and test general relativity directly in the strong-field, dynamical regime. Recently, major breakthroughs have been made in modeling black hole mergers using numerical relativity. This talk will survey these exciting developments, focusing on the gravitational waveforms and the recoil kicks produced from non-equal mass mergers.

Author

*Black Holes (Astronomy); Gravitational Waves; Astronomical Models; Coalescing*

90  
**ASTROPHYSICS**

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

**20070014885** Lawrence Livermore National Lab., Livermore, CA USA

**Laboratory Measurements of the Line Emission from Mid-Z I-Shell Ions in the EUV**

Lepson, J. K.; Beiersdorfer, P.; Chen, H.; Gu, M. F.; Kahn, S. M.; May 03, 2006; 6 pp.; In English

Report No.(s): DE2006-895992; UCRL-PROC-221077; No Copyright; Avail.: Department of Energy Information Bridge

We are continuing EBIT measurements of line lists in the EUV region for use as astrophysical diagnostics and have recently measured the same transitions in much denser plasma of the NSTX tokamak. This allows us to calibrate density-sensitive line ratios at their upper limits. We compare our observations at low and high density with calculations from the Flexible Atomic Code.

NTIS

*Extreme Ultraviolet Radiation; Ions*

**20070014888** Lawrence Livermore National Lab., Livermore, CA USA

**Laboratory Measurements of the X-Ray Line Emission from Neon-Like Fe XVII**

Brown, G. V.; Beiersdorfer, P.; Chen, H.; Scofield, J.; Boyce, K. R.; May 01, 2006; 6 pp.; In English

Report No.(s): DE2006-895993; UCRL-PROC-220995; No Copyright; Avail.: Department of Energy Information Bridge

The authors have conducted a systematic study of the dominant x-ray line emission from Fe XVII. These studies include relative line intensities in the optically thin limit, intensities in the presence of radiation from satellite lines from lower charge states of iron, and the absolute excitation cross sections of some of the strongest lines. These measurements were conducted at the Lawrence Livermore National Laboratory electron beam ion trap facility using crystal spectrometers and a NASA-Goddard Space Flight Center microcalorimeter array.

NTIS

*Emission; X Rays; Iron; Spectral Emission; Spectrum Analysis; Spectroscopy*

**20070014892** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Evolution of Dust in Extreme Astrophysical Environments**

Dwek, Eli; Galliano, Frederic; Jones, Anthony; [2006]; 1 pp.; In English; Dust and Gas in Ultraluminous Infrared Galaxies, 19-22 Jun. 2006, Ithaca, NY, USA; Copyright; Avail.: Other Sources; Abstract Only

The recent discovery of QSOs located at redshift  $z$  greater than 6, with high infrared luminosities (typically  $1.E13$  solar luminosities), challenges our understanding of dust evolution. Indeed, these high infrared luminosities imply more than  $1.E8$  solar masses of dust and nearly solar gas-to-dust mass ratios. An interesting question is how do we make so much dust within approx. 400 Myr, which is roughly the age of the galaxy assuming it formed at  $z=10$ . During this epoch, AGB stars could not have enriched the ISM, so that all the dust must have formed by supernovae (SN). However, SN blast waves also play an important role in destroying the dust in the ISM. Understanding the formation and evolution of the dust in such objects requires therefore the construction of a detailed model for the chemical evolution of the gas and dust phases of the ISM. We focus on the well-studied quasar SDSS J1148+5251, at  $z=6.42$ . Using the IR luminosities as tracers of the star formation rate (SFR) in these objects implies a rates of  $3E3 M_{\text{sun}}/\text{yr}$ , and SN rates of about 200/yr. However, this quasar contains an embedded AGN, so that the IR luminosity may not be a good tracer of the SFR in this object. Using the estimated mass of gas as a tracer of the SFR we construct a self-consistent model for the evolution of interstellar dust, which also follows the formation and destruction of the dust by SN. Finally, we discuss the contribution of the AGN to the total infrared luminosity, and its implications for the mass of the black hole that is required to power the observed IR emission.

Author

*Astrophysics; Cosmic Dust; Black Holes (Astronomy); Gas Evolution*

**20070014894** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**RXTE Observations of A1744-361: Correlated Spectral and Timing Behavior**

Bhattacharyya, Sudip; Strohmayer, Tod E.; Swank, Jean H.; Markwardt, Craig B.; [2007]; 19 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

We analyze Rossi X-ray Timing Explorer (RXTE) Proportional Counter Array (PCA) data of the transient low mass X-ray binary (LMXB) system A1744-361. We explore the X-ray intensity and spectral evolution of the source, perform timing

analysis, and find that A1744-361 is a weak LMXB, that shows atoll behavior at high intensity states. The color-color diagram indicates that this LMXB was observed in a low intensity spectrally hard (low-hard) state and in a high intensity banana state. The low-hard state shows a horizontal pattern in the color-color diagram, and the previously reported dipper QPO appears only during this state. We also perform energy spectral analyses, and report the first detection of broad iron emission line and iron absorption edge from A1744-361.

Author

*X Ray Binaries; X Ray Timing Explorer; Mass; Spectrum Analysis*

**20070014898** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**NASA's Future X-ray Missions: From Constellation-X to Generation-X**

Hornschemeier, A.; [2006]; 1 pp.; In English; Making the Most of the Great Observatories Conference, 21-25 May 2006, Pasadena, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Among the most important topics in modern astrophysics are the formation and evolution of supermassive black holes in concert with galaxy bulges, the nature of the dark energy equation of state, and the self-regulating symmetry imposed by both stellar and AGN feedback. All of these topics are readily addressed with observations at X-ray wavelengths. NASA's next major X-ray observatory is Constellation-X, which is being developed to perform spatially resolved high-resolution X-ray spectroscopy. Con-X will directly measure the physical properties of material near black holes' last stable orbits and the absolute element abundances and velocities of hot gas in clusters of galaxies. The Con-X mission will be described, as well as its successor, Generation-X (anticipated to fly approx. 1 decade after Con-X). After describing these missions and their driving science areas, the talk will focus on areas in which Chandra observing programs may enable science with future X-ray observatories. These areas include a possible ultra-deep Chandra imaging survey as an early Universe pathfinder, a large program to spatially resolve the hot intracluster medium of massive clusters to aid dark energy measurements, and possible deep spectroscopic observations to aid in preparatory theoretical atomic physics work needed for interpreting Con-X spectra.

Author

*X Ray Astronomy; Galactic Clusters; X Rays; X Ray Spectroscopy; Dark Energy; Astrophysics; Abundance*

**20070014934** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A CLOUDY/XSPEC Interface**

Porter, R. L.; Ferland, G. J.; Kraemer, S. B.; Armentrout, B. K.; Arnaud, K. A.; Turner, T. J.; [2007]; 11 pp.; In English Contract(s)/Grant(s): NAG5-7385; NAG5-7067; NNG04GG56G; Copyright; Avail.: CASI: A03, Hardcopy

We discuss new functionality of the spectral simulation code CLOUDY which allows the user to calculate grids with one or more initial parameters varied and formats the predicted spectra in the standard FITS format. These files can then be imported into the x-ray spectral analysis software XSPEC and used as theoretical models for observations. We present and verify a test case. Finally, we consider a few observations and discuss our results.

Author

*Computerized Simulation; Mathematical Models; Spectrum Analysis; Black Body Radiation; X Ray Spectra*

**20070014940** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Black Holes across the Mass Spectrum-from Stellar Mass BH to ULXs and AGN**

Mushotzky, Richard; May 02, 2006; 1 pp.; In English; IAU General Assembly, 14-25 Aug. 2006, Prague, Czech Republic; No Copyright; Avail.: Other Sources; Abstract Only

I will discuss the observational characteristics of black holes and how they compare across the  $10^8$  range in mass and as a function of luminosity and apparent Eddington ratio. I will concentrate on the broad band spectrum, the timing signatures and the energy budget of these objects. In particular I will stress the similarities and differences in the x-ray spectra and power density spectra of AGN, ultraluminous x-ray sources and galactic black holes as a function of 'state'. I will also discuss the nature of the Fe K line and other diagnostics of the regions near the event horizon.

Author

*Black Holes (Astronomy); Mass Spectra; Stellar Mass; Active Galactic Nuclei; Luminosity; X Ray Sources*

**20070015080** Stanford Linear Accelerator Center, CA, USA

**Separating Signal From Background Using Ensembles of Rules**

Friedman, J. H.; January 2006; 10 pp.; In English

Contract(s)/Grant(s): DE-AC02-76SF00515

Report No.(s): DE2006-895817; SLAC-PUB-12247; No Copyright; Avail.: National Technical Information Service (NTIS)

Machine learning has emerged as an important tool for separating signal events from associated background in high energy particle physics experiments. This paper describes a new machine learning method based on ensembles of rules. Each rule consists of a conjunction of a small number of simple statements ('cuts') concerning the values of individual input variables. These rule ensembles produce predictive accuracy comparable to the best methods. However their principal advantage lies in interpretation. Because of its simple form, each rule is easy to understand, as is its influence on the predictive model. Similarly, the degree of relevance of each of the respective input variables can be assessed. Graphical representations are presented that can be used to ascertain the dependence of the model jointly on the variables used for prediction.

NTIS

*High Energy Interactions; Machine Learning; Particle Theory*

**20070015151** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Galaxy Evolution Explorer (GALEX)**

Neff, Susan; [2007]; 1 pp.; In English; Ate of Gas in Galaxies, 11-17 Jul. 2006, Groningen, Netherlands; No Copyright; Avail.: Other Sources; Abstract Only

The Galaxy Evolution Explorer was designed to detect and quantify star formation in a wide variety of environments. I report new scientific results, based on GALEX observations, such as star formation in tidal tails, extended disks, intra-group and Intra-cluster, and induced by outflows from active galactic nuclei.

Author

*Galactic Evolution; Star Formation*

**20070015456** Bulgarian Academy of Sciences, Sofia, Bulgaria

**International Symposium on Recent Observations and Simulations of the Sun-Earth System**

Kartalev, Monio; Jan 10, 2007; 116 pp.; In English

Contract(s)/Grant(s): FA8655-06-1-5028

Report No.(s): AD-A464344; No Copyright; Avail.: CASI: [A06](#), Hardcopy

ONLINE: <http://hdl.handle.net/100.2/ADA464344>

The Final Proceedings for International Symposium on Recent Observations and Simulations of the Sun-Earth System, 18 September 2006 - 22 September 2006. The main purpose of the symposium is to create an international forum for scientists from solar, heliospheric, magnetospheric, and earth sciences communities to present and discuss recent advances in our understanding of the structure and complex interactions of the Sun-Earth System. The focused discussions will include, but are not limited to: (1) Solar Cycle variations in the Sun-Earth system; (2) Solar dynamics and the response of geospace; (3) Production, transport, and loss of energetic particles; (4) Sun-Earth system modeling and prediction. The main emphasis will be put on the integration of these studies - ranging from observations to related interpretation, theory and numerical modeling across different temporal and spatial scales of the Sun-Earth system. Participants should come away with a better realization of the dynamic nature of the space environment, while appreciating the benefits of interdisciplinary approaches to understanding the dynamic Sun-Earth system.

DTIC

*Aerospace Environments; Conferences; Earth Sciences; Simulation; Solar Physics; Space Weather; Sun*

**20070015736** Naval Research Lab., Washington, DC USA

**Diffuse Galactic Gamma-Ray Continuum**

Purcell, W R; Bouchet, L; Johnson, W N; Jung, G; Kinzer, R L; Kurfess, J D; Mandrou, P; Roques, J P; Skibo, J G; Vedrenne, G; Oct 2, 1995; 5 pp.; In English

Report No.(s): AD-A464399; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Coordinated observations of the galactic center region using the imaging SIGMA instrument and the high-sensitivity OSSE instrument were performed to separate the compact source contributions from the diffuse component. The resulting compact-source corrected spectrum of the galactic center region is found to be similar in both intensity and spectral index to the spectra obtained from OSSE observations of the galactic plane at  $l = 25$  degrees and 339 degrees, suggesting that the spatial distribution of the emission is broad and nearly flat in galactic longitude. At energies below  $\sim 100$  keV, the observed spectrum is found to be softer and more intense than predicted by theoretical models. The observed low energy continuum may be either diffuse in origin, or due to unresolved X-ray sources below the SIGMA detection threshold.

DTIC

*Continuums; Gamma Rays*

**20070015737** Air Force Research Lab., Kirkland AFB, NM USA

**The Demonstration and Science Experiments (DSX): A Fundamental Science Research Mission Advancing Technologies that Enable MEO Spaceflight**

Schoenberg, Jon; Ginet, Gregory; Dichter, Bronislaw; Xapsos, Michael; Adler, Aaron; Scherbarth, Mark; Smith, Durand; Jan 2006; 14 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA9453-05-C-0028; Proj-3005

Report No.(s): AD-A464400; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Air Force Research Laboratory has developed the Demonstration and Science Experiments (DSX) to research technologies needed to significantly advance the capability to operate spacecraft in the harsh radiation environment of medium-earth orbits (MEO). The ability to operate effectively in the MEO environment significantly increases the capability to field space systems that provide persistent global targeting-grade space surveillance, high-speed satellite-based communication, lower-cost GPS navigation, and protection from space weather on a responsive satellite platform. The DSX physics based research areas are: 1)Wave Particle Interaction Experiment: Researching the physics of very low-frequency (VLF) transmissions in the magnetosphere and characterizing the feasibility of natural and man-made VLF waves to reduce space radiation; 2)Space Weather Experiment: Characterizing and modeling the space radiation environment in MEO, an orbital regime attractive for future DoD and commercial missions; and 3)Space Environmental Effects: Researching and characterizing the space weather effects on spacecraft electronics and materials.

DTIC

*Aerospace Environments; Scientific Satellites; Space Flight*

**20070015738** Naval Research Lab., Washington, DC USA

**Gamma Ray Line Observational Results from OSSE**

Kurfess, J D; Murphy, R J; Leising, M D; Purcell, W R; Jan 1995; 15 pp.; In English

Report No.(s): AD-A464403; No Copyright; Avail.: CASI: [A03](#), Hardcopy

A major objective of the Oriented Scintillation Spectrometer Experiment (OSSE) on NASA's COMPTON Observatory is the observation of gamma ray line emission from a variety of astronomical objects. Gamma ray lines are of particular interest because they provide unique information on the production, relative abundances, acceleration and interactions of the nuclear component of matter. In this paper, we present some of the initial results obtained by OSSE on observations of line gamma-ray emission from solar flares, the galactic center region, and from supernovae.

DTIC

*Gamma Rays; Spectrometers*

**20070015740** Northwestern Univ., Evanston, IL USA

**Radio Continuum Emission from the Central Stars of M20, and the Detection of a New Supernova Remnant Near M20**

Yusef-Zadeh, F; Shure, Mark; Wardle, Mark; Kassim, N; Sep 10, 2000; 10 pp.; In English

Report No.(s): AD-A464407; No Copyright; Avail.: CASI: [A02](#), Hardcopy

The Trifid Nebula (M20) is a well-known prominent optical H II region trisected by obscuring dust lanes. Radio continuum VLA observations of this nebula show free-free emission at wavelength = 3.6 and 6 cm from three stellar sources lying close to the O7 V star at the center of the nebula. We argue that neutral material associated with these stars is photoionized externally by the UV radiation from the hot central star. We also report the discovery of a barrel-shaped supernova remnant, SNR G7.06--0.12, at the northwest rim of the nebula, and two shell-like features, G6.67--0.42 and G6.83--0.21, adjacent to W28 and M20. We discuss the nature of these features and their possible relationship to the pulsar PSR 1801--2306 and W28 OH (1720 MHz) masers.

DTIC

*Continuums; Emission; Extraterrestrial Radio Waves; Nebulae; Radio Emission; Radio Frequencies; Supernova Remnants*

**20070015741** Naval Research Lab., Washington, DC USA

**330 MHz VLA Observations of 20 Galactic Supernova Remnants**

Kassim, Namir E; Mar 1992; 12 pp.; In English

Report No.(s): AD-A464408; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present 330 MHz images and integrated flux densities for 20 previously identified 1st quadrant Galactic Supernova Remnants (SNRs). The observations were made in the D configuration of the VLA giving an angular resolution of  $\sim 3'$  and providing good sensitivity to extended structure. Such emission, particularly if it is nonthermal, might be missed on higher

frequency surveys due to confusion with the Galactic background and confusion with thermal sources in complex regions. Both problems are reduced by interferometric observations at this lower frequency. The flux densities presented can be used to anchor the low frequency end of the radio spectra of these sources, which are often poorly determined by previous observations at both high and low frequencies. The measurements presented here are also useful for distinguishing steeper spectrum shell-type emission from flatter spectrum plerionic emission for SNRs whose intrinsic morphological type is not well established.

DTIC

*Flux Density; Images; Measurement; Near Infrared Radiation; Spectroscopy; Supernova Remnants; Very Large Array (VLA)*

**20070015751** Naval Research Lab., Washington, DC USA

**Radio Spectrum Studies of 32 First-Quadrant Galactic Supernova Remnants**

Kassim, Namir E; Dec 1989; 18 pp.; In English

Contract(s)/Grant(s): AST-8416179

Report No.(s): AD-A464419; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present a comprehensive list of integrated radio continuum flux density measurements for 32 first- quadrant Galactic supernova remnants (SNRs). The list includes all available measurements from the literature, as well as some previously unpublished low-frequency measurements from the Clark Lake Galactic plane survey. All measurements have been placed on the same absolute flux density scale, and those which are deemed poor or otherwise inappropriate for the purposes of constructing continuum spectra have been noted. This compilation has been used in a separate paper to construct accurate spectra and to constrain the distribution and physical properties of ionized gas in the interstellar medium.

DTIC

*Flux Density; Interstellar Matter; Ionized Gases; Quadrants; Radio Spectra; Supernova Remnants*

**20070015752** Naval Research Lab., Washington, DC USA

**The Radiometric Bode's law and Extrasolar Planets**

Lazio, T J; Farrell, W M; Dietrick, Jill; Greenlees, Elizabeth; Hogan, Emily; Jones, Christopher; Hennig, L A; Sep 1, 2004; 9 pp.; In English

Report No.(s): AD-A464421; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We predict the radio flux densities of the extrasolar planets in the current census, making use of an empirical relation the radiometric Bode's law determined from the five 'magnetic' planets in the solar system (the Earth and the four gas giants). Radio emission from these planets results from solar wind powered electron currents depositing energy in the magnetic polar regions. We find that most of the known extrasolar planets should emit in the frequency range 10-1000 MHz and, under favorable circumstances, have typical flux densities as large as 1 mJy. We also describe an initial, systematic effort to search for radio emission in low radio frequency images acquired with the Very Large Array (VLA). The limits set by the VLA images ( 300 mJy) are consistent with, but do not provide strong constraints on, the predictions of the model. Future radio telescopes, such as the Low Frequency Array and the Square Kilometer Array, should be able to detect the known extrasolar planets or place austere limits on their radio emission. Planets with masses much lower than those in the current census will probably radiate below 10 MHz and will require a space-based array.

DTIC

*Extrasolar Planets; Flux Density; Planets; Radio Emission; Radiometers; Solar Wind; Very Large Array (VLA)*

**20070015753** Naval Research Lab., Washington, DC USA

**Gamma Ray Observations of Cygnus X-1 With OSSE**

Phlips, B F; Jung, G V; Leising, M D; Grove, J E; Johnson, W N; Kinser, R L; Kroeger, R A; Kurfess, J D; Strickman, M S; Grabelsky, D A; Matz, S M; Purcell, W R; Ulmer, M P; McNaron-Brown, K; Jan 1996; 5 pp.; In English

Report No.(s): AD-A464422; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report on ~120 days of observations of Cygnus X-1 with OSSE onboard the Compton Observatory. Emission is detected in the range 50 keV to 1 MeV and we find evidence for a continuum of hard X-ray spectra over a broad range of fluxes rather than the existence of distinct flux states. Comparisons of the source spectra with various theoretical models show that an exponentially truncated power law best describes the average spectrum in the OSSE energy band. Although we have measured a new minimum in the hard X-ray flux from the source, no evidence was found for either a broad 1 MeV feature or a narrow 511 keV line previously reported in association with a low flux state. Upper limits on such emission features are an order of magnitude lower than earlier reported detections. The 5.6-day periodicity of the source measured at optical



wavelengths was not detected with a sensitivity to the rms modulation fraction of 5% in the 60-140 keV energy band.  
DTIC

*Black Holes (Astronomy); Gamma Rays; X Ray Binaries*

**20070015755** Naval Research Lab., Washington, DC USA

**OSSE Observations of the Vela and Geminga Pulsars**

Strickman, M S; Grove, J E; Johnson, W N; Kinzer, R L; Kroeger, R A; Kurfess, J D; Grabelsky, D A; Matz, S M; Purcell, W R; Ulmer, M P; Jung, G V; Jan 1996; 24 pp.; In English

Report No.(s): AD-A464424; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment (OSSE) on board the Compton Gamma Ray Observatory detected the Vela Pulsar (PSR B0833-45) during August-September 1991, April-May 1992, and August 1993. Observed light curves have a two-peak pulse profile similar to that observed at higher energies, although the second peak may be wider in the OSSE light curve. Pulsed emission in the first gamma-ray peak was detected with 4.6 sigma statistical significance in the 0.07-0.6 MeV band in the sum of all three observing periods. The second gamma ray peak was detected at no more than 3 sigma significance in the same band. Due to the low statistical significance of the observations, little can be said concerning longer-term temporal variability. The spectrum is hard at lower energies and, in combination with higher energy data, appears to require a break in the 20 MeV region. OSSE also observed Geminga during July 1992, December 1993, and July 1994. No significant pulsed or time averaged emission was observed on any occasion. Upper limits to the pulsed emission suggest, but do not require, a break from the extrapolation of the spectrum measured at higher energies.

DTIC

*Gamma Rays; Pulsars*

**20070015757** Naval Research Lab., Washington, DC USA

**OSSE Upper Limits to Pulsar Gamma-Ray Emission**

Schroeder, P C; Ulmer, M P; Matz, S M; Grabelsky, D A; Purcell, W R; Grove, J E; Johnson, W N; Kinzer, R L; Kurfess, J D; Strickman, M S; Jung, G V; Sep 30, 1994; 28 pp.; In English

Report No.(s): AD-A464427; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present upper limits from CGRO Oriented Scintillation Spectrometer Experiment (OSSE) observations of pulsars and a summary of pulsar observations made with the Compton Gamma-Ray Observatory (CGRO). We also report an upper limit to phase-averaged emission for the globular cluster 47 Tuc which is thought to contain many millisecond pulsars. The 2sigma upper limit is  $3 \times 10^{(exp-5)}$  photons  $\text{cm}^{-2} \text{s}^{-1} \text{keV}^{-1}$  in the 50-150 keV energy range. The best predictor of a pulsar having a detectable gamma-ray emission appears to be the X-ray luminosities observed by the Rontgen Satellite (ROSAT) (~0.1-2.4 keV) or the EINSTEIN Satellite (~0.1-4.0 keV). We compare the gamma-ray data to models related to the inferred magnetic field, the spin down rate, and/or the frequency. Apparent correlations indicated by the pulsars detected by OSSE and the CGRO Energetic Gamma Ray Experiment Telescope (EGRET) have counter-examples in all cases.

DTIC

*Gamma Rays; Pulsars*

**20070015764** Naval Research Lab., Washington, DC USA

**Upper Limits on the Continuum Emission from Geminga at 74 and 326 MHz**

Kassim, Namir E; Lazio, T J; Dec 20, 1999; 5 pp.; In English

Report No.(s): AD-A464434; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report a search for radio continuum emission from the gamma-ray pulsar Geminga. We have used the VLA to image the location of the optical counterpart of Geminga at 74 and 326 MHz. We detect no radio counterpart. We derive upper limits to the pulse-averaged flux density of Geminga, taking diffractive scintillation into account. We find that diffractive scintillation is probably quenched at 74 MHz and does not influence our upper limit,  $56 \text{ mJy}$  (2 sigma), but that a 95% confidence level at 326 MHz is  $5 \text{ mJy}$ . Owing to uncertainties on the other low-frequency detections and the possibility of intrinsic variability or extrinsic variability (refractive interstellar scintillation) or both, our nondetections are nominally consistent with these previous detections.

DTIC

*Continuums; Emission; Pulsars; Radio Emission; Radio Frequencies; Scintillation*

**20070015768** Naval Research Lab., Washington, DC USA

**Hydra A at Low Radio Frequencies**

Lane, W M; Clarke, T E; Taylor, G B; Perley, R A; Kassim, N E; Jan 2004; 6 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464439; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We present new, low-frequency images of the powerful FR I radio galaxy Hydra A (3C 218). Images were made with the Very Large Array at frequencies of 1415, 330, and 74 MHz, with resolutions on the order of 20'. The morphology of the source is seen to be more complex and even larger than previously known and extends nearly 8' (530 kpc) in a north-south direction. The southern lobe is bent to the east and extends in that direction for nearly 3' (200 kpc). In addition, we find that the northern lobe has a flatter spectral slope than the southern lobe, consistent with the appearance of greater confinement to the south. We measure overall spectral indices 74-330 GHz = -0.83 and 330-1414 GHz = -0.89.

DTIC

*Galaxies; Images; Low Frequencies; Radio Frequencies; Radio Galaxies*

**20070015769** Institute of Astronomy, Cambridge, UK

**The Properties of the X-Ray Holes in the Intracluster Medium of the Perseus Cluster**

Fabian, A C; Celotti, A; Blundell, K M; Kassim, N E; Perley, R A; Jan 2002; 8 pp.; In English

Report No.(s): AD-A464440; No Copyright; Avail.: CASI: [A02](#), Hardcopy

High-resolution X-ray and low-frequency radio imaging now allow us to examine in detail the interaction and physical properties of the radio source 3C 84 and the surrounding thermal gas. The radiative and dynamical properties of the inner X-ray holes, which coincide with the radio lobes, indicate that the ratio of the energy factor  $k$  to the filling factor  $f$  is in the range  $180 \leq k/f \leq 500$ . We define  $k$  to be the ratio of the total particle energy to that of the electrons radiating above a fiducial frequency of 10 MHz. The relativistic plasma and magnetic field are not in equipartition, since the field must be a factor of 4 or more lower than required for pressure balance. Unexpected steep-spectrum spurs in the low-frequency radio maps point to outer X-ray holes, which are plausibly buoyant old radio lobes. The evidence that the inner lobes are currently expanding subsonically, yet have not detached due to buoyancy, and the requirement that the synchrotron cooling time must exceed the age of the hole enable us to constrain the jet power of the nucleus to between  $10(\exp 44)$  and  $10(\exp 45)$  erg s (exp-1), depending on the filling factor of the relativistic plasma.

DTIC

*Galactic Clusters; Intergalactic Media; Magnetic Fields; Radio Astronomy; X Rays*

**20070015775** Naval Research Lab., Washington, DC USA

**Two Low Frequency Surveys of Radio Galaxies**

Cohen, A S; Lane, W M; Lazio, T J; Kassim, N E; Perley, R A; Cotton, W D; Condon, J; Roettgering, H J; Wilman, R; Best, P; Jan 17, 2003; 7 pp.; In English

Report No.(s): AD-A464451; No Copyright; Avail.: CASI: [A02](#), Hardcopy

High resolution, low frequency observations are very efficient for surveying radio galaxies because of: 1) the wide field of view and 2) the bias toward steep spectrum (lobe dominated) emission. Here I present preliminary results from two ongoing low frequency radio surveys: the 4 Meter All Sky Survey (4MASS) and the low frequency counterpart to the XMM-Large Scale Structure (XMM-LSS) survey. 4MASS is an NRL-NRAO project to survey the entire sky above  $\delta = -20$  degrees at 74 MHz with a resolution of 1.3'. So far, 0.66 steradians have been observed and over 5000 objects identified, with the steep spectrum objects being followed up in a search for high redshift radio galaxies. The XMM-Large Scale Structure (XMM-LSS) survey is a major project underway to map the large scale structure of the universe out to cosmological distances. We are conducting a survey at both 325 MHz and 74 MHz in the 8 x 8 square degree XMM-LSS region. The radio counterpart to this deep X-ray survey is designed to explore the relation of the large scale structure to the location and properties of extragalactic radio sources. Statistical results of preliminary analysis of these two surveys are presented.

DTIC

*Galaxies; Low Frequencies; Radio Galaxies; Surveys*

**20070015778** Naval Research Lab., Washington, DC USA

**LWS Observations of the Colliding Galaxies NGC 4038/39**

Fischer, J; Shier, L M; Luhman, M L; Satyapal, S; Smith, H A; Stacey, G J; Unger, S J; Greenhouse, M A; Spinoglio, L; Malkan, M A; Jan 1996; 5 pp.; In English

Report No.(s): AD-A464459; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Infrared Space Observatory (ISO) Long Wavelength Spectrometer (LWS) and ground-based Fabry-Perot imaging spectroscopic observations are used to penetrate the extinction to the powerful burst of star formation that has occurred in the extranuclear molecular cloud complex in the galaxy overlap region of the galaxies NGC 4038/39 ('The Antennae'). Parameters of the starburst and typical molecular cloud core characteristics are derived. It is found that the starburst can power the infrared luminosity of this galaxy system.

DTIC

*Galactic Evolution; Galaxies; Infrared Spectroscopy; Interacting Galaxies; Spectrometers; Starburst Galaxies*

**20070015780** Naval Research Lab., Washington, DC USA

#### **OSSE Observations of X-Ray Pulsars**

Grove, J E; Kurfess, J D; Philips, B F; Strickman, M S; Ulmer, M P; Jan 1995; 5 pp.; In English

Report No.(s): AD-A464467; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report on OSSE observations of the Be binary pulsars A0535+26, GRO J1008-57, and 4U 0115+63 at energies above 50 keV. The spectra are generally thermal, with exponential folding energies of 15-25 keV, and no evidence for hard power-law tails. We have clearly detected a strong cyclotron absorption line at 110 keV from A0535+26 [1], and we find a suggestion of an absorption line near 90 keV from GRO J1008-57.

DTIC

*Pulsars; X Rays*

**20070015782** Universities Space Research Association, Washington, DC USA

#### **Operation and Performance of the OSSE Instrument**

Cameron, R A; Kurfess, J D; Johnson, W N; Kinzer, R L; Kroeger, R A; Leising, M D; Murphy, R J; Share, G H; Strickman, M S; Grove, J E; Jan 1991; 12 pp.; In English

Report No.(s): AD-A464471; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment (OSSE) on the Arthur Holly Compton Gamma Ray Observatory is described. An overview of the operation and control of the instrument is given, together with a discussion of typical observing strategies used with OSSE and basic data types produced by the instrument. Some performance measures for the instrument are presented, obtained from pre-launch and in-flight data. These include observing statistics, continuum and line sensitivity, and detector effective area and gain stability.

DTIC

*Detectors; Gamma Rays; Neutrons; Pulsars; Solar Flares; Spectrometers*

**20070015786** Naval Academy, Annapolis, MD USA

#### **Spatial Variations of the Synchrotron Spectrum Within Tycho's Supernova Remnant (3C 10): A Spectral Tomography Analysis of Radio Observations at 20 and 90 Centimeter Wavelengths**

Katz-Stone, D M; Kassim, Namir E; Lazio, T J; O'Donnell, R; Jan 20, 2000; 11 pp.; In English

Contract(s)/Grant(s): N00014-98-WR20010

Report No.(s): AD-A464479; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present subarcminute-resolution (approx. 10'), high-dynamic range radio observations of Tycho's supernova remnant (3C 10) at  $\lambda = 20$  cm and  $\lambda = 90$  cm with the Very Large Array (VLA). The thermal-noise-limited 90 cm image has been compensated properly for the noncoplanar characteristics of the VLA and is the most sensitive low-frequency image of this source presently available. We use these images to search for spatial variations in the continuum radio spectral index within the remnant. Such spatial variations should be related to the electron acceleration processes associated with the evolution of the blast wave. We have also utilized, for the first time in an analysis of a supernova remnant, spectral tomography to search for localized regions within which the spectral index is different from the surroundings. We have identified 13 filaments, ranging in size from approx. 40' to approx. 260', embedded in a smoother, background component. The average spectral index of the filaments ( $\alpha_g = -0.52 \pm 0.02$ ) is consistent with that of the background component ( $\alpha_g = -0.500 \pm 0.007$ ). However, the filaments in the outer rim show a trend such that brighter filaments have a flatter spectral index. This trend may be due to either supernova remnant (SNR) blast wave-ambient medium interactions or internal inhomogeneities of the magnetic field within the remnant. These hypotheses could be tested by an image at comparable resolution and fidelity at a third frequency.

DTIC

*Radio Observation; Spectra; Spectrum Analysis; Supernova Remnants; Supernovae; Synchrotrons; Tomography*

**20070015788** Naval Research Lab., Washington, DC USA

**Fabry-Perot Imaging Spectroscopy of Interacting and Merging Galaxies: NGC 3690 and NGC 6240**

Fischer, Jacqueline; Smith, Howard A; Glaccum, William; Jan 1990; 5 pp.; In English

Report No.(s): AD-A464484; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We present 2 micrometer spectroscopic images in the H2 nu=1-0 S(1) line, the Br gamma recombination line of atomic hydrogen, and the neighboring continuum of the central regions of the galaxies NGC 3690/IC 694 and NGC 6240. Based on the morphology of these images we assess the contributions of star formation, colliding disks, and nuclear activity to the line emission.

DTIC

*Fabry-Perot Spectrometers; Galaxies; Images; Imaging Techniques; Spectroscopy*

**20070015791** Pittsburgh Univ., Pittsburgh, PA USA

**Low-Redshift Damped Ly(alpha) Galaxies Toward the Quasars B2 0827+243, PKS 0952+179, PKS 1127-145, and PKS 1629+120**

Rao, Sandhya M; Nestor, Daniel B; Turnshek, David A; Lane, Wendy M; Monier, Eric M; Bergeron, Jacqueline; Sep 20, 2003; 16 pp.; In English

Report No.(s): AD-A464487; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present optical and near-infrared ground-based imaging results on four low-redshift damped Ly-alpha (DLA) galaxies. The corresponding DLA systems were discovered in our Hubble Space Telescope spectroscopic surveys for DLA lines in known strong Mg ii absorption-line systems toward the quasars B2 0827+243, PKS 0952+179, PKS 1127 145, and PKS 1629+120. Two of the four DLA galaxies have confirmed slit redshifts, one has a photometric redshift consistent with the absorption-line redshift, and the fourth identification is based on the galaxy's proximity to the quasar sight line. The DLA galaxies span a mixture of morphological types from patchy, irregular, and low surface brightness to spiral galaxies. We also discovered several extremely red objects (EROs) in two of these fields and discuss the possibility that they are associated with the DLA galaxies. These observations add to the small but growing list of DLA galaxies at low redshift. At the present time, 14 DLA galaxies in the redshift range 0.05 smaller or approx. Z smaller or approx. 1 have been studied. The distributions of DLA galaxy properties for these 14 cases are discussed, and some important trends emerge. Low-luminosity dwarf galaxies with small impact parameters dominate this small sample. Also, four of the five highest column density systems, which dominate in the determination of the cosmological neutral gas mass density, arise in low surface brightness dwarf galaxies. Zwaan et al. have shown that only 15% of the neutral gas at the present epoch is contained in low surface brightness galaxies. Thus, if the low-redshift DLA galaxy trends hold up with larger samples, it would indicate that a different population of objects is responsible for the bulk of the neutral hydrogen gas in the universe at Z approx. 0.5.

DTIC

*Galaxies; Hydrogen; Quasars; Red Shift*

**20070015800** Naval Research Lab., Washington, DC USA

**Charge Division Readout of a Two-Dimensional Germanium Strip Detector**

Kroeger, R A; Inderhees, S E; Johnson, W N; Kinzer, R L; Kurfess, J D; Gehrels, N; Jan 1993; 6 pp.; In English

Report No.(s): AD-A464505; No Copyright; Avail.: CASI: [A02](#), Hardcopy

Germanium strip detectors combine superior spectroscopy typical of germanium detectors with good spatial resolution. Our work has been to develop a 2-dimensional position readout of a 5 x 5 strip X-Y detector. The prototype device uses two capacitive charge division strings. Each string is read-out by two 13-bit ADCs, one on each end of the string. The four data channels are stored as an event list for subsequent processing. We form a response map over the detector surface in order to locate the position of each interaction with the spatial resolution of the strip pitch, in our case 9 mm. Cross-talk and non-linearities are removed using the response map. Energy resolution of 5.5 keV FWHM is achieved between 60 and 662 keV across the full surface of the detector.

DTIC

*Calibrating; Capacitance; Detectors; Germanium; Readout; Resolution*

**20070015806** California Inst. of Tech., Pasadena, CA USA

**An OSSE Search for the Binary Radio Pulsar 1259-63**

Ray, P S; Grove, J E; Kurfess, J D; Prince, T A; Ulmer, M P; Jan 1993; 6 pp.; In English

Report No.(s): AD-A464513; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We have searched data from the Oriented Scintillation Spectrometer Experiment (OSSE) on the Compton Gamma Ray Observatory (GRO) for evidence of low-energy gamma-ray emission from the binary radio pulsar PSR 1259-63. This 47 ms pulsar is in a long-period, highly eccentric orbit around a Be stellar companion and was observed by OSSE approximately 400 days after periastron. The period derivative allowed by the published radio ephemeris (Johnston et al. 1992) suggests that the pulsar might be relatively young, and therefore a gamma-ray source. However, the ephemeris is not sufficiently accurate to allow the traditional epoch folding technique over the full OSSE observation. Instead, the OSSE data were analyzed using Fourier transform spectral techniques after applying trial accelerations to correct for a range of possible orbital accelerations. We searched 48 accelerations; each FFT was  $2(\exp 29)$  points sampled at 2 ms, spanning  $\sim 10(\exp 6)$  seconds of observation time. There was no evidence of pulsed emission in the 64-150 keV band, with a 99.9% confidence upper limit of  $6 \times 10^{-3}$  photons  $\text{sq cm s}(\exp -1)$  MeV $(\exp -1)$  or  $\sim 40$  m Crab pulsars, which suggests that the pulsar's intrinsic period derivative is small and its magnetic field weak. This work was performed on the Concurrent Supercomputing Consortium's Intel Touchstone Delta parallel supercomputer as part of a GRO Phase I Guest Investigation.

DTIC

*Gamma Rays; Pulsars*

**20070015837** Kennesaw State Univ., GA USA

**New Nonthermal Filaments at the Galactic Center: Are They Tracing a Globally Ordered Magnetic Field**

LaRosa, T N; Nord, Michael E; Lazio, T J; Kassim, Namir E; May 20, 2004; 8 pp.; In English

Report No.(s): AD-A464576; No Copyright; Avail.: CASI: [A02](#), Hardcopy

New high-resolution, wide-field 90 cm Very Large Array (VLA) observations of the Galactic center (GC) region by Nord and coworkers have revealed 20 nonthermal filament (NTF) candidates. We report 6 cm polarization observations of six of these. All of the candidates have the expected NTF morphology, and two show extended polarization, confirming their identification as NTFs. One of the new NTFs appears to be part of a system of NTFs located in the Sgr B region, 64 pc in projection north of Sgr A. These filaments cross the Galactic plane with an orientation similar to the filaments in the Galactic center radio arc. They extend the scale over which the NTF phenomena is known to occur to almost 300 pc along the Galactic plane. Another NTF was found in the Galactic plane south of the Sgr C filament but with an orientation of 45 to the Galactic plane. This is only the second of 12 confirmed NTFs that is not oriented perpendicular to the Galactic plane. An additional candidate in the Sgr C region was resolved into multiple filamentary structures. Polarization was detected only at the brightness peak of one of the filaments. Several of these filaments run parallel to the Galactic plane and can be considered additional evidence for nonpoloidal magnetic fields at the GC. Together the 90 and 6 cm observations indicate that the GC magnetic field may be more complex than a simple globally ordered dipolar field.

DTIC

*Magnetic Fields; Radio Astronomy*

**20070015838** Institute of Radio Astronomy, Bologna, Italy

**Spectral Index Maps of the Radio Halos in Abell 665 and Abell 2163**

Feretti, L; Orru, E; Brunetti, G; Giovannini, G; Kassim, N; Setti, G; Apr 14, 2004; 10 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464577; No Copyright; Avail.: CASI: [A02](#), Hardcopy

New radio data at 330 MHz are presented for the rich clusters Abell 665 and Abell 2163, whose radio emission is characterized by the presence of a radio halo. These images allowed us to derive the spectral properties of the two clusters under study. The integrated spectra of these halos between 0.3 GHz and 1.4 GHz are moderately steep: varies as  $1.4/0.3 = 1.04$  and varies as  $1.4/0.3 = 1.18$ , for A665 and A2163, respectively. The spectral index maps, produced with an angular resolution of the order of  $\sim 1'$ , show features of the spectral index (flattening and patches), which are indication of a complex shape of the radiating electron spectrum, and are therefore in support of electron reacceleration models. Regions of flatter spectrum are found to be related to the recent merger activity in these clusters. This is the first strong confirmation that the cluster merger supplies energy to the radio halo. In the undisturbed cluster regions, the spectrum steepens with the distance from the cluster center. This is interpreted as the result of the combination of the magnetic field profile with the spatial distribution of the

reacceleration efficiency, thus allowing us to set constraints on the radial profile of the cluster magnetic field.

DTIC

*Galactic Clusters; Galaxies; Halos; Spectra*

**20070015840** National Radio Astronomy Observatory, Socorro, NM USA

**M87 at 90 Centimeters: A Different Picture**

Owen, Frazer N; Eilek, Jean A; Kassim, Namir E; Jun 15, 2000; 10 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A464583; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We report new radio imaging of the large-scale radio structure of M87 with the VLA at 90 cm. These new images show the complex structure of the radio emission more clearly than previous attempts, some of which date back to the 1940s. The images suggest that the outward flow from the M87 nucleus extends well beyond the 2 kpc jet. Two 'bubbles' of synchrotron emission appear to be inflated by this flow. A simple model of the emission, combined with our knowledge of the inner jet, suggest that the energy input into this region from the M87 nucleus exceeds the energy being radiated away as X-rays. This argues that the region within 40 kpc of the center of M87 is currently dominated by energy input from the M87 nucleus. The gas in the region is expanding, not owing inward as is envisioned in the cooling flow model.

DTIC

*Cooling; Elliptical Galaxies; Galaxies; Images; Radio Emission; Radio Frequencies*

**20070015842** Hawaii Univ., Hilo, HI USA

**A Low-Frequency Survey of the Galactic Plane Near  $l = 11$  degs: Discovery of Three New Supernova Remnants**

Brogan, C L; Devine, K E; Lazio, T J; Kassim, N E; Tam, C R; Brisken, W F; Dyer, K K; Roberts, M S; Jan 2004; 14 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NSF-AST-01-03879

Report No.(s): AD-A464585; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We have imaged a  $\sim 1$  deg<sup>2</sup> field centered on the known Galactic supernova remnant (SNR) G11.2-0.3 at 74, 330, and 1465 MHz with the Very Large Array radio telescope and 235 MHz with the Giant Metrewave Radio Telescope. The 235, 330, and 1465 MHz data have a resolution of 25', while the 74 MHz data have a resolution of  $\sim 100'$ . The addition of this low-frequency data has allowed us to confirm the previously reported low-frequency turnover in the radio continuum spectra of the two known SNRs in the field, G11.2-0.3 and G11.4-0.1, with unprecedented precision. Such low-frequency turnovers are believed to arise from free-free absorption in ionized thermal gas along the lines of sight to the SNRs. Our data suggest that the 74 MHz optical depths of the absorbing gas is 0.56 and 1.1 for G11.2-0.3 and G11.4-0.1, respectively. In addition to adding much needed low-frequency integrated flux measurements for two known SNRs, we have also detected three new SNRs: G11.15-0.71, G11.03-0.05, and G11.18+011. These new SNRs have integrated spectral indices between -0.44 and -0.80. Because of confusion with thermal sources, the high resolution (compared with previous Galactic radio frequency surveys) and surface brightness sensitivity of our observations have been essential to the identification of these new SNRs. With this study we have more than doubled the number of SNRs within just a  $\sim 1$  deg<sup>2</sup> field of view in the inner Galactic plane. This result suggests that future low-frequency observations of the Galactic plane of similar quality may go a long way toward alleviating the long-recognized incompleteness of Galactic SNR catalogs.

DTIC

*Low Frequencies; Supernova Remnants; Supernovae; Surveys*

**20070015844** Maryland Univ., College Park, MD USA

**Ionospheric Corrections for VLA Observations Using Local GPS Data**

Erickson, W C; Perley, R A; Flatters, C; Kassim, N E; Jan 2001; 11 pp.; In English

Report No.(s): AD-A464587; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We have conducted an experiment to evaluate the usefulness of ionospheric data produced using the Global Positioning System (GPS) for making Faraday rotation and interferometer phase corrections at the NRAO Very Large Array (VLA). Four GPS receivers were installed at the VLA site -- one at the array center and one at the end of each arm. A simple ionospheric model consisting of a vertical TEC, a horizontal gradient, and the azimuth of that gradient was developed and fitted to the GPS Total Electron Content (TEC) data from each receiver. The model was then used to predict the TEC in the observing direction. Ionospheric Faraday rotation and phase gradients were then estimated and compared with VLA measurements taken at frequencies of 322 and 333 MHz. We find that we can normally make Faraday rotation corrections that are accurate to less than or approximately 2 deg, although one unexplained discrepancy remains. The interferometer phase shifts caused by

large-scale (greater than or approx. 1000 km) ionospheric structures can be predicted by our model. However the phase shifts caused by smaller (less than or approx. 100 km) structures can be estimated only when the direction of observation lies within a few degrees of one of the GPS satellites.

DTIC

*Atmospheric Models; Correction; Earth Ionosphere; Electron Density (Concentration); Faraday Effect; Global Positioning System; Interferometry; Radio Astronomy; Very Large Array (VLA)*

**20070015846** George Mason Univ., Fairfax, VA USA

**Background and Sensitivity Simulation of a Space Based Germanium Compton Telescope**

Graham, B L; Philips, B F; Kurfess, J D; Kroeger, R A; Jan 1997; 6 pp.; In English

Report No.(s): AD-A464590; No Copyright; Avail.: CASI: [A02](#), Hardcopy

A Monte Carlo simulation code has been developed that calculates the isotopes produced by spallation and propagates the products of radioactive decays for the purpose of studying activation backgrounds in space based gamma-ray telescopes. This code has been applied to study a Compton telescope consisting of two large arrays of position sensitive germanium detectors. Activation of the germanium by cosmic rays and their secondary particles is the major source of background. These simulations quantify the contributions and spectrum of each background component.

DTIC

*Germanium; Sensitivity; Simulation; Telescopes*

**20070015853** Naval Research Lab., Washington, DC USA

**Thin Scintillators and Position Sensitive Photomultiplier Tubes for Hard X-ray Imaging in Space**

Kroeger, R A; Grove, J E; Inderhees, S E; Johnson, W N; Kinzer, R L; Kurfess, J D; Philips, B P; Jun 1997; 5 pp.; In English

Report No.(s): AD-A464603; No Copyright; Avail.: CASI: [A01](#), Hardcopy

Monolithic and segmented CsI(Tl) scintillators coupled to a position sensitive photomultiplier tube (PSPMT) have been tested for imaging and environmental performance necessary for hard X-ray astrophysics missions. Using a crossed-wire PSPMT and individual anode-wire readout, spatial resolution of 1-2 mm rms at 60 keV over the entire photo-cathode imaging surface is obtained out to near the edges of the scintillator. A PSPMT mapping correction was used to obtain energy resolution close to what is expected from CsI(Tl) scintillators.

DTIC

*Photomultiplier Tubes; Scintillation Counters; Sensitivity; X Ray Imagery*

**20070015855** Tokyo Astronomical Observatory, Mitaka, Japan

**Strong Evidence for a Buried Active Galactic Nucleus in UGC 5101: Implications for Liner-Type Ultraluminous Infrared Galaxies**

Imanishi, Masatoshi; Dudley, C C; Maloney, Philip R; Sep 10, 2001; 5 pp.; In English

Report No.(s): AD-A464606; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report on the results of 3-4 micrometers spectroscopy of the ultraluminous infrared galaxy (ULIRG) UGC 5101. It has a cool far-infrared color and a LINER-type optical spectrum and so, based on a view gaining some currency, would be regarded as dominated by star formation. However, we find that it has strong 3.4 micrometers carbonaceous dust absorption, low equivalent width 3.3 micrometers polycyclic aromatic hydrocarbon (PAH) emission, and a small 3.3 micrometers PAH to far-infrared luminosity ratio. This favors an alternative scenario, in which an energetically dominant active galactic nucleus (AGN) is present behind obscuring dust. The AGN is plausibly obscured along all lines of sight (a 'buried AGN') rather than merely obscured along our particular line of sight. Such buried AGNs have previously been found in thermal infrared studies of the ULIRGs IRAS 08572 3915 and IRAS F00183-7111, both classified optically as LINERs. We argue that buried AGNs can produce LINER-type optical spectra and that at least some fraction of LINER-type ULIRGs are predominantly powered by buried AGNs.

DTIC

*Active Galactic Nuclei; Galaxies; Infrared Radiation; Linings; Luminosity*

**20070015860** Northwestern Univ., Evanston, IL USA

**BATSE/OSSE Rapid Burst Response**

Matz, S M; Grove, J E; Johnson, W N; Kurfess, J D; Share, G H; Fishman, G J; Meegan, C A; Jul 12, 1995; 5 pp.; In English

Report No.(s): AD-A464612; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The BATSE and OSSE instrument teams have modified ight software to promptly (within 2 min of trigger) slew the OSSE detectors to burst locations determined on-board by BATSE. This enables OSSE to make sensitive searches for prompt and delayed post-burst line and continuum emission above 50 keV. In the best cases our sensitivity will be more than an order of magnitude better than any other search in this energy range. We expect to slew to 1-2 bursts per month, based on the OSSE FOV and BATSE event rate. Detections or limits from continued operation of this system may provide significant constraints on burst models. As an example of the observations made using this system, we present preliminary limits for post-burst emission from GRB 950223 on several time scales.

DTIC

*Accuracy; Emission; Gamma Ray Bursts; Gamma Ray Observatory*

**20070015867** Tokyo Astronomical Observatory, Mitaka, Japan

**Energy Diagnoses of Nine Infrared Luminous Galaxies Based on 3-4 Micron Spectra**

Imanishi, Masatoshi; Dudley, C C; Dec 20, 2000; 12 pp.; In English

Report No.(s): AD-A464633; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The energy sources of nine infrared luminous galaxies (IRLGs) are diagnosed based on their ground-based 3-4 micron spectra. Both the equivalent width of the 3.3 micron polycyclic aromatic hydrocarbon (PAH) emission feature and the 3.3 micron PAH to far-infrared luminosity ratio are analyzed. Assuming that nuclear compact starburst activity in these sources produces the 3.3 micron PAH emission as strongly as that in starburst galaxies with lower far-infrared luminosities, the following results are found. For six IRLGs, both the observed equivalent widths and the PAH to far-infrared luminosity ratios are too small to explain the bulk of their far-infrared luminosities by compact starburst activity, indicating that active galactic nucleus (AGN) activity is a dominant energy source. For the other three IRLGs, while the 3.3 micron PAH equivalent widths are within the range of starburst galaxies, the 3.3 micron PAH to far-infrared luminosity ratios after correction for screen dust extinction are a factor of ~3 smaller. The uncertainty in the dust extinction correction factor and in the scatter of the intrinsic PAH to far-infrared luminosity ratios for starburst galaxies does not allow a determination of the ultimate energy sources for these three IRLGs.

DTIC

*Diagnosis; Galaxies; Infrared Radiation; Infrared Spectroscopy*

**20070015869** Cornell Univ., Ithaca, NY USA

**Anomalous Radio-Wave Scattering from Interstellar Plasma Structures**

Cordes, J M; Lazio, T J; Mar 10, 2001; 15 pp.; In English

Report No.(s): AD-A464645; No Copyright; Avail.: CASI: [A03](#), Hardcopy

This paper considers scattering screens that have arbitrary spatial variations of scattering strength transverse to the line of sight, including screens that are spatially well confined, such as disks and filaments. We calculate the scattered image of a point source and the observed pulse shape of a scattered impulse. The consequences of screen confinement include (1) source image shapes that are determined by the physical extent of the screen rather than by the shapes of much smaller diffracting microirregularities (these include image elongations and orientations that are frequency dependent); (2) variation with frequency of angular broadening that is much weaker than the trademark  $\nu^{-2}$  scaling law (for a cold, unmagnetized plasma), including frequency-independent cases; and (3) similar departure of the pulse-broadening time from the usually expected  $\nu^{-4}$  scaling law. We briefly discuss applications that include scattering of pulses from the Crab pulsar by filaments in the Crab Nebula; image asymmetries from Galactic scattering of the sources Cyg X-3, Sgr A\*, and NGC 6334B; and scattering of background active galactic nuclei by intervening galaxies. We also address the consequences for inferences about the shape of the wavenumber spectrum of electron density irregularities, which depend on scaling laws for the image size and the pulse broadening. Future low-frequency ( $\sim 100$  MHz) array observations will also be strongly affected by the Galactic structure of scattering material. Our formalism is derived in the context of radio scattering by plasma density fluctuations. It is also applicable to optical, UV, and X-ray scattering by grains in the interstellar medium.

DTIC

*Extraterrestrial Radio Waves; Interstellar Matter; Plasmas (Physics); Pulsars; Radio Waves; Scattering; Wave Scattering*

**20070015924** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Science with the James Webb Space Telescope**

Gardner, Jonathan P.; [2006]; 1 pp.; In English; International Society for Optical Engineering Conference, 24-30 May 2006, Orlando, FL, USA; No Copyright; Avail.: Other Sources; Abstract Only



The scientific capabilities of the James Webb Space Telescope (JWST) fall into four themes. The End of the Dark Ages: First Light and Reionization theme seeks to identify the first luminous sources to form and to determine the ionization history of the universe. The Assembly of Galaxies theme seeks to determine how galaxies and the dark matter, gas, stars, metals, morphological structures, and active nuclei within them evolved from the epoch of reionization to the present. The Birth of Stars and Protoplanetary Systems theme seeks to unravel the birth and early evolution of stars, from infall onto dustenshrouded protostars, to the genesis of planetary systems. Planetary Systems and the Origins of Life theme seeks to determine the physical and chemical properties of planetary systems around nearby stars and of our own, and investigate the potential for life in those systems. To enable these for science themes, JWST will be a large (6.5m) cold (50K) telescope with four instruments, capable of imaging and spectroscopy from 0.6 to 27 microns wavelength.

Author

*James Webb Space Telescope; Astrophysics; Protoplanets; Planetary Evolution*

**20070015925** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Stellar Imager (SI) Space Mission: Stellar Magnetic Activity**

Carpenter, K. G.; [2006]; 1 pp.; In English; IAU General Assembly/IAU Division IV 'Stars', 14-22 Aug. 2006, Prague, Cape Verde; No Copyright; Avail.: Other Sources; Abstract Only

The Stellar Imager (SI) is a UV-Optical, Space-Based interferometer designed to enable 0.1 milli-arcsecond (mas) spectral imaging of stellar surfaces and stellar interiors (via asteroseismology) and of the Universe in general. SI is identified as a 'Flagship and Landmark Discovery Mission' in the 2005 Sun Solar System Connection (SSSC) Roadmap and as a candidate for a 'Pathways to Life Observatory' in the Exploration of the Universe Division (EUD) Roadmap (May, 2005). The ultra-sharp images of the Stellar Imager will revolutionize our view of many dynamic astrophysical processes: The 0.1 mas resolution of this deep-space telescope will transform point sources into extended sources, and snapshots into evolving views. SI'S science focuses on the role of magnetism in the Universe, particularly on magnetic activity on the surfaces of stars like the Sun. SI'S prime goal is to enable long-term forecasting of solar activity and the space weather that it drives in support of the Living With a Star program in the Exploration Era. SI will also revolutionize our understanding of the formation of planetary systems, of the habitability and climatology of distant planets, and of many magneto-hydrodynamically controlled processes in the Universe. In this paper we will discuss the science goals of the SI Mission and a mission architecture that could meet those goals.

Author

*Imaging Techniques; Stellar Activity; Stellar Magnetic Fields; Space Missions; Spaceborne Telescopes; Astrophysics*

**20070015954** Naval Research Lab., Washington, DC USA

**Infrared Space Observatory Measurements of a [C II] 158 micron Line Deficit in Ultraluminous Infrared Galaxies**

Luhman, M L; Satyapal, S; Fischer, J; Wolfire, M G; Cox, P; Lord, S D; Smith, H A; Stacey, G J; Unger, S J; Jul 23, 1998; 6 pp.; In English

Report No.(s): AD-A464598; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We report measurements of the [C II] 157.74 microns fine-structure line in a sample of seven ultraluminous infrared galaxies (ULIGs) with the Long Wavelength Spectrometer on the Infrared Space Observatory. The [C II] line is an important coolant in galaxies and arises in interstellar gas exposed to far-ultraviolet photons; in ULIGs, this radiation stems from the bursts of star formation and/or from the active galactic nuclei that power the tremendous infrared luminosity. The [C II] 158 micronline is detected in four of the seven ULIGs; the absolute line flux (about a few times  $10(\exp -20) \text{ W cm}(\exp -2)$ ) represents some of the faintest extragalactic [C II] emission yet observed. Relative to the far-infrared continuum, the [C II] flux from the observed ULIGs is approx. 10% of that seen from nearby normal and starburst galaxies. We discuss possible causes for the [C II] deficit, namely (1) self-absorbed or optically thick [C II] emission, (2) saturation of the [C II] emission in photodissociated gas with high gas density  $n$  or with a high ratio of incident UV flux  $G(\text{sub } 0)$  to  $n$  or (3) the presence of a soft ultraviolet radiation field caused, for example, by a stellar population deficient in massive main-sequence stars. As nearby examples of colliding galaxies, ULIGs may resemble high-redshift protogalaxies in both morphology and spectral behavior. If true, the suggested [C II] deficit in ULIGs poses limitations on the detection rate of high- $z$  sources and on the usefulness of [C II] as an eventual tracer of protogalaxies.

DTIC

*Background Radiation; Far Ultraviolet Radiation; Galaxies; Infrared Radiation; Infrared Space Observatory (ISO); Luminosity*

**20070015958** Naval Research Lab., Washington, DC USA

**Spatially Resolved Thermal Continuum Absorption Against Supernova Remnant W49B**

Lacey, C K; Lazio, T J; Kassim, Namir E; Duric, N; Briggs, D S; Dyer, K K; Oct 1, 2001; 10 pp.; In English  
Report No.(s): AD-A464477; No Copyright; Avail.: CASI: [A02](#), Hardcopy

We present subarcminute resolution imaging of the Galactic supernova remnant W49B at 74 MHz (25') and 327 MHz (6'), the former being the lowest frequency at which the source has been resolved. While the 327 MHz image shows a shell-like morphology similar to that seen at higher frequencies, the 74 MHz image is considerably different, with the southwest region of the remnant almost completely attenuated. The implied 74 MHz optical depth (approximately 1.6) is much higher than the intrinsic absorption levels seen inside two other relatively young remnants, Cas A and the Crab Nebula, nor are natural variations in the relativistic electron energy spectra expected at such levels. The geometry of the absorption is also inconsistent with intrinsic absorption. We attribute the absorption to extrinsic free-free absorption by an intervening cloud of thermal electrons. Its presence has already been inferred from the low-frequency turnover in the integrated continuum spectrum and from the detection of radio recombination lines toward the remnant. Our observations confirm the basic conclusions of those measurements, and our observations have resolved the absorber into a complex of classical H II regions surrounded either partially or fully by low-density H II gas. We identify this low-density gas as an extended H II region envelope (EHE), whose statistical properties were inferred from low-resolution meter- and centimeter-wavelength recombination line observations. Comparison of our radio images with H I and H<sub>2</sub>CO observations shows that the intervening thermal gas is likely associated with neutral and molecular material as well. This EHE may be responsible for the enhanced radio-wave scattering seen in the general direction of the W49 complex.

DTIC

*Continuums; Imaging Techniques; Low Frequencies; Radio Astronomy; Supernova Remnants; Supernovae; Thermal Absorption*

**20070015959** Naval Research Lab., Washington, DC USA

**G359.87+0.18, An FR II Radio Galaxy 15' from Sagittarius A\*: Implications for the Scattering Region in the Galactic Center**

Lazio, T J; Anantharmaiah, K R; Goss, W M; Kassim, Namir E; Cordes, James M; Apr 10, 1999; 11 pp.; In English  
Report No.(s): AD-A464480; No Copyright; Avail.: CASI: [A03](#), Hardcopy

G359.87 + 0.18 is an enigmatic object located 15' from Sgr A\*. It has been variously classified as an extragalactic source, a Galactic jet source, and a young supernova remnant. We present new observations of G359.87 + 0.18 between 0.33 and 15 GHz and an H I absorption spectrum and use these to argue that this source is an FR II radio galaxy. We are able to place a crude limit on its redshift of  $z \lesssim 0.1$ . The source has a spectral index of  $\alpha \approx -1$  (S proportional to  $\nu^{-1}$ ), suggestive of a radio galaxy with a redshift  $z \lesssim 2$ . The scattering diameters of Sgr A\* and several nearby OH masers (approx. 1' at 1 GHz) indicate that a region of enhanced scattering is along the line of sight to the Galactic center. If the region covers the Galactic center uniformly, the implied diameter for a background source is at least 600' at 0.33 GHz, which is in contrast with the observed 20' diameter of G359.87 + 0.18. Using the scattering diameter of a nearby OH maser OH 359.762 + 0.120 and the widths of two nearby nonthermal threads, G0.08 + 0.15 and G359.79 + 0.17, we show that a uniform scattering region should cover G359.87 + 0.18. We therefore conclude that the Galactic center scattering region is inhomogeneous on a scale of 5' (approx. 10 pc at a distance of 8.5 kpc). This scale is comparable with the size scale of molecular clouds in the Galactic center. The close agreement between these two length scales is an indication that the scattering region is linked intimately to the Galactic center molecular clouds.

DTIC

*Flux Density; Galaxies; Radio Galaxies; Sagittarius Constellation; Scattering*

**20070015960** Naval Research Lab., Washington, DC USA

**The Low-Frequency Radio Counterpart of the XMM Large-Scale Structure Survey**

Cohen, A S; Roettgering, H J; Kassim, N E; Cotton, W D; Perley, R A; Wilman, R; Best, P; Pierre, M; Birkinshaw, M; Bremer, M; Jul 10, 2003; 23 pp.; In English

Report No.(s): AD-A464482; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The XMM Large-Scale Structure Survey (XMM-LSS) is a major project to map the large-scale structure of the universe out to cosmological distances. An 8 deg. x 8 deg. region will be surveyed by XMM with planned optical follow-up to produce a three-dimensional map of many hundreds of clusters out to a redshift of  $z \sim 1$ . To explore the relation of the large-scale structure to the location and properties of extragalactic radio sources, the XMM-LSS project also includes a low-frequency radio survey of this region. This combination will provide unprecedented insight into how the radio source formation and

evolution are affected by the local environment. Here we present preliminary results from our 325 and 74 MHz surveys in this region. We describe these results and explore what they tell us about the population of extragalactic low-frequency radio sources. The 74 MHz survey represents the first presentation of a deep, subarcminute resolution survey at such a low frequency. This was made possible by recent advances in both hardware and data reduction algorithms, which we describe in detail.

DTIC

*Cosmology; Low Frequencies; Spectral Counterparts (Astronomy); Surveys*

**20070016034** Stanford Linear Accelerator Center, Stanford, CA USA

**X-ray Astronomy at SLAC**

Saz Parkinson, P M; Dec 2002; 3 pp.; In English

Contract(s)/Grant(s): DE-AC-03-76-SFO0515

Report No.(s): AD-A464582; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The USA (Unconventional Stellar Aspect) experiment was launched in February of 1999 and operated for approximately 18 months. Group K at SLAC (Stanford Linear Accelerator Center) participated in this experiment along with the Naval Research Laboratory (NRL). I discuss the USA experiment and the data accumulated along with some of the results obtained from the observations of such objects as the extragalactic BL Lac object 1ES1959+65, the Black Hole Candidate (BHC) XTE J1118+480, and the eccentric X-ray binary system Circinus X-1.

DTIC

*X Ray Astronomy; Linear Accelerators*

**20070016037** Naval Research Lab., Washington, DC USA

**Limits on Nuclear Gamma-Ray Emission from Orion**

Murphy, Ronald J; Share, Gerald H; Grove, J E; Johnson, W N; Kurfess, James D; Purcell, William R; McNaron-Brown, K; Ramaty, Reuven; Jan 1996; 15 pp.; In English

Report No.(s): AD-A464521; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The discovery of gamma-ray line emission in the 3-7 MeV range from the Orion complex was recently reported (Bloemen et al. 1994). The observed Compton Telescope (COMPTEL) spectrum suggested that the emission results from the de-excitation of excited states of C-12 and O-16. We report on a search for these lines using the Oriented Scintillation Spectrometer Experiment (OSSE) on the Compton Gamma Ray Observatory (CGRO) during a 5-week observation from April to June in 1995. The OSSE detectors were pointed midway between the Orion A and B radio sources in three different viewing configurations. We find no compelling evidence for line emission near 4.4 or 6.1 MeV. The sensitivity of the OSSE measurements is dependent on the widths of the reported C and O lines and on the source location and spatial extent. A point source at the flux level reported by COMPTEL and located on-axis would have been detected by OSSE at  $\sim 7$  sigma and  $\sim 5$  sigma levels of confidence for narrow and broad lines, respectively. A spatially-distributed source of the same strength with a distribution following the intense CO emission localized around Orion A and Orion B (see Maddalena et al. 1986) would have been detected by OSSE at  $\sim 3.5$  sigma and  $\sim 2.5$  sigma, respectively. Thus, these OSSE observations require that any gamma-ray line source must be even more extended to be consistent with the reported COMPTEL intensity.

DTIC

*Gamma Rays; Nuclear Radiation; Orion (Radio Interferometry Network)*

**20070016038** Naval Research Lab., Washington, DC USA

**OSSE Observations of GX 339-4**

Grabelsky, D A; Matz, S M; Purcell, W R; Ulmer, M P; Grove, J E; Johnson, W N; Kinzer, R L; Kurfess, J D; Strickman, M S; Jung, G V; Jan 1995; 20 pp.; In English

Report No.(s): AD-A464469; No Copyright; Avail.: CASI: [A03](#), Hardcopy

The Oriented Scintillation Spectrometer Experiment on the Compton Gamma Ray Observatory observed the Galactic black hole candidate GX 339-4 as a target of opportunity in 1991 September, in response to the outburst reported by BATSE. We report here on energy spectra in the 50 keV to 10 MeV range obtained by OSSE. The source was detected from 50 to 400 keV at a level relative to the Crab nebula of  $\sim 30\%$ . The observed spectrum was described reasonably well by a power law with an exponential cutoff; a least-squares fit yielded a photon index of  $.88$  plus or minus  $.05$  and a cutoff energy of  $(68$  plus or minus  $2)$  keV. The addition of a Compton reflection component did not significantly improve the overall fit. An optically-thin thermal bremsstrahlung spectrum also provides a good fit, and the thermal Comptonization model of Sunyaev

and Titarchuk, while deficient in describing the data above about 200 keV, cannot formally be ruled out. A pure power law with reflection does not fit the observed spectrum. During a follow-up observation made in 1991 November, the intensity of the source below 100 keV had dropped by more than a factor of 40, and it was no longer detected above about 100 keV.

DTIC

*Black Holes (Astronomy); Scintillation; Spectrometers; Galaxies*

**20070016046** Naval Research Lab., Washington, DC USA

**OSSE Observations of the Vela Pulsar**

Strickman, M S; Grove, J E; Johnson, W N; Kinzer, R L; Kroeger, R A; Kurfess, J D; Grabelsky, D A; Matz, S M; Purcell, W R; Ulmer, M P; Jan 1993; 5 pp.; In English

Report No.(s): AD-A464425; No Copyright; Avail.: CASI: [A01](#), Hardcopy

The OSSE detector on board the Compton Gamma Ray Observatory observed the Vela Pulsar (PSR 0833-45) during August-September 1991 and April-May 1992. Pulsed emission was detected at the 4-5 sigma level in the 0.06-0.57 MeV band in the sum of the two observing periods, as well as in each individual observation at lower significance. There is no significant variability observed. Light curves have a peak structure similar to that observed at higher energies. The spectrum is hard at lower energies and appears to require a break in the 0.5-2 MeV region.

DTIC

*Pulsars; Gamma Ray Observatory*

**20070016062** Kennesaw State Univ., GA USA

**A Wide-Field 90 Centimeter VLA Image of the Galactic Center Region**

LaRosa, T N; Kassim, Namir E; Lazio, T J; Hyman, S D; Jan 2000; 36 pp.; In English

Report No.(s): AD-A464575; No Copyright; Avail.: CASI: [A03](#), Hardcopy

We present a wide-field, high dynamic range, high-resolution, long-wavelength ( $\lambda = 90$  cm) Very Large Array (VLA) image of the Galactic center region. The image is centered on Sgr A, covers an area of 4 deg. x 5 deg. with an angular resolution of 43', and has a rms sensitivity of approx. 5 mJy beam(expo. -1). The image was constructed from archival (1989 and 1991) VLA data of Pedlar et al. and Anantharamaiah et al. using new three-dimensional image restoration techniques. These three-dimensional imaging techniques resolve the problem of non-coplanar baselines encountered at long wavelengths and yield distortion-free imaging of far-field sources with improved sensitivity. At  $\lambda = 90$  cm the VLA is sensitive to both thermal and nonthermal emission and the resulting image gives an unprecedented contextual perspective of the large-scale radio structure in this unique and complicated region. We have catalogued over a hundred sources from this image and present for each source its 90 cm flux density, position, and size. For many of the small-diameter sources, we also derive the 20/90 cm spectral index. The spectral index as a function of length along several of the isolated nonthermal filaments has been estimated and found to be constant. We have found six new small-diameter sources, as well as several extended regions of emission, which are clearly distinct sources that have not been previously identified at higher frequencies. These data are presented as a first epoch of VLA observations that can be used to search for source variability in conjunction with a second epoch of observations that were recently initiated.

DTIC

*Flux Density; Image Processing; Very Large Array (VLA); Radio Sources (Astronomy); Galaxies*

**20070016063** National Radio Astronomy Observatory, Socorro, NM USA

**Discovery of a Nonthermal Galactic Center Filament (G358.85+0.47) Parallel to the Galactic Plane**

Lang, Cornelia C; Anantharamaiah, K R; Kassim, N E; Lazio, T J; Aug 10, 1999; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464579; No Copyright; Avail.: CASI: [A01](#), Hardcopy

We report the discovery of a new nonthermal filament, G358.85+0.47, the Pelican, located ~225 pc in projection from Sagittarius A and oriented parallel to the Galactic plane. VLA continuum observations at 20 cm reveal that this 7' (17.5 pc) structure bends at its northern extension and is comprised of parallel strands, which are most apparent at its ends. Observations at 6 and 3.6 cm reveal that the Pelican is a synchrotron-emitting source and is strongly linearly polarized over much of its extent. The spectral index of the filament changes from to varies as  $20/6 = -.08$  to varies as  $6/3.6 = -1.5$ . The rotation measures exhibit a smooth gradient, with values ranging from -1000 to 500 rad  $m^{-2}$ . The intrinsic magnetic field is well aligned along the length of the filament. Based on these properties, we classify the Pelican as one of the nonthermal filaments unique to the Galactic center. Since these filaments (most of which are oriented perpendicular to the Galactic plane) are believed to trace

the overall magnetic field in the inner Galaxy, the Pelican is the first detection of a component of this field parallel to the plane. The Pelican may thus mark a transition region of the magnetic field orientation in the inner 1 kpc of the Galaxy.

DTIC

*Radio Astronomy; Galaxies*

**20070016570** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Recoil of the Stellar Remnant from the Puppis A Supernova: Proper-Motion Measurement from Chandra**

Petre, Robert; Winkler, P. F.; [2006]; 1 pp.; In English; High Energy Astrophysics Division Meeting, 4-7 Oct. 2006, San Francisco, CA, USA

Contract(s)/Grant(s): GO4-5062X; Copyright; Avail.: Other Sources; Abstract Only

A sequence of three Chandra X-ray Observatory High Resolution Camera images taken over a span of five years reveals arc-second-scale displacement of RX-J0822--4300, the stellar remnant near the center of the Puppis A supernova remnant. We measure its proper motion to be  $0.16 \pm 0.02$  arcsec/yr toward the west-southwest. At a distance of 2 kpc, this corresponds to a transverse space velocity of approx. 1500 km/s. This is the first case of a compact X-ray source with a directly measured proper motion. The space velocity is consistent with the explosion center inferred from proper motions of the oxygen-rich optical filaments, and confirms the idea that Puppis A resulted from an asymmetric explosion accompanied by a kick that imparted on the order of  $3 \times 10^{49}$  ergs of kinetic energy (some 3 percent of the supernova kinetic energy) to the stellar remnant. We will summarize this measurement and discuss possible mechanisms for producing such a violent kick. This research has been supported by NASA grant G04-5062X.

Author

*Supernova Remnants; X Ray Sources; X Ray Astrophysics Facility; High Resolution; Kinetic Energy; Asymmetry*

**20070016573** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Swift-BAT Hard X-ray Transient Monitor**

Krimm, Hans; Markwardt, C. B.; Sanwal, D.; Tueller, J.; [2006]; 1 pp.; In English; American Astronomical Society High Energy Astrophysics Division Meeting, 4-7 Oct. 2006, San Francisco, CA, USA

Contract(s)/Grant(s): NCC5-637; No Copyright; Avail.: Other Sources; Abstract Only

The Burst Alert Telescope (BAT) on the Swift satellite is a large field of view instrument that continually monitors the sky to provide the gamma-ray burst trigger for Swift. An average of more than 70% of the sky is observed on a daily basis. The survey mode data is processed on two sets on time scales: from one minute to one day as part of the transient monitor program, and from one spacecraft pointing (approx. 20 minutes) to the full mission duration for the hard X-ray survey program. The transient monitor has recently become public through the web site <http://swift.gsfc.nasa.gov/docs/swift/results/transients/>. Sky images are processed to detect astrophysical sources in the 15-50 keV energy band and the detected flux or upper limit is calculated for  $\sim 100$  sources on time scales up to one day. Light curves are updated each time that new BAT data becomes available (approx. 10 times daily). In addition, the monitor is sensitive to an outburst from a new or unknown source. Sensitivity as a function of time scale for catalog and unknown sources will be presented. The daily exposure for a typical source is approx. 1500-3000 seconds, with a 1-sigma sensitivity of approx. 4 mCrab. 90% of the sources are sampled at least every 16 days, but many sources are sampled daily. It is expected that the Swift-BAT transient monitor will become an important resource for the high energy astrophysics community.

Author

*Telescopes; Gamma Ray Bursts; Field of View; Time Dependence; Astrophysics; Actuators; Exposure*

**20070016618** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Suzaku Observation of Diffuse X-ray Emission from the Carina Nebula**

Hamaguchi, Kenji; Petre, Robert; Matsumoti, Hironori; Tsujimoto, Masahiro; Holt, Stephan S.; Ezoe, Yuichiro; Ozawa, Hideki; Tsuboi, Yohko; Soong, Yang; Kitamoto, Shunji; Sekiguchi, Akiko; Kokubun, Motohide; [2007]; 21 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

We studied extended X-ray emission from the Carina Nebula taken with the Suzaku CCD camera XIS on 2005 Aug. 29. The X-ray morphology, plasma temperature and absorption to the plasma are consistent with the earlier Einstein results. The Suzaku spectra newly revealed emission lines from various species including oxygen, but not from nitrogen. This result restricts the N/O ratio significantly low, compared with evolved massive stellar winds, suggesting that the diffuse emission is originated in an old supernova remnant or a super shell produced by multiple supernova remnants. The X-ray spectra from the north and south of eta Car showed distinct differences between 0.3-2 keV. The south spectrum shows strong L-shell lines of iron ions

and K-shell lines of silicon ions, while the north spectrum shows them weak in intensity. This means that silicon and iron abundances are a factor of 2-4 higher in the south region than in the north region. The abundance variation may be produced by an SNR ejecta, or relate to the dust formation around the star forming core.

Author

*X Ray Spectra; Nebulae; Emission Spectra; Plasma Temperature; X Ray Absorption; Morphology; Star Formation*

**20070016638** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **The Cosmic Battery Revisited**

Contopoulos, Ioannis; Kazanas, Demosthenes; Christodoulos, Dimistris M.; [2007]; 17 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

We reinvestigate the generation and accumulation of magnetic flux in optically thin accretion flows around active gravitating objects. The source of the magnetic field is the azimuthal electric current associated with the Poynting-Robertson drag on the electrons of the accreting plasma. This current generates magnetic field loops which open up because of the differential rotation of the flow. We show through simple numerical simulations that what regulates the generation and accumulation of magnetic flux near the center is the value of the plasma conductivity. Although the conductivity is usually considered to be effectively infinite for the fully ionized plasmas expected near the inner edge of accretion disks, the turbulence of those plasmas may actually render them much less conducting due to the presence of anomalous resistivity. We have discovered that if the resistivity is sufficiently high throughout the turbulent disk while it is suppressed interior to its inner edge, an interesting steady-state process is established: accretion carries and accumulates magnetic flux of one polarity inside the inner edge of the disk, whereas magnetic diffusion releases magnetic flux of the opposite polarity to large distances. In this scenario, magnetic flux of one polarity grows and accumulates at a steady rate in the region inside the inner edge and up to the point of equipartition when it becomes dynamically important. We argue that this inward growth and outward expulsion of oppositely-directed magnetic fields that we propose may account for the approx. 30 min cyclic variability observed in the galactic microquasar GRS1915+105.

Author

*Quasars; Cosmology; Magnetic Flux; Accretion Disks; Astrophysics*

**20070016639** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **A Spitzer Infrared Radius for the Transiting Extrasolar Planet HD 209458 b**

Richardson, L. Jeremy; Harrington, Joseph; Seager, Sara; Deming, Drake; [2007]; 18 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

We have measured the infrared transit of the extrasolar planet HD 209458 b using the Spitzer Space Telescope. We observed two primary eclipse events (one partial and one complete transit) using the 24 micrometer array of the Multiband Imaging Photometer for Spitzer (MIPS). We analyzed a total of 2392 individual images (10-second integrations) of the planetary system, recorded before, during, and after transit. We perform optimal photometry on the images and use the local zodiacal light as a short-term flux reference. At this long wavelength, the transit curve has a simple box-like shape, allowing robust solutions for the stellar and planetary radii independent of stellar limb darkening, which is negligible at 24 micrometers. We derive a stellar radius of  $R(\text{sub } *) = 1.06 \pm 0.07$  solar radius, a planetary radius of  $R(\text{sub } p) = 1.26 \pm 0.08 R(\text{sub } J)$ , and a stellar mass of 1.17 solar mass. Within the errors, our results agree with the measurements at visible wavelengths. The 24 micrometer radius of the planet therefore does not differ significantly compared to the visible result. We point out the potential for deriving extrasolar transiting planet radii to high accuracy using transit photometry at slightly shorter IR wavelengths where greater photometric precision is possible.

Author

*Extrasolar Planets; Radii; Space Infrared Telescope Facility; Astrophysics*

**20070016645** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **Interplanetary Shocks and ‘Suprathermal’ Flare Particles**

Cane, H. V.; Richardson, I. G.; vonRosenvinge, T. T.; [2006]; 1 pp.; In English; Symposium on the Composition of Mater/ACE Science Team and the International Space Science Institute, 11-15 Sep. 2006, Grindelwald, Switzerland; Copyright; Avail.: Other Sources; Abstract Only

We use ion-composition data from ACE/ULEIS, low energy electrons from ACE/EPAM, high energy protons from SoHO/ERNE, radio data from Wind/WAVES, and solar wind data from ACE/SWEPAM and ACE/MAG to investigate the solar and interplanetary circumstances near the times of passage of near-Earth shocks. We are particularly interested in claims

that local acceleration by some interplanetary shocks produces Fe/O  $\approx$  0.3 ('Fe-rich' shocks). The choice of the specific interval used to calculate the Fe/O ratio is extremely important because shock-accelerated particles can be masked by particles from flare events, related or unrelated to the shock, that have Fe/O  $\approx$  0.3. We conclude that shock-accelerated populations have Fe/O  $\approx$  0.3. We illustrate 5 events which have been reported to be Fe-rich and for which Fe/O increases with energy in the 0.5-2 MeV/nuc range. We find that in each case there are direct flare particles included in the averaging time interval. We also demonstrate that the Fe/O ratio increases as a result of the averaging time interval being too large.

Author

*Interplanetary Shock Waves; Proton Energy; Electric Potential; Electrons; Radio Waves*

## 91

### LUNAR AND PLANETARY SCIENCE AND EXPLORATION

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

**20070014867** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Microfossils of Cyanobacteria in the Orgueil Meteorite**

Hoover, Richard B.; [2007]; 53 pp.; In English; No Copyright; Avail.: CASI: [C01](#), CD-ROM: [A04](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070014867>

Electron Microscopy investigations of freshly fractured, interior surfaces of the Orgueil C11 carbonaceous meteorite have resulted in the detection of well-preserved non-filamentous and filamentous microstructures with recognizable biological morphologies. The Orgueil filaments occur as individuals and in clusters or dense mats and consortia. They are often embedded in the meteorite rock matrix and enveloped in a carbonaceous sheath. Some filaments have lateral cross wall constrictions or sheaths sufficiently electron transparent that the dimensions of internal cells may be determined. Many of the Orgueil filaments are isodiametric with dimensions and size ranges of the cells, trichomes, and filaments consistent with Oscillatorian cyanobacteria. Others are polarized and taper from the base to the apex. Some exhibit the extremely complex morphologies of the Nostoclean and Stigonometalean cyanobacteria. These include evidence of true and false branching and differentiation into complex and highly specialized cellular structures with size, morphology and location on the filament consistent with intercalary and terminal basal heterocysts and akinetes as are known in heterocystous cyanobacteria. A few of the filaments are so well preserved that nanometric structures such as lophotrichous tufts of fimbriae have been imaged. Energy Dispersive X-ray Spectroscopy (EDS) analysis has shown that the Orgueil filaments are often infilled with magnesium and sulfate minerals and have sheaths that are significantly enhanced in carbon with respect to other portions of the filament and the meteorite rock matrix. The elemental abundances vary widely over micron size scales but the elemental compositions of the filaments are consistent with elements that principally comprise the meteorite rock matrix. This is consistent with an interpretation of indigenicity. The Orgueil meteorite is a microregolith breccia composed of microscopic clay minerals and particulates cemented together by water-soluble salts. Experiments confirm that it quickly disintegrates upon contact with liquid water, and thus could not have been contaminated post-arrival with the benthic aquatic microorganisms and hence the Orgueil filaments cannot be interpreted as recent biological contaminants. Comparative Energy Dispersive X-ray Spectroscopy (EDS) analyses indicate that almost all of the Orgueil filaments are severely depleted in Nitrogen when compared with recent cyanobacteria and other microbial extremophiles. Filaments found embedded in-situ in the Orgueil meteorite during this study are consistent in size, size range, and detailed morphological features representative of all five cyanobacterial orders: Chroococcales, Pleurocapsales, Oscillatoriales, Nostocales and Stigonematales. This paper presents the Field Emission and Environmental Scanning Electron Microscope images and EDS data and provides the scientific rationale for interpreting the Orgueil forms as unambiguous microfossils of cyanobacteria and associated benthic prokaryotic mats that grew on the parent body of the Orgueil C11 carbonaceous meteorite.

Author

*Bacteria; Fossils; Orgueil Meteorite; Microstructure; Exobiology*

**20070014870** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Lunar Geodetic Opportunities with the Laser Altimeter on LRO**

Zuber, Maria T.; Smith, David E.; [2006]; 1 pp.; In English; AOGS 2006, 9-12 Jul. 2006, Singapore; Copyright; Avail.:

Other Sources; Abstract Only

The Lunar Reconnaissance Orbiter (LRO) is to be launched at the end of 2008 and will carry 7 instruments, one of which is a laser altimeter (LOLA), and obtain observations of the Moon for a period of 1 year. The orbit will be near polar and

approximately circular at 50 km altitude with monthly orbital adjustments to maintain the mean altitude. The LOLA instrument has a -10 cm single-shot accuracy, with 5 beams, and operates at 28 Hz. It provides 5 adjacent profiles, each approximately 12 to 15 meters apart with a swath of approximately 65 meters. The 5 beams are arranged in a cross-shaped pattern that provides simultaneous along and cross track altimetry and providing slopes in 2 orthogonal directions every 50 meters along track. In combination with the LRO tracking data LOLA will be used to improve the model of the lunar gravity by using the altimeter on both the lunar near-side and far-side as an additional tracking system to enable precise positioning of the LRO spacecraft at about the 50 meter level rms. The instrument is expected to provide full polar coverage at very high northern and southern latitudes with spatial resolutions of 25 meters or better. In addition to the range to the surface LOLA measures the surface roughness from the spreading of the laser pulse and also the reflectance of the surface at 1064 nm. These measurements in conjunction with the altimetry will assist in the selection of future landing sites for future robotic and human missions to the Moon.

Author

*Lunar Orbiter; Geodesy; Laser Altimeters; Reconnaissance Spacecraft*

**20070016011** NASA Johnson Space Center, Houston, TX, USA

#### **Pyroclastic Activity at Home Plate in Gusev Crater, Mars**

Squyres, S. W.; Aharonson, O.; Clark, B. S.; Cohen, B.; Crumpler, L.; deSouza, P. A.; Farrand, W. H.; Gellert, R.; Grant, J.; Grotzinger, J. P.; Haldemann, A. F. C.; Johnson, J. R.; Klingelhofer, G.; Lewis, K. W.; Li, R.; McCoy, T.; McEwen, A. S.; McSween, H. Y.; Ming, D. W.; Moore, J. M.; Morris, R. V.; Parker, T. J.; Rice, J. W., Jr.; Ruff, S.; Schmidt, M.; [2007]; 25 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: [A03](#), Hardcopy

Home Plate is a layered plateau in Gusev crater on Mars. It is composed of clastic rocks of moderately altered alkali basalt composition, enriched in some highly volatile elements. A coarse-grained lower unit is overlain by a finer-grained upper unit. Textural observations indicate that the lower strata were emplaced in an explosive event, and geochemical considerations favor an explosive volcanic origin over an impact origin. The lower unit likely represents accumulation of pyroclastic materials, while the upper unit may represent eolian reworking of the same pyroclastic materials.

Author

*Geochemistry; Mars Craters; Plateaus; Sedimentary Rocks; Mars Surface; Mineralogy*

**20070016018** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Multi-Wavelength Dielectrometer (MWD) Sensor For Planetary Subsurface Exploration**

Deshpande, Manohar; VanSteenberg, Michael; Hilliard, Lawrence; [2006]; 1 pp.; In English; Asia-Pacific Remote Sensing 2006, 13-17 Nov. 2006, anaji, Goa, India; No Copyright; Avail.: Other Sources; Abstract Only

NASA's mission to Moon, Mars, and Beyond envisions landing of a light weight measurement platform on the planetary surface. The Multi-Wavelength Dielectrometer (MWD) on-board consists of essential electronics and metallic plates acting as electrodes attached to the body of such platform. An electric signal applied to one of the electrodes acting as a cathode sets up electric field pattern (in the soil medium) between the cathode and other electrodes acting as anodes. The electrodes are swept through multiple wavelengths (1Hz-1MHz) and the electric current drawn by the electrodes is measured at each frequency. The measured current whose amplitude and phase depend upon electrode spacing, dielectric constant of the subsurface soil, and the frequency is then used to estimate electrical properties of the soil. In this paper the MWD sensor that will measure the dielectric properties of Moon/Mars soil is presented. A procedure to process the MWD measured data for extracting the soil properties is also described. Assuming the subsurface soil structure as multilayer strata having varying electric properties, an electric equivalent circuit of the multiple electrodes configuration placed on a multi-layer soil sample is obtained. The current drawn by the equivalent circuit from the low frequency signal generator is then calculated. By minimizing the difference between the model's estimated current and measured MWD data the electric properties of soil samples are extracted. Experimental and simulated results will be presented to validate the proposed procedure for extracting soil properties.

Author

*Sensors; Soil Science; Mars Surface; Moon; Planetary Geology; Electrometers; Space Exploration*



**20070016053** NASA Johnson Space Center, Houston, TX, USA

**NanoSIMS opens a New Window for Deciphering Organic Matter in Terrestrial and Extraterrestrial Samples**

Oehler, Dorothy ZS.; Robert, Francois; Mostefaoui, Smail; Meibom, Anders; Selo, Madeleine; McKay, David S.; Gibson, Everett K.; [2007]; 16 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NRA-03-OSS-01-EXOB; Copyright; Avail.: CASI: [A03](#), Hardcopy

Recognition of the earliest morphological or chemical evidence of terrestrial life has proved to be challenging, as organic matter in ancient rocks is commonly fragmentary and difficult to distinguish from abiotically-produced materials (Schopf, 1993; Van Zuilen et al., 2002; Altermann & Kazmierczak, 2003; Cady et al., 2003; Brasier et al., 2002, 2004, 2005; Hofmann, 2004; Skrzypczak et al., 2004, 2005). Yet, the ability to identify remnants of earliest life is critical to our understanding of the timing of life's origin on earth, the nature of earliest terrestrial life, and recognition of potential remnants of microbial life that might occur in extraterrestrial materials. The search for earliest life on Earth now extends to early Archean organic remains; these tend to be very poorly preserved and considerably more difficult to interpret than the delicately permineralized microfossils known from many Proterozoic deposits. Thus, recent efforts have been directed toward finding biosignatures that can help distinguish fragmentary remnants of ancient microbes from either pseudofossils or abiotic organic materials that may have formed hydrothermally or in extraterrestrial processes (House et al., 2000; Boyce et al., 2001; Kudryavtsev et al., 2001; Schopf, 2002; Schopf et al., 2002, 2005a,b; Cady et al., 2003; Garc a-Ruiz et al., 2003; Hofmann, 2004; Brasier et al., 2005; Rushdi and Simoneit, 2005; Skrzypczak et al., 2005). An exciting area of biosignature research involves the developing technology of NanoSIMS. NanoSIMS is secondary ion mass spectrometry (SIMS) for ultrafine feature, elemental and isotopic analysis. Its resolution approaches 0.05 micrometers for element mapping, which is 10-50 times finer than that attainable with conventional SIMS or electron microprobes. Consequently, NanoSIMS has the potential to reveal previously unknown, chemical and structural characteristics of organic matter preserved in geologic materials. Robert et al. (2005) were the first to combine NanoSIMS element maps with optical microscopic imagery in an effort to develop a new method for assessing biogenicity. They showed that the ability to simultaneously map the distribution of organic elements [such as carbon (C), nitrogen (N), and sulfur (S)] and compare those element distributions with optically recognizable, cellularly preserved fossils could provide significant new insights into the origin of organic materials in ancient sediments. This chapter details a recent NanoSIMS study which was designed to acquire new data relevant to establishing critical biosignatures (Oehler et al., 2006a-c). In this study, NanoSIMS was used to characterize element distributions of spheroidal and filamentous microfossils and associated organic laminae in chert from the approx. 0.85 billion year old (Ga) Bitter Springs Formation of Australia. Previous work established preservation of a diverse microbiota in the Bitter Springs Formation (Schopf, 1968; Schopf and Blacic, 1971), and there is no dispute within the scientific community regarding the biogenicity of any of the Bitter Springs structures evaluated in this new study. Thus, the NanoSIMS results described below provide new insight into - and can be used as a guide for assessing - the origin of less well understood organic materials that may occur in early Archean samples and in meteorites or other extraterrestrial samples.

Author

*Organic Materials; Secondary Ion Mass Spectrometry; Nanotechnology; Extraterrestrial Matter; Precambrian Period; Exobiology*

**20070016600** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Atmospheres of Extrasolar Planets**

Richardson, L. J.; Seager, S.; [2007]; 22 pp.; In English; No Copyright; Avail.: CASI: [A03](#), Hardcopy

ONLINE: <http://hdl.handle.net/2060/20070016600>

In this chapter we examine what can be learned about extrasolar planet atmospheres by concentrating on a class of planets that transit their parent stars. As discussed in the previous chapter, one way of detecting an extrasolar planet is by observing the drop in stellar intensity as the planet passes in front of the star. A transit represents a special case in which the geometry of the planetary system is such that the planet's orbit is nearly edge-on as seen from Earth. As we will explore, the transiting planets provide opportunities for detailed follow-up observations that allow physical characterization of extrasolar planets, probing their bulk compositions and atmospheres.

Derived from text

*Extrasolar Planets; Planetary Atmospheres; Atmospheric Models; Solar System*

Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 *Space Radiation*.

**20070014866** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Width of a Solar Coronal Mass Ejection and the Source of the Driving Magnetic Explosion**

Moore, Ronald L.; Sterling, Alphonse C.; Suess, Steven T.; January 26, 2007; 28 pp.; In English; Original contains black and white illustrations; No Copyright; Avail.: CASI: [C01](#), CD-ROM: [A03](#), Hardcopy  
ONLINE: <http://hdl.handle.net/2060/20070014866>

We show that the strength of the magnetic field in the area covered by the flare arcade following a CME-producing ejective solar eruption can be estimated from the final angular width of the CME in the outer corona and the final angular width of the flare arcade. We assume (1) the flux-rope plasmoid ejected from the flare site becomes the interior of the CME plasmoid, (2) in the outer corona ( $R$  greater than  $2R(\text{sub Sun})$ ) the CME is roughly a spherical plasmoid with legs shaped like a light bulb, and (3) beyond some height in or below the outer corona the CME plasmoid is in lateral pressure balance with the surrounding magnetic field. The strength of the nearly radial magnetic field in the outer corona is estimated from the radial component of the interplanetary magnetic field measured by Ulysses. We apply this model to three well-observed CMEs that exploded from flare regions of extremely different size and magnetic setting. One of these CMEs is an over-and-out CME that exploded from a laterally far offset compact ejective flare. In each event, the estimated source-region field strength is appropriate for the magnetic setting of the flare. This agreement (1) indicates that CMEs are propelled by the magnetic field of the CME plasmoid pushing against the surrounding magnetic field, (2) supports the magnetic-arch-blowout scenario for over-and-out CMEs, and (3) shows that a CME's final angular width in the outer corona can be estimated from the amount of magnetic flux covered by the source-region flare arcade.

Author

*Coronal Mass Ejection; Interplanetary Magnetic Fields; Solar Corona; Width; Mathematical Models; Magnetic Fields*

**20070014873** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Correlated Flare and CME Energies for the October/November 2003 Events**

Dennis, Brian R.; Haga, Leah; Medlin, Drew; Tolbert, A. Kimberly; [2006]; 1 pp.; In English; American Astronomical Society Solar Physics Division Meeting, 26-30 Jun. 2006, Durham, NH, USA; Copyright; Avail.: Other Sources; Abstract Only

We find a strong correlation between the kinetic energies (KEs) of the coronal mass ejections (CMEs) and the radiated energies of the associated solar flares for the events that occurred during the period of intense solar activity between 18 October and 08 November 2003. CME start times, speeds, mass, and KEs were taken from Gopalswamy et al. (2005), who used SOHO/LASCO observations. The GOES observations of the associated flares were analyzed to find the peak SXR flux, the radiated energy in SXRs ( $L(\text{sub sxr})$ ), and the radiated energy from the SXR emitting plasma across all wavelengths ( $L(\text{sub hot})$ ). RHESSI observations were also used to find the energy in non-thermal electrons, ions, and the plasma thermal energy for some events. For two events, SORCE/TIM observations of the total solar irradiance during a flare were also available to give the total radiated flare energy ( $L(\text{sub total})$ ). We find that the total flare energies of the larger events are of the same order of magnitude as the CME KE with a stronger correlation than has been found in the past for other time intervals. The following rule-of-thumb (good to an order of magnitude for the larger events) can be used to relate flare and CME energies:  $\text{CME KE} \sim L(\text{sub total}) \sim 10 L(\text{sub hot}) \sim 100 L(\text{sub SXR})$ .

Author

*Coronal Mass Ejection; Solar Flares; Thermal Energy; Kinetic Energy*

**20070014939** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Implications of RHESSI Observations for Solar Flare Models and Energetics**

Holman, Gordon D.; [2006]; 1 pp.; In English; Astrophysical Institute meeting, 9-13 Apr. 2006, Potsdam, Germany; No Copyright; Avail.: Other Sources; Abstract Only

Observations of solar flares in X-rays and gamma-rays provide the most direct information about the hottest plasma and energetic electrons and ions accelerated in flares. The Ramaty High Energy Solar Spectroscopic Imager (RHESSI) has observed over 18000 solar flares in X-rays and gamma-rays since its launch in February of 2002. RHESSI observes the full Sun at photon energies from as low as 3 keV to as high as 17 MeV with a spectral resolution on the order of 1 keV. It also provides images in arbitrary bands within this energy range with spatial resolution as good as 3 seconds of arc. Full images

are typically produced every 4 seconds, although higher time resolution is possible. This unprecedented combination of spatial, spectral, and temporal resolution, spectral range and flexibility has led to fundamental advances in our understanding of flares. I will show RHESSI and coordinated observations that confirm coronal magnetic reconnection models for eruptive flares and coronal mass ejections, but also present new puzzles for these models. I will demonstrate how the analysis of RHESSI spectra has led to a better determination of the energy flux and total energy in accelerated electrons, and of the energy in the hot, thermal flare plasma. I will discuss how these energies compare with each other and with the energy contained in other flare-related phenomena such as interplanetary particles and coronal mass ejections.

Author

*Solar Flares; Spectrum Analysis; Temporal Resolution; Spatial Resolution; Spectral Resolution; Flexibility; Gamma Rays*

**20070016617** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Glory Program: Global Science from a Unique Spacecraft Integration**

Bajpayee Jaya; Durham, Darcie; Ichkawich, Thomas; Mar. 4, 2006; 10 pp.; In English; 2006 IEEE Aerospace Conference, 4 Mar. 2006, Big Sky, MT, USA; Original contains black and white illustrations

Report No.(s): IEEEAC Paper #1414/Ver-1; Copyright; Avail.: CASI: [A02](#), Hardcopy

The Glory program is an Earth and Solar science mission designed to broaden science community knowledge of the environment. The causes and effects of global warming have become a concern in recent years and Glory aims to contribute to the knowledge base of the science community. Glory is designed for two functions: one is solar viewing to monitor the total solar irradiance and the other is observing the Earth's atmosphere for aerosol composition. The former is done with an active cavity radiometer, while the latter is accomplished with an aerosol polarimeter sensor to discern atmospheric particles. The Glory program is managed by NASA Goddard Space Flight Center (GSFC) with Orbital Sciences in Dulles, VA as the prime contractor for the spacecraft bus, mission operations, and ground system. This paper will describe some of the more unique features of the Glory program including the integration and testing of the satellite and instruments as well as the science data processing. The spacecraft integration and test approach requires extensive analysis and additional planning to ensure existing components are successfully functioning with the new Glory components. The science mission data analysis requires development of mission unique processing systems and algorithms. Science data analysis and distribution will utilize our national assets at the Goddard Institute for Space Studies (GISS) and the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP). The Satellite was originally designed and built for the Vegetation Canopy Lidar (VCL) mission, which was terminated in the middle of integration and testing due to payload development issues. The bus was then placed in secure storage in 2001 and removed from an environmentally controlled container in late 2003 to be refurbished to meet the Glory program requirements. Functional testing of all the components was done as a system at the start of the program, very different from a traditional program. The plan for Glory is to minimize any changes to the spacecraft in order to meet the Glory requirements. This means that the instrument designs must adhere to the existing interfaces and capabilities as much as possible. Given Glory's unique history and the potential science return, the program is one of significant value to both the science community and the world. The findings Glory promises will improve our understanding of the drivers for global climate change for a minimal investment. The program hopes to show that reuse of existing government assets can result in a lower cost, and fully successful mission.

Author

*Earth Sciences; Solar Radiation; Space Missions; Spacecraft Orbits; Glory Mission Satellite; Solar Physics; Systems Integration*

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**SPACE RADIATION**

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics*.

**20070016627** NASA Johnson Space Center, Houston, TX, USA

**Space Radiation Risk Assessment for Future Lunar Missions**

Kim, Myung-Hee Y.; Ponomarev, Artem; Atwell, Bill; Cucinotta, Francis A.; July 12, 2007; 1 pp.; In English; International Congress of Space Radiation Research, 8-12 Jul. 2007, San Francisco, CA, USA; Copyright; Avail.: Other Sources;

Abstract Only

For lunar exploration mission design, radiation risk assessments require the understanding of future space radiation environments in support of resource management decisions, operational planning, and a go/no-go decision. The future GCR

flux was estimated as a function of interplanetary deceleration potential, which was coupled with the estimated neutron monitor rate from the Climax monitor using a statistical model. A probability distribution function for solar particle event (SPE) occurrence was formed from proton fluence measurements of SPEs occurred during the past 5 solar cycles (19-23). Large proton SPEs identified from impulsive nitrate enhancements in polar ice for which the fluences are greater than  $2 \times 10^9$  protons/sq cm for energies greater than 30 MeV, were also combined to extend the probability calculation for high level of proton fluences. The probability with which any given proton fluence level of a SPE will be exceeded during a space mission of defined duration was then calculated. Analytic energy spectra of SPEs at different ranks of the integral fluences were constructed over broad energy ranges extending out to GeV, and representative exposure levels were analyzed at those fluences. For the development of an integrated strategy for radiation protection on lunar exploration missions, effective doses at various points inside a spacecraft were calculated with detailed geometry models representing proposed transfer vehicle and habitat concepts. Preliminary radiation risk assessments from SPE and GCR were compared for various configuration concepts of radiation shelter in exploratory-class spacecrafts.

Author

*Space Missions; Radiation Protection; Risk; Extraterrestrial Radiation; Lunar Exploration; Management Planning; Mission Planning; Assessments; Exposure; Solar Corpuscular Radiation*

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