National Aeronautics and
Space Administration
Langley Research Center

Scientific and Technical
Information Program Office

# Scientific and Technical Aerospace Reports

# STAR

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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.

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- 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.

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# Introduction

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*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 world-wide 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. Others should visit the program at 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, 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.

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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**

# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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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.

**20070018854** NASA Langley Research Center, Hampton, VA, USA

**Terrain Portrayal for Synthetic Vision Systems Head-Down Displays Evaluation Results: Compilation of Pilot Transcripts**

Hughes, Monica F.; Glaab, Louis J.; April 2007; 250 pp.; In English

Contract(s)/Grant(s): WBS 609866.02.07.07

Report No.(s): NASA/TP-2007-214864/SUPPL1; L-19336/SUPPL1; No Copyright; Avail.: CASI: C01, CD-ROM: A11, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018854

The Terrain Portrayal for Head-Down Displays (TP-HDD) simulation experiment addressed multiple objectives involving twelve display concepts (two baseline concepts without terrain and ten synthetic vision system (SVS) variations), four evaluation maneuvers (two en route and one approach maneuver, plus a rare-event scenario), and three pilot group classifications. The TP-HDD SVS simulation was conducted in the NASA Langley Research Center's (LaRC's) General Aviation WorkStation (GAWS) facility. The results from this simulation establish the relationship between terrain portrayal fidelity and pilot situation awareness, workload, stress, and performance and are published in the NASA TP entitled Terrain Portrayal for Synthetic Vision Systems Head-Down Displays Evaluation Results. This is a collection of pilot comments during each run of the TP-HDD simulation experiment. These comments are not the full transcripts, but a condensed version where only the salient remarks that applied to the scenario, the maneuver, or the actual research itself were compiled.

Author

*Display Devices; Enhanced Vision; Simulation; Terrain; Head Down Tilt; Civil Aviation; Test Facilities*

## 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.

**20070018770** NASA Langley Research Center, Hampton, VA, USA

**Evaluation of Head-Worn Display Concepts for Commercial Aircraft Taxi Operations**

Bailey, Randall E.; Arthur, Jarvis J., III; Prinzel, Lawrence J., III; Kramer, Lynda J.; Apr. 9, 2007; 17 pp.; In English; SPIE Defense and Security Symposium 2007, 9-13 Apr. 2007, Orlando, FL, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 609866.02.07.07

Report No.(s): SPIE 6557-31; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018770

Previous research has demonstrated that a Head-Up Display (HUD) can be used to enable more capacity and safer aircraft surface operations. This previous research also noted that the HUD exhibited two major limitations which hindered the full potential of the display concept: 1) the monochrome HUD format; and, 2) a limited, fixed field of regard. Full-color Head

Worn Displays (HWDs) with very small sizes and weights are emerging to the extent that this technology may be practical for commercial and business aircraft operations. By coupling the HWD with a head tracker, full-color, out-the-window display concepts with an unlimited field-of-regard may be realized to improve efficiency and safety in surface operations. A ground simulation experiment was conducted at NASA Langley to evaluate the efficacy of head-worn display applications which may directly address the limitations of the HUD while retaining all of its advantages in surface operations. The simulation experiment used airline crews to evaluate various displays (HUD, HWD) and display concepts in an operationally realistic environment by using a Chicago, O Hare airport database. The results pertaining to the implications of HWDs for commercial business and transport aviation applications are presented herein. Overall HWD system latency was measured and found to be acceptable, but not necessarily optimal. A few occurrences of simulator sickness were noted while wearing the HWD, but overall there appears to be commercial pilot acceptability and usability to the concept. Many issues were identified which need to be addressed in future research including continued reduction in user encumbrance due to the HWD, and improvement in image alignment, accuracy, and boresighting.
Author
*Commercial Aircraft; Head-Up Displays; Air Transportation; Taxiing; Airline Operations; Flight Simulators*

**20070018771** NASA Langley Research Center, Hampton, VA, USA
**Design and Testing of an Unlimited Field-of-regard Synthetic Vision Head-worn Display for Commercial Aircraft Surface Operations**
Arthur, Jarvis J., III; Prinzel, Lawrence J., III; Shelton, Kevin J.; Kramer, Lynda J.; Williams, Steven P.; Bailey, Randall E.; Norman, Robert M.; Apr. 9, 2007; 19 pp.; In English; SPIE Defense and Security Symposium 2007, 9-13 Apr. 2007, Orlando, FL, USA; Original contains color and black and white illustrations
Report No.(s): LAR-17290-1; SPIE 6559-12; Copyright; Avail.: CASI: A03, Hardcopy

Experiments and flight tests have shown that a Head-Up Display (HUD) and a head-down, electronic moving map (EMM) can be enhanced with Synthetic Vision for airport surface operations. While great success in ground operations was demonstrated with a HUD, the research noted that two major HUD limitations during ground operations were their monochrome form and limited, fixed field of regard. A potential solution to these limitations found with HUDs may be emerging Head Worn Displays (HWDs). HWDs are small, lightweight full color display devices that may be worn without significant encumbrance to the user. By coupling the HWD with a head tracker, unlimited field-of-regard may be realized for commercial aviation applications. In the proposed paper, the results of two ground simulation experiments conducted at NASA Langley are summarized. The experiments evaluated the efficacy of head-worn display applications of Synthetic Vision and Enhanced Vision technology to enhance transport aircraft surface operations. The two studies tested a combined six display concepts: (1) paper charts with existing cockpit displays, (2) baseline consisting of existing cockpit displays including a Class III electronic flight bag display of the airport surface; (3) an advanced baseline that also included displayed traffic and routing information, (4) a modified version of a HUD and EMM display demonstrated in previous research; (5) an unlimited field-of-regard, full color, head-tracked HWD with a conformal 3-D synthetic vision surface view; and (6) a fully integrated HWD concept. The fully integrated HWD concept is a head-tracked, color, unlimited field-of-regard concept that provides a 3-D conformal synthetic view of the airport surface integrated with advanced taxi route clearance, taxi precision guidance, and data-link capability. The results of the experiments showed that the fully integrated HWD provided greater path performance compared to using paper charts alone. Further, when comparing the HWD with the HUD concept, there were no differences in path performance. In addition, the HWD and HUD concepts were rated via paired-comparisons the same in terms of situational awareness and workload. However, there were over twice as many taxi incursion events with the HUD than the HWD.
Author
*Airline Operations; Commercial Aircraft; Display Devices; Enhanced Vision; Flight Tests; Head-Up Displays; Systems Engineering*

**20070018792** Research and Technology Organization, Neuilly-sur-Seine, France, NASA Langley Research Center, Hampton, VA, USA
**Fusion of Synthetic and Enhanced Vision for All-Weather Commercial Aviation Operations**
Bailey, Randall E.; Kramer, Lynda J.; Prinzel, Lawrence, III; Apr. 23, 2007; 26 pp.; In English; NATO HFM-141 Symposium on Human Factors of Day/Night All-Weather Operations, 23-25 Apr. 2007, Heraklion, Greece; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 609866.02.07.07; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018792

NASA is developing revolutionary crew-vehicle interface technologies that strive to proactively overcome aircraft safety barriers that would otherwise constrain the full realization of the next-generation air transportation system. A piloted simulation experiment was conducted to evaluate the complementary use of Synthetic and Enhanced Vision technologies. Specific focus was placed on new techniques for integration and/or fusion of Enhanced and Synthetic Vision and its impact within a two-crew flight deck during low visibility approach and landing operations. Overall, the experimental data showed that significant improvements in situation awareness, without concomitant increases in workload and display clutter, could be provided by the integration and/or fusion of synthetic and enhanced vision technologies for the pilot-flying and the pilot-not-flying. During non-normal operations, the ability of the crew to handle substantial navigational errors and runway incursions were not adversely impacted by the display concepts although the addition of Enhanced Vision did not, unto itself, provide an improvement in runway incursion detection.

Author

*All-Weather Air Navigation; Commercial Aircraft; Enhanced Vision; Air Transportation; Airline Operations*

**20070018949** Lockheed Martin Technology Services Group, Mesa, AZ USA

**Next-Generation Flight Simulators: Image-Update-Rate Considerations**

Lindholm, Julie M; Scharine, Angelique A; Pierce, Byron J; May 2003; 16 pp.; In English

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

Report No.(s): AD-A465197; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465197

The level of detail in flight-simulator images depends upon the resolutions of the database, the image generator (IG), and the display. In response to the need for greater detail, resources are being devoted to increasing the spatial resolution of each of these system components. Next-generation flight-simulator visual systems will thus be capable of representing smaller environmental features and of representing a given feature at a greater distance. However, flight-simulator imagery is more than a sequence of static, spatial images. The visual system of a simulator creates three-dimensional space-time images, and the quality of these images depends on the temporal as well as the spatial characteristics of both the IG and the display. Here we discuss how the spatial resolutions of the database and the IG affect the temporal frequencies in an image and thus the extent of temporal aliasing likely with a standard, 60-Hz image-update rate. We also discuss how the spatial and temporal resolutions of a display system limit the spatiotemporal-frequency spectrum of the display image. We conclude with a brief description of some perceptual effects of temporal aliasing.

DTIC

*Flight Simulators; Flight Training*

**20070019157** Civil Aeromedical Inst., Oklahoma City, OK USA

**Voluntary Aviation Safety Information-Sharing Process: Preliminary Audit of Distributed FOQA and ASAP Archives Against Industry Statement of Requirements**

Chidester, Thomas R; Apr 2007; 14 pp.; In English

Report No.(s): AD-A465642; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465642

The Voluntary Aviation Safety Information-Sharing Process (VASIP) is designed to provide a means for the commercial aviation industry and the Federal Aviation Administration (FAA) to collect, share safety-related information, and to use that information to proactively identify, analyze, and correct safety issues that affect commercial aviation. The key to VASIP is the development of a technical process to extract de-identified safety data from any participating airline Flight Operations Quality Assurance (FOQA) or Aviation Safety Action Program (ASAP), aggregate it through a distributed database, and make it accessible to appropriate industry stakeholders for analysis. In 2004, the ASAP and FOQA Aviation Rulemaking Committees (ARCs) identified the National Aeronautics and Space Administration (NASA) as having the institutional background, resources, and personnel capable of developing this technical aggregation framework, as well as the analytical tools to support the process. Beginning in June of 2004, NASA led a collaborative partnership of participating airlines, employee organizations, and FAA representatives to define key components of archives of FOQA and ASAP data. This defined a set of functional requirements for archive development that were approved by the FOQA and ASAP ARCs. In October 2004, at the request of and with partial funding by the FAA, NASA initiated an Information Sharing Initiative under the Aviation Safety and Security Program to provide funds and oversight to develop distributed archiving and analysis. The basic infrastructure

was deployed in January 2006, and data archiving began at participating airlines. The current document audits the hardware, software, and networking infrastructure against the original functional specifications provided by the ARCs to NASA.
DTIC
*Aircraft Safety; Airline Operations; Commercial Aircraft; Data Bases; Documents; Flight Safety; Industries; Information Systems*

**20070019298** Army Research Inst. for the Behavioral and Social Sciences, Fort Rucker, AL USA
**Evaluation of the Effectiveness of Flight School XXI**
Wesolek, Michael L; Mar 2007; 56 pp.; In English
Contract(s)/Grant(s): Proj-A790
Report No.(s): AD-A465655; ARI-TR-1197; No Copyright; Avail.: CASI: A04, Hardcopy

This research examined the effectiveness of the U.S. Army's Flight School XXI (FSXXI) flight training program in comparison to the previous (legacy) flight training program. The primary focus of the research was whether or not FSXXI produces graduates that are more proficient, and subsequently become fully mission capable pilots in fewer flight hours than graduates of the legacy flight training program. A 2X2 repeated-measures ANOVA was conducted to compare the readiness level progression rates of graduates of the FSXXI and the legacy flight training program. These data were supplemented by an instructor pilot survey and a cost comparison. It was found that there was a statistically significant difference between the FSXXI pilots and the legacy pilots, and in each of these cases the number of hours required for FSXXI graduates to become fully mission capable pilots was lower than for legacy pilots. Additionally, there was no difference between instructors' perceptions of FSXXI and legacy pilot aptitude for the CH-47 aircraft, but there was a difference for the UH-60 aircraft. The cost comparison revealed that legacy training is substantially less expensive than FSXXI training for both types of aircraft. These findings are discussed in relation to the existing research in this area, including experiential learning and Kolb's learning cycle.
DTIC
*Education; Flight Training; Schools; Statistical Analysis*

## 04
## 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.

**20070019374** Ohio Univ., Athens, OH, USA
**Wireless Channel Characterization in the 5 GHz Microwave Landing System Extension Band for Airport Surface Areas**
Matolak, David W.; May 2007; 236 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNC04GB45G; WBS 411931.02.07.03.02
Report No.(s): NASA/CR-2007-214456; E-15720; No Copyright; Avail.: CASI: A11, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019374

In this project final report, entitled 'Wireless Channel Characterization in the 5 GHz Microwave Landing System Extension Band for Airport Surface Areas,' we provide a detailed description and model representation for the wireless channel in the airport surface environment in this band. In this executive summary, we review report contents, describe the achieved objectives and major findings, and highlight significant conclusions and recommendations.
Author
*Airports; Microwave Landing Systems; Air Traffic Control; Wireless Communication; Channels (Data Transmission); Mathematical Models; Extensions*

## 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.

**20070018865** NASA Langley Research Center, Hampton, VA, USA

**Frequency Response of an Aircraft Wing with Discrete Source Damage Using Equivalent Plate Analysis**

Krishnamurthy, T.; Eldred, Lloyd B.; April 23, 2007; 18 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 732759.07.09; Copyright; Avail.: CASI: A03, Hardcopy

An equivalent plate procedure is developed to provide a computationally efficient means of matching the stiffness and frequencies of flight vehicle wing structures for prescribed loading conditions. Several new approaches are proposed and studied to match the stiffness and first five natural frequencies of the two reference models with and without damage. One approach divides the candidate reference plate into multiple zones in which stiffness and mass can be varied using a variety of materials including aluminum, graphite-epoxy, and foam-core graphite-epoxy sandwiches. Another approach places point masses along the edge of the stiffness-matched plate to tune the natural frequencies. Both approaches are successful at matching the stiffness and natural frequencies of the reference plates and provide useful insight into determination of crucial features in equivalent plate models of aircraft wing structures.

Author

*Frequency Response; Wings; Aircraft Structures; Plates (Structural Members); Mathematical Models; Damage Assessment; Discrete Functions; Mechanical Properties*

**20070018996** Lookahead Decisions, Inc., Davis, CA USA

**SmartSwarms: Distributed UAVs that Think**

Prieditis, Armand; Dalal, Mukesh; Arcilla, Andrew; Groel, Brett; Van Der Bock, Michael; Kong, Richard; Jun 2004; 23 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465279; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465279

Unmanned Aerial Vehicles (UAVs) have demonstrated tremendous capability in recent military operations. Recently swarm technology has been suggested as a possible solution to automatically control and coordinate multiple UAVs. The idea behind a swarm is that simple local rules that govern the behavior of individual entities can lead to complex emergent behavior of the system as a whole. Although such systems have achieved limited success in simulated applications, finding good rules can be difficult for humans. Moreover, such rules can result in odd behavior or unnecessarily long missions. This paper describes a swarm-based multi-UAV system, called SmartSwarms, using a radically different approach: instead of operating with human-defined rules, each individual reasons using Simulated LookAhead (SLA), thus incorporating a model of its world and nearby entities in decision-making. Our results show that this approach can improve swarm behavior in UAVs. SLA is affordable, scalable to a large number of UAVs, deconflicts in real-time, learns over time, is interoperable, reusable, fault tolerant, and error tolerant, and can handle uncertainty.

DTIC

*Artificial Intelligence; Decision Making; Drone Vehicles; Interoperability; Military Operations*

**20070018999** Leninetz Holding Co., Saint Petersburg, Russian Federation

**Researching the Possibility of Creating Highly Effective Catalysts for the Thermochemical Heat Regeneration and Hydrocarbon Reforming**

Kuranov, Alexander L; Nov 2006; 84 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-03-D-0001-0004

Report No.(s): AD-A465282; No Copyright; Avail.: CASI: A05, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465282

This report results from a contract tasking Leninetz Holding Company. NIPGS as follows: The contractor will investigate using a two-stage fuel conversion process for cooling hypersonic air vehicle and engine structures. The two stage process has been shown to significantly reduce fuel coking while maximizing cooling capacity. In the first stage the fuel is reformed to produce methane. The second stage provides additional cooling and reforms the methane into hydrogen. The contractor will develop the catalysts, substrate and processing procedures required for the two step hydrocarbon steam reforming process.

Specifically. for both the stage I and stage II reactors they will (1) develop catalytic materials for low and high temperature operation; (2) develop the plasma spraying technique for applying the catalysts to the substrate material; (3) manufacture samples for testing; and (4) conduct tests to evaluate mechanical and catalytic properties.
DTIC
*Catalysis; Catalysts; Cooling; Hydrocarbons; Hypersonic Vehicles; Refueling; Steam; Thermochemistry*

**20070019002** Air Force Research Lab., Wright-Patterson AFB, OH USA
**A Flexible Hypersonic Vehicle Model Developed With Piston Theory (Preprint)**
Oppenheimer, Michael W; Doman, David B; Dec 2006; 27 pp.; In English
Contract(s)/Grant(s): Proj-A03G
Report No.(s): AD-A465285; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465285

For high Mach number flows, M \g 4, piston theory has been used to calculate the pressures on the surfaces of a vehicle. In a two-dimensional inviscid flow, a perpendicular column of fluid stays intact as it passes over a solid surface. Thus, the pressure at the surface can be calculated assuming the surface were a piston moving into a column of fluid. In this work, first-order piston theory is used to calculate the forces, moments, and stability derivatives for longitudinal motion of a hypersonic vehicle. The advantage of piston theory over other techniques, such as Prandtl-Meyer flow, oblique shock, or Newtonian impact theory, is that unsteady aerodynamic effects can be included in the model. The unsteady effects, considered in this work, include perturbations in the linear velocities and angular rates, due to rigid body motion. A flexible model is developed using Euler-Bernoulli beam theory and the unsteady effects due to aeroelastics are captured in the model.
DTIC
*Aerodynamics; Hypersonic Vehicles; Models; Piston Theory; Pistons; Unsteady Aerodynamics*

**20070019094** Clemson Univ., SC USA
**Control of a Remotely Operated Quadrotor Aerial Vehicle and Camera Unit Using a Fly-The-Camera Perspective**
Lee, DongBin; Chitrakaran, Vilas; Burg, Timothy; Dawson, Darren; Xian, Bin; Mar 11, 2007; 16 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465496; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465496

This paper presents a mission-centric approach to controlling the optical axis of a video camera mounted on a camera manipulator and fixed to a quadrotor remotely operated vehicle. The approach considers that for video collection tasks a single operator should be able to operate the systems by ‘flying-the-camera"; that is, collect video from the perspective that the operator is looking out of and is the pilot of the camera. This will allow the control of the quadrotor and the camera positioner to be fused into a single control problem where the camera is positioned using the four degree-of-freedom (DOF) quadrotor and the two DOF camera positioner to provide a full six DOF actuation of the camera view. The closed-loop controller is designed based on a Lyapunov-type analysis and is shown to produce Globally Uniformly Ultimately Bounded (GUUB) tracking of a desired trajectory. Computer simulation results are provided to demonstrate the performance of the suggested controller.
DTIC
*Cameras; Degrees of Freedom; Remote Control; Robotics*

**20070019166** Civil Aeromedical Inst., Oklahoma City, OK USA
**An Assessment of Pilot Control Interfaces for Unmanned Aircraft**
Williams, Kevin W; Apr 2007; 16 pp.; In English
Report No.(s): AD-A465657; DOT/FAA/AM-07/8; No Copyright; Avail.: CASI: A03, Hardcopy

An inventory of control systems for unmanned aircraft was completed for 15 systems from nine separate manufacturers. To complete the inventory, a taxonomy of control architectures was developed. The taxonomy identified four levels of horizontal aircraft control, four levels of vertical control, and three levels of speed control. The most automated level of control was a waypoint-level that was found to be present in all of the systems inventoried. Implications of these levels of control on design are discussed.
DTIC
*Aircraft; Control; Pilotless Aircraft*

**20070019183** Clemson Univ., SC USA

**Vision Assisted Landing of an Unmanned Aerial Vehicle**

Chitrakaran, Vilas K; Dawson, Darren M; Chen, Jian; Feemster, Mathew; Jan 2005; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465706; CU/CRB/8/8/05/ 1; No Copyright; Avail.: Defense Technical Information Center (DTIC)

In this paper, a strategy for an autonomous landing maneuver for an under-actuated, unmanned aerial vehicle (UAV) using position information obtained from a single monocular on-board camera is presented. Although the UAV is underactuated in translational control inputs (i.e., a lift force can only be produced), the proposed controller is shown to achieve globally uniform ultimate boundedness (GUUB) in position regulation error during the landing approach. The proposed vision-based control algorithm is built upon homography-based techniques and Lyapunov design methods.

DTIC

*Drone Vehicles; Landing; Landing Aids; Pilotless Aircraft; Vision*

**20070019220** Bolt, Beranek, and Newman, Inc., Cambridge, MA USA

**ACT - The Automated Clearance Tool: Improving the Diplomatic Clearance Process for AMC**

Mulvehill, Alice; Benyo, Brett; Rager, David; DePalma, Edward; Jun 2004; 26 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465792; No Copyright; Avail.: CASI: A03, Hardcopy

This paper describes a decision-support tool being developed to support diplomatic clearance processing for AMC (Air Mobility Command) mission aircraft. We describe the approach employed to design and develop the Automated Clearance Tool (ACT). Our work is one example of the types of decision-support tools and/or systems that can operate within, and leverage the concept of a 'Semantic Web'. The vision behind the Semantic Web is based on the idea of encoding information so that computers or supporting software agents can use it to support a given application. A number of markup languages such as the Web Ontology Language (OWL) have been developed to support web information encoding. Several tools are being developed to facilitate the use of this language, including the Jena Semantic Web Toolkit and RDQL query language. Early adopters in government and business are using this approach to develop applications. In this paper, we describe how ongoing advances in semantic annotation and the extension of XML with languages such as OWL have influenced the way ACT was designed and developed. Also, we provide some recommendations about how semantically annotated data can be used to support command and control (C2).

DTIC

*Aircraft; Clearances; International Relations; Mobility; Personnel*

## 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.

**20070019347** NASA Johnson Space Center, Houston, TX, USA

**Remote Controlled Orbiter Capability**

Garske, Michael; delaTorre, Rafael; May 11, 2007; 28 pp.; In English; AIAA Conference, 11 May 2007, Houston, TX, USA; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

The Remote Control Orbiter (RCO) capability allows a Space Shuttle Orbiter to perform an unmanned re-entry and landing. This low-cost capability employs existing and newly added functions to perform key activities typically performed by flight crews and controllers during manned re-entries. During an RCO landing attempt, these functions are triggered by automation resident in the on-board computers or uplinked commands from flight controllers on the ground. In order to properly route certain commands to the appropriate hardware, an In-Flight Maintenance (IFM) cable was developed. Currently, the RCO capability is reserved for the scenario where a safe return of the crew from orbit may not be possible. The flight crew would remain in orbit and await a rescue mission. After the crew is rescued, the RCO capability would be used on the unmanned Orbiter in an attempt to salvage this national asset.

Author

*Remote Control; Space Shuttle Orbiters; Unmanned Spacecraft; Spacecraft Landing; Spacecraft Reentry; Avionics; Spacecraft Control*

**20070019371** NASA Langley Research Center, Hampton, VA, USA

**Collocation and Pattern Recognition Effects on System Failure Remediation**

Trujillo, Anna C.; Press, Hayes N.; Apr. 23, 2007; 6 pp.; In English; 14th International Symposium on Aviation Psychology, 23-26 Apr. 2007, Dayton, OH, USA; Original contains black and white illustrations

Contract(s)/Grant(s): WBS 457280.02.07.07.06; Copyright; Avail.: CASI: A02, Hardcopy

Previous research found that operators prefer to have status, alerts, and controls located on the same screen. Unfortunately, that research was done with displays that were not designed specifically for collocation. In this experiment, twelve subjects evaluated two displays specifically designed for collocating system information against a baseline that consisted of dial status displays, a separate alert area, and a controls panel. These displays differed in the amount of collocation, pattern matching, and parameter movement compared to display size. During the data runs, subjects kept a randomly moving target centered on a display using a left-handed joystick and they scanned system displays to find a problem in order to correct it using the provided checklist. Results indicate that large parameter movement aided detection and then pattern recognition is needed for diagnosis but the collocated displays centralized all the information subjects needed, which reduced workload. Therefore, the collocated display with large parameter movement may be an acceptable display after familiarization because of the possible pattern recognition developed with training and its use.

Author

*Collocation; Pattern Recognition; System Failures; Display Devices*

## 07
## AIRCRAFT PROPULSION AND POWER

Includes primary propulsion systems and related systems and components, e.g., gas turbine engines, compressors, and fuel systems; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power; 28 Propellants and Fuels; and 44 Energy Production and Conversion.

**20070018937** NASA Glenn Research Center, Cleveland, OH, USA

**Model Specification for Rework of Aircraft Engine, Power Transmission, and Accessory/Auxiliary Ball and Roller Bearings**

Zaretsky, Erwin V.; Branzai, Emanuel V.; March 2007; 48 pp.; In English

Contract(s)/Grant(s): WBS 561581.02.07.03.03.03

Report No.(s): NASA/TP-2007-214463; E-15213; Copyright; Avail.: CASI: A03, Hardcopy

This document provides a model specification for the rework and/or repair of bearings used in aircraft engines, helicopter main power train transmissions, and auxiliary bearings determined to be critical by virtue of performance, function, or availability. The rolling-element bearings to be processed under the provisions of this model specification may be used bearings removed after service, unused bearings returned from the field, or certain rejected bearings returned for reinspection and salvage. In commercial and military aircraft application, it has been a practice that rolling-element bearings removed at maintenance or overhaul be reworked and returned to service. Depending on the extent of rework and based upon theoretical analysis, representative life factors (LF) for bearings subject to rework ranged from 0.87 to 0.99 the lives of new bearings. Based on bearing endurance data, 92 percent of the bearing sets that would be subject to rework would result in L(sub 10) lives equaling and/or exceeding that predicted for new bearings. The remaining 8 percent of the bearings have the potential to achieve the analytically predicted life of new bearings when one of the rings is replaced at rework. The potential savings from bearing rework varies from 53 to 82 percent of that of new bearings depending on the cost, size, and complexity of the bearing

Author

*Ball Bearings; Roller Bearings; Aircraft Engines; Power Transmission; Specifications; Auxiliary Power Sources*

## 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.

**20070018945** Naval Research Lab., Washington, DC USA

**Applying the SCR Requirements Method to a Simple Autopilot**

Bharadwaj, Ramesh; Heitmeyer, Constance; Sep 1997; 16 pp.; In English

Report No.(s): AD-A465145; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465145

Although formal methods for developing computer systems have been available for more than a decade, few have had significant impact in practice. A major barrier to their use is that developers find formal methods difficult to understand and apply. One exception is a formal method called SCR for specifying computer system requirements which, due to its easy-to-use tabular notation and demonstrated scalability, has achieved some success in industry. To demonstrate and evaluate the SCR method and tools, we recently used SCR to specify the requirements of a simplified mode control panel for the Boeing 737 autopilot. This paper presents the SCR requirements specification of the autopilot, outlines the process we used to create the SCR specification from a prose description, and discusses the problems and questions that arose in developing the specification. Formalizing and analyzing the requirements specification in SCR uncovered a number of problems with the original prose description, such as incorrect assumptions about the environment, incompleteness, and inconsistency. The paper also introduces a new tabular format we found useful in understanding and analyzing the required behavior of the autopilot. Finally, the paper compares the SCR approach to requirements with that of Butler [5], who uses the PVS language and prover [14] to represent and analyze the autopilot requirements.
DTIC
*Automatic Pilots; Computer Programming; Requirements; Software Engineering*

**20070019059** Civil Aeromedical Inst., Oklahoma City, OK USA
**Color Analysis in Air Traffic Control Displays, Part II. Auxiliary Displays**
Xing, Jing; Mar 2007; 22 pp.; In English
Report No.(s): AD-A465404; DOT/FAA/AM-07-5; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465404

This report presents the second part of our analysis of color use in Air Traffic Control displays. Part I of the study focused on operational displays, while this investigation focuses on auxiliary information displays with which controllers acquire additional information to make decisions. We chose three frequently used decision-support displays for the analysis. Those are: User Request Evaluation Tool (URET), Traffic Management Advisor (TMA), and Integrated Terminal Weather System (ITWS). For each display, we documented the background and default colors, color-coding, color usage, associated purposes of color use, and color complexity. With this systematic documentation, we were able to assess compatibility across displays. Using the color checklists we developed earlier, we also analyzed the effectiveness and shortcomings of color use in these displays. The results revealed a number of instances where the use of color might not be effective for its given purpose and where a color could have potential negative effects on task performance. The results of this study can benefit design prototypes and acquisition evaluation for new Air Traffic Control technologies.
DTIC
*Air Traffic Control; Color; Display Devices*

## 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*.

**20070018829** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Hydra Rendezvous and Docking Sensor**
Roe, Fred; Carrington, Connie; [2007]; 1 pp.; In English; IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; No Copyright; Avail.: Other Sources; Abstract Only

The U.S. technology to support a CEV AR&D activity is mature and was developed by NASA and supporting industry during an extensive research and development program conducted during the 1990's and early 2000 time frame at the Marshall Space Flight Center. Development and demonstration of a rendezvous/docking sensor was identified early in the AR&D Program as the critical enabling technology that allows automated proxin~ity operations and docking. A first generation rendezvous/docking sensor, the Video Guidance Sensor (VGS) was developed and successfully flown on STS 87 and again on STS 95, proving the concept of a video-based sensor. Advances in both video and signal processing technologies and the lessons learned from the two successful flight experiments provided a baseline for the development of a new generation of video based rendezvous/docking sensor. The Advanced Video Guidance Sensor (AVGS) has greatly increased performance and additional capability for longer-range operation. A Demonstration Automatic Rendezvous Technology (DART) flight

experiment was flown in April 2005 using AVGS as the primary proximity operations sensor. Because of the absence of a docking mechanism on the target satellite, this mission did not demonstrate the ability of the sensor to co~ltrold ocking. Mission results indicate that the rendezvous sensor operated successfully in 'spot mode' (2 km acquisition of the target, bearing data only) but was never commanded to 'acquire and track' the docking target. Parts obsolescence issues prevent the construction of current design AVGS units to support the NASA Exploration initiative. This flight proven AR&D technology is being modularized and upgraded with additional capabilities through the Hydra project at the Marshall Space Flight Center. Hydra brings a unique engineering approach and sensor architecture to the table, to solve the continuing issues of parts obsolescence and multiple sensor integration. This paper presents an approach to sensor hardware trades, to address the needs of future vehicles that may rendezvous and dock with the International Space Station (ISS). It will also discuss approaches for upgrading AVGS to address parts obsolescence, and concepts for modularizing the sensor to provide configuration flexibility for multiple vehicle applications. Options for complementary sensors to be integrated into the multi-head Hydra system will also be presented. Complementary sensor options include ULTOR, a digital image correlator system that could provide relative six-degree-of-freedom information independently from AVGS, and time-of-flight sensors, which determine the range between vehicles by timing pulses that travel from the sensor to the target and back. Common targets and integrated targets, suitable for use with the multi-sensor options in Hydra, will also be addressed.
Author
*International Space Station; Orbital Rendezvous; Spacecraft Docking; Guidance Sensors; Technology Utilization*

## 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*.

**20070019005** Air Force Research Lab., Wright-Patterson AFB, OH USA
**Analysis of the Reconfigurable Control Capabilities of a Space Access Vehicle (Preprint)**
Oppenheimer, Michael W; Ngo, Anhtuan D; Blake, William B; Dec 2006; 13 pp.; In English
Contract(s)/Grant(s): Proj-A03G
Report No.(s): AD-A465288; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465288

Future access to space vehicles will be required to achieve a high level of safety and operability. In order to achieve these goals, integrated adaptive guidance and control can be used to recover a vehicle from off-nominal conditions, such as control effector failures, engine out, loss of engine gimbal, and so on. In this work, a preliminary configuration for a space access vehicle is defined. The vehicle contains five control surfaces, a bodyflap, two elevons, and two rudders. A guidance and control (G&C) design tool to rapidly assess the necessary control effort of the vehicle to track its flight trajectory is developed. Given the conceptual configuration and a desired trajectory for re-entry flight, this G&C tool provides an inner-loop feedback control law and outer-loop feedback guidance law to track the given trajectory. The inner-loop control law, based on dynamic inversion with a non-linear control allocator, is used to linearize the vehicle dynamics over its flight envelope and assign control tasks to the available control effectors to track the desired roll rate, pitch rate, and yaw rate. The outer-loop guidance law is based on a backstepping method. Assessment of the vehicle's ability to recover from control failures is conducted in this work for a nominal re-entry flight.
DTIC
*Adaptation; Control Theory; Models; Recoverable Spacecraft*

**20070019038** 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-A465340; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465340

A modulating retroreflector (MRR) is used for a free-space optics (FSO) implementation of the MIL-STD-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 Links; Modulation; Optical Communication; Protocol (Computers); Retroreflectors*

**20070019041** Research Support Instruments, Inc., Lanham, MD USA
**Low Frequency Sampling Adaptive Thresholding for Free-Space Optical Communication Receivers with Multiplicative Noise**
Burris, H R; Moore, C; Vilcheck, M; Mahon, R; Stell, M; Suite, M; Davis, M; Scharpf, W; Reed, A; Rabinovich, W; Jan 2004; 15 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465346; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465346

An adaptive thresholding method is presented for optimum detection for optical receivers with large multiplicative noise. The technique uses low frequency sampling of the detected current that enables calculation of the bit means and variances and estimation of the optimum detection threshold. The regime in which this holds is when the sampling frequency is lower than the bit rate but higher than atmospheric turbulence frequency content. Simulations are done with data obtained from the NRL Chesapeake Bay Lasercomm Testbed. The results of simulations comparing BER performance versus sample rate and parameter estimation error will be presented. If the system parameters are characterized in advance with reasonable accuracy, the BER obtained will typically be an order of magnitude improvement over the equal variance threshold (depending on the signal to noise ratio).
DTIC
*Free-Space Optical Communication; Low Frequencies; Optical Communication; Quantum Wells; Receivers; Sampling*

## 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*.

**20070018773** NASA Marshall Space Flight Center, Huntsville, AL, USA
**NASA Robotics for Space Exploration**
Fischer, RIchard T.; [2007]; 38 pp.; In English; Third Technological Age Congress, 22-24 Mar. 2007, Michoacan, Mexico; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018773

This presentation focuses on NASA's use of robotics in support of space exploration. The content was taken from public available websites in an effort to minimize any ITAR or EAR issues. The agenda starts with an introduction to NASA and the 'Vision for Space Exploration' followed by NASA's major areas of robotic use: Robotic Explorers, Astronaut Assistants, Space Vehicle, Processing, and In-Space Workhorse (space infrastructure). Pictorials and movies of NASA robots in use by the major NASA programs: Space Shuttle, International Space Station, current Solar Systems Exploration and Mars Exploration, and future Lunar Exploration are throughout the presentation.
Author
*Robotics; Space Exploration; Space Missions; NASA Space Programs*

## 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*.

**20070018936** NASA Glenn Research Center, Cleveland, OH, USA
**Dilution-of-Precision-Based Lunar Surface Navigation System Analysis Utilizing Lunar Orbiters**
Welch, Bryan W.; Connolly, Joseph W.; Sands, Obed S.; April 2007; 188 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): WBS 439432.07.04.03.01
Report No.(s): NASA/TP-2007-214427; E-15704; No Copyright; Avail.: CASI: A09, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018936

The NASA Vision for Space Exploration is focused on the return of astronauts to the Moon. Although navigation systems have already been proven in the Apollo missions to the Moon, the current exploration campaign will involve more extensive and extended missions requiring new concepts for lunar navigation. In contrast to Apollo missions, which were limited to the near-side equatorial region of the Moon, those under the Exploration Systems Initiative will require navigation on the Moon's limb and far side. Since these regions have poor Earth visibility, a navigation system comprised solely of Earth-based tracking stations will not provide adequate navigation solutions in these areas. In this report, a dilution-of-precision (DoP)-based analysis of the performance of a network of Moon orbiting satellites is provided. This analysis extends a previous analysis of a lunar network (LN) of navigation satellites by providing an assessment of the capability associated with a variety of assumptions. These assumptions pertain to the minimum surface user elevation angle and a total single satellite failure in the lunar network. The assessment is accomplished by making appropriately formed estimates of DoP. Different adaptations of DoP, such as geometric DoP and positional DoP (GDoP and PDoP), are associated with a different set of assumptions regarding augmentations to the navigation receiver or transceiver.
Author
*Surface Navigation; Navigation Satellites; Tracking Stations; Space Exploration; Systems Analysis; Lunar Orbiter; Geometric Dilution of Precision*

**20070019290** ZIN Technologies, Inc., Brook Park, OH, USA
**Strategic Adaptation of SCA for STRS**
Quinn, Todd; Kacpura, Thomas; April 2007; 13 pp.; In English; 2006 Software Defined Radio Forum Technical Conference, 13-17 Nov. 2006, Orlando, FL, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS3-99154; WBS 439432.07.02.03.03
Report No.(s): NASA/CR-2007-214688; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019290
The Space Telecommunication Radio System (STRS) architecture is being developed to provide a standard framework for future NASA space radios with greater degrees of interoperability and flexibility to meet new mission requirements. The space environment imposes unique operational requirements with restrictive size, weight, and power constraints that are significantly smaller than terrestrial-based military communication systems. With the harsh radiation environment of space, the computing and processing resources are typically one or two generations behind current terrestrial technologies. Despite these differences, there are elements of the SCA that can be adapted to facilitate the design and implementation of the STRS architecture.
Author
*Radio Communication; Telecommunication; Architecture (Computers); Radio Equipment; Software Engineering*

## 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\fSafety*.

**20070018746** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Ares Launch Vehicles Overview: Space Access Society**
Cook, Steve; Mar. 22, 2007; 44 pp.; In English; Space Access Society Annual Meeting/Space Access Society, 22-24 Mar. 2007, Phoenix, AZ, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018746
America is returning to the Moon in preparation for the first human footprint on Mars, guided by the U.S. Vision for Space Exploration. This presentation will discuss NASA's mission, the reasons for returning to the Moon and going to Mars, and how NASA will accomplish that mission in ways that promote leadership in space and economic expansion on the new frontier. The primary goals of the Vision for Space Exploration are to finish the International Space Station, retire the Space Shuttle, and build the new spacecraft needed to return people to the Moon and go to Mars. The Vision commits NASA and the nation to an agenda of exploration that also includes robotic exploration and technology development, while building on lessons learned over 50 years of hard-won experience. NASA is building on common hardware, shared knowledge, and unique experience derived from the Apollo Saturn, Space Shuttle, and contemporary commercial launch vehicle programs. The

journeys to the Moon and Mars will require a variety of vehicles, including the Ares I Crew Launch Vehicle, which transports the Orion Crew Exploration Vehicle, and the Ares V Cargo Launch Vehicle, which transports the Lunar Surface Access Module. The architecture for the lunar missions will use one launch to ferry the crew into orbit, where it will rendezvous with the Lunar Module in the Earth Departure Stage, which will then propel the combination into lunar orbit. The imperative to explore space with the combination of astronauts and robots will be the impetus for inventions such as solar power and water and waste recycling. This next chapter in NASA's history promises to write the next chapter in American history, as well. It will require this nation to provide the talent to develop tools, machines, materials, processes, technologies, and capabilities that can benefit nearly all aspects of life on Earth. Roles and responsibilities are shared between a nationwide Government and industry team. The Exploration Launch Projects Office at the Marshall Space Flight Center manages the design, development, testing, and evaluation of both vehicles and serves as lead systems integrator. A little over a year after it was chartered, the Exploration Launch Projects team is testing engine components, refining vehicle designs, performing wind tunnel tests, and building hardware for the first flight test of Ares I-X, scheduled for spring 2009. The Exploration Launch Projects team conducted the Ares I System Requirements Review (SRR) at the end of 2006. In Ares' first year, extensive trade studies and evaluations were conducted to refine the design initially recommended by the Exploration Systems Architecture Study, conceptual designs were analyzed for fitness, and the contractual framework was assembled to enable a development effort unparalleled in American space flight since the Space Shuttle. Now, the project turns its focus to the Preliminary Design Review (PDR), scheduled for 2008. Taking into consideration the findings of the SRR, the design of the Ares I is being tightened and refined to meet the safety, operability, reliability, and affordability goals outlined by the Constellation Program. The Ares V is in the early design stage, focusing its activities on requirements validation and ways to develop this heavy-lift system so that synergistic hardware commonality between it and the Ares I can reduce the operational footprint and foster sustained exploration across the decades ahead.
Author
*NASA Space Programs; Ares 1 Launch Vehicle; Ares 5 Cargo Launch Vehicle; General Overviews; Space Missions; Spacecraft Configurations*

**20070018803** NASA Johnson Space Center, Houston, TX, USA
**An Overview of the Space Shuttle Orbiter's Aging Aircraft Program**
Russell, Richard W.; [2007]; 19 pp.; In English; 18th Aeromat Conference and Exposition, 25-28 Jun. 2007, Baltimore, MD, USA; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018803

The Space Shuttle Orbiter has well exceeded its original design life of 10 years or 100 missions. The Orbiter Project Office (OPO) has sponsored several activities to address aging vehicle concerns, including a Corrosion Control Review Board (CCRB), a mid-life certification program, and most recently the formation of the Aging Orbiter Working Group (AOWG). The AOWG was chartered in 2004 as a proactive group which provides the OPO oversight for aging issues such as corrosion, non-destructive inspection, non-metallics, wiring and subsystems. The core team consists of mainly representatives from the Materials and Processes Problem Resolution Team (M&P PRT) and Safety and Mission Assurance (S&MA). Subsystem engineers and subject matter experts are called in as required. The AOWG has functioned by forming issues based sub-teams. Examples of completed sub-teams include adhesives, wiring and wing leading edge metallic materials. Current sub-teams include Composite Over-Wrapped Pressure Vessels (COPV), elastomeric materials and mechanisms.
Author
*Space Shuttle Orbiters; Nondestructive Tests; Pressure Vessels; Certification; Corrosion*

**20070018804** NASA Marshall Space Flight Center, Huntsville, AL, USA
**NDE Development for Inspection of the Ares I Crew Launch Vehicle**
Richter, Joel; Russell, Sam S.; [2007]; 1 pp.; In English; American Society for Nondestructive Testing, 26-30 Mar. 2007, Orlando, FL, USA; No Copyright; Avail.: Other Sources; Abstract Only

NASA is designing a new crewed launch vehicle called Ares I to replace the Space Shuttle after its scheduled retirement in 2010. This new launch vehicle will build on the Shuttle technology in many ways including using a first stage based upon the Space Shuttle Solid Rocket Booster, advanced aluminum alloys for the second stage tanks, and friction stir welding to assemble the second stage. Friction stir welding uses a spinning pin that is inserted in the joint between two panels that are to be welded. The pin mechanically mixes the metal together below the melting temperature to form the weld. Friction stir welding allows high strength joints in metals that would otherwise lose much of their strength as they are melted during the fusion welding process. One significant change from the Space Shuttle that impacts NDE is the implementation of self-reacting friction stir welding for non-linear welds on the primary metallic structure. The self-reacting technique differs

from the conventional technique because the load of the pin tool pressing down on the metal being joined is reacted by a nut on the end of the tool rather than an anvil behind the part. No spacecraft has ever flown with a self-reacting friction stir weld, so this is a major advancement in the manufacturing process, bringing with it a whole new set of challenges for NDE to overcome. Another impact is the proposed usage of an aluminum face sheet, phenolic honeycomb sandwich structure for a common bulkhead between the fuel and oxidizer tanks. This design was used on the second stage of Saturn IB and the second and third stages of Saturn V, but both the manufacturing and subsequent inspection were very costly and time consuming so a more efficient inspection method is sought. The current state of development of these inspections will be presented, along with other information pertinent to NDE of the Ares I.
Author
*Launch Vehicles; Welded Joints; Friction Stir Welding; Fusion Welding; Nondestructive Tests; Ares 1 Launch Vehicle; Space Shuttles; High Strength*

**20070018808** NASA Johnson Space Center, Houston, TX, USA
**Boeing Crew Exploration Vehicle Environmental Control and Life Support System Architecture Overview**
Saiidi, Mo; Lewis, John F.; [2007]; 5 pp.; In English; International Conference of Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): 644423.02.36.12.10
Report No.(s): Rept-07ICES-284; Copyright; Avail.: Other Sources

The Boeing Company under the teaming agreement with the Northrop Grumman Systems Corporation and in compliance with the NASA Phase 1 contract, had the responsibilities for the CEV architecture development of the Environmental control and life support (ECLS) system under the NASA Phase 1 contract. The ECLS system was comprised of the various subsystems which provided for a shirt-sleeve habitable environment for crew to live and work in the crew module of the CEV. This architecture met the NASA requirements to ferry cargo and crew to ISS, and Lunar sortie missions, with extensibility to long duration missions to Moon and MARS. This paper provides a summary overview of the CEV ECLS subsystems which was proposed in compliance with the contract activities.
Author
*Spacecrews; Environmental Control; Life Support Systems; Habitability; Control Systems Design; Crew Exploration Vehicle*

**20070018815** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Demonstration of Self-Training Autonomous Neural Networks in Space Vehicle Docking Simulations**
Patrick, M. Clinton; Thaler, Stephen L.; Stevenson-Chavis, Katherine; December 28, 2006; 6 pp.; In English; 2007 IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains black and white illustrations
Report No.(s): IEEEAC Ppaper 1409; Copyright; Avail.: CASI: A02, Hardcopy

Neural Networks have been under examination for decades in many areas of research, with varying degrees of success and acceptance. Key goals of computer learning, rapid problem solution, and automatic adaptation have been elusive at best. This paper summarizes efforts at NASA's Marshall Space Flight Center harnessing such technology to autonomous space vehicle docking for the purpose of evaluating applicability to future missions.
Author
*Autonomous Docking; Neural Nets; Education; Docking*

**20070018821** NASA Marshall Space Flight Center, Huntsville, AL, USA
**NDE Methods for the External Tank Spray on Foam Insulation**
Walker, James L.; Johnson, Kenneth L.; Santos, Fernando E.; Ussery, W. Warren; [2007]; 2 pp.; In English; American Society for Nondestructive Testing 16th Annual Research Symposium, 27-29 Mar. 2007, Orlando, FL, USA; Copyright; Avail.: Other Sources; Abstract Only

The foam thermal protection system (TPS) of the space shuttle External Tank (ET) has provided some unique challenges to the nondestructive testing community. Three nondestructive evaluation methods have been developed to identify defects in the foam TPS of the ET. Terahertz imaging and backscatter radiography have been developed to identify voids in thick foam regions while shearography has been developed to identify shallow delaminations, shallow voids and crush damage in the foam. The basic theory of operation along with factors, determined from a series of designed experiments, affecting the results

of these methods will be described. Results from both test panels and flight tank inspections will be provided, along with predicted probability of detection estimates to show the range in defect sizes and types that can be readily detected.
Author
*External Tanks; Thermal Protection; Nondestructive Tests; Insulation; Foams; Damage*

**20070018830** NASA Langley Research Center, Hampton, VA, USA
**Structural Design and Analysis of Un-pressurized Cargo Delivery Vehicle**
Martinovic, Zoran N.; [2007]; 16 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 136905.10.10.20.20
Report No.(s): AIAA-2007-2370; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018830

As part of the Exploration Systems Architecture Study, NASA has defined a family of vehicles to support lunar exploration and International Space Station (ISS) re-supply missions after the Shuttle s retirement. The Un-pressurized Cargo Delivery Vehicle (UCDV) has been envisioned to be an expendable logistics delivery vehicle that would be used to deliver external cargo to the ISS. It would be launched on the Crew Launch Vehicle and would replace the Crew Exploration Vehicle. The estimated cargo would be the weight of external logistics to the ISS. Determining the minimum weight design of the UCDV during conceptual design is the major issue addressed in this paper. This task was accomplished using a procedure for rapid weight estimation that was based on Finite Element Analysis and sizing of the vehicle by the use of commercially available codes. Three design concepts were analyzed and their respective weights were compared. The analytical structural weight was increased by a factor to account for structural elements that were not modeled. Significant reduction in weight of a composite design over metallic was achieved for similar panel concepts.
Author
*International Space Station; Structural Design; Systems Engineering; Mathematical Models; Logistics; Cargo Spacecraft*

**20070018831** NASA Langley Research Center, Hampton, VA, USA
**A Conceptual Aerospace Vehicle Structural System Modeling, Analysis and Design Process**
Mukhopadhyay, Vivek; [2007]; 13 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 56181.02
Report No.(s): AIAA 2007-2372; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018831

A process for aerospace structural concept analysis and design is presented, with examples of a blended-wing-body fuselage, a multi-bubble fuselage concept, a notional crew exploration vehicle, and a high altitude long endurance aircraft. Aerospace vehicle structures must withstand all anticipated mission loads, yet must be designed to have optimal structural weight with the required safety margins. For a viable systems study of advanced concepts, these conflicting requirements must be imposed and analyzed early in the conceptual design cycle, preferably with a high degree of fidelity. In this design process, integrated multidisciplinary analysis tools are used in a collaborative engineering environment. First, parametric solid and surface models including the internal structural layout are developed for detailed finite element analyses. Multiple design scenarios are generated for analyzing several structural configurations and material alternatives. The structural stress, deflection, strain, and margins of safety distributions are visualized and the design is improved. Over several design cycles, the refined vehicle parts and assembly models are generated. The accumulated design data is used for the structural mass comparison and concept ranking. The present application focus on the blended-wing-body vehicle structure and advanced composite material are also discussed.
Author
*Aerospace Vehicles; Structural Analysis; Computational Fluid Dynamics; Crew Exploration Vehicle; Spacecraft Models; Spacecraft Configurations*

**20070018835** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Photonic Component Qualification and Implementation Activities at NASA Goddard Space Flight Center**
Ott, Melanie N.; Jin, Xiaodan Linda; Chuska, Richard F.; LaRocca, Frank V.; MacMurphy, Shawn L.; Matuszeski, Adam J.; Zellar, Ronald S.; Friedberg, Patricia R.; Malenab, Mary C.; [2006]; 13 pp.; In English; SPIE's Optics and Photonics

Symposium, 13-17 Aug. 2007, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

The photonics group in Code 562 at NASA Goddard Space Flight Center supports a variety of space flight programs at NASA including the: International Space Station (ISS), Shuttle Return to Flight Mission, Lunar Reconnaissance Orbiter (LRO), Express Logistics Carrier, and the NASA Electronic Parts and Packaging Program (NEPP). Through research, development, and testing of the photonic systems to support these missions much information has been gathered on practical implementations for space environments. Presented here are the highlights and lessons learned as a result of striving to satisfy the project requirements for high performance and reliable commercial optical fiber components for space flight systems. The approach of how to qualify optical fiber components for harsh environmental conditions, the physics of failure and development lessons learned will be discussed.

Author

*Photonics; Optical Fibers; International Space Station; Space Transportation System Flights; Logistics; Lunar Orbiter; Reconnaissance; Aerospace Environments*

**20070018855** NASA Johnson Space Center, Houston, TX, USA

**Lessons Learned from the Node 1 Sample Delivery Subsystem Design**

Williams, David E.; [2007]; 5 pp.; In English; 37th International Conference on Environmental, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations

Contract(s)/Grant(s): 401769.06.01.01.01

Report No.(s): 2007-01-3184; Copyright; Avail.: Other Sources

This paper will provide an overview of the International Space Station (ISS) Environmental Control and Life Support (ECLS) design of the Node 1 Sample Delivery Subsystem (SDS) and it will document some of the lessons that have been learned to date for this part of the subsystem.

Author

*Environmental Control; International Space Station; Life Support Systems; Systems Engineering*

**20070019378** NASA Johnson Space Center, Houston, TX, USA

**Structural Design of Glass and Ceramic Components for Space System Safety**

Bernstein, Karen S.; May 14, 2007; 16 pp.; In English; Second IAASS COnference: Space Safety in a Global World, 14-16 May 2007, Chicago, IL, USA; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019378

Manned space flight programs will always have windows as part of the structural shell of the crew compartment. Astronauts and cosmonauts need to and enjoy looking out of the spacecraft windows at Earth, at approaching vehicles, at scientific objectives and at the stars. With few exceptions spacecraft windows have been made of glass, and the lessons learned over forty years of manned space flight have resulted in a well-defined approach for using this brittle, unforgiving material in NASA's vehicles, in windows and other structural applications. This chapter will outline the best practices that have developed at NASA for designing, verifying and accepting glass (and ceramic) windows and other components for safe and reliable use in any space system.

Derived from text

*Glass; Aerospace Systems; Brittle Materials; Aerospace Safety; Ceramics; Structural Design*

## 19
## SPACECRAFT INSTRUMENTATION AND ASTRIONICS

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information see also *06 Avionics and Aircraft Instrumentation*; for spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; for spaceborne telescopes and other astronomical instruments see *89 Astronomy*.

**20070018807** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Programmable Thermostat Module Upgrade for the Multi-Purpose Logistics Module**

Clark, Dallas; Glasgow, Shaun; Reagan, Shawn; Presson, Keith; Howard, David; Smith, Dennis; []2007]; 11 pp.; In English;

Spacecraft Thermal Control Workshop, 27 Feb. - 1 Mar. 2007, El Segundo, CA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018807

The STS-121/ULF1.1 mission was the maiden flight of the Programmable Thermostat Module (PTM) system used to control the 28 V shell heaters on the Multi-Purpose Logistics Module (MPLM). These PTMs, in conjunction with a Data Recorder Module (DRM), provide continuous closed loop temperature control and data recording of MPLM on-orbit heater operations. This paper will discuss the hardware design, development, test and verification (DDT&V) activities performed at the Marshall Space Flight Center (MSFC) as well as the operational implementation and mission performance.
Author
*Data Recorders; Multi-Purpose Logistics Modules; Thermostats; Programmable Logic Devices; Systems Engineering; Space Shuttle Missions*

**20070018869** United Space Alliance, Houston, TX, USA
**System Software Framework for System of Systems Avionics**
Ferguson, Roscoe C.; Peterson, Benjamin L; Thompson, Hiram C.; October 30, 2005; 1 pp.; In English; 24th Digital Avionics Systems Conference (DASC)IEEE/AIAA, 30 October - 3 November 2005, Washington, DC, USA
Contract(s)/Grant(s): NAS9-20000; No Copyright; Avail.: Other Sources; Abstract Only

Project Constellation implements NASA's vision for space exploration to expand human presence in our solar system. The engineering focus of this project is developing a system of systems architecture. This architecture allows for the incremental development of the overall program. Systems can be built and connected in a 'Lego style' manner to generate configurations supporting various mission objectives. The development of the avionics or control systems of such a massive project will result in concurrent engineering. Also, each system will have software and the need to communicate with other (possibly heterogeneous) systems. Fortunately, this design problem has already been solved during the creation and evolution of systems such as the Internet and the Department of Defense's successful effort to standardize distributed simulation (now IEEE 1516). The solution relies on the use of a standard layered software framework and a communication protocol. A standard framework and communication protocol is suggested for the development and maintenance of Project Constellation systems. The ARINC 653 standard is a great start for such a common software framework. This paper proposes a common system software framework that uses the Real Time Publish/Subscribe protocol for framework-to-framework communication to extend ARINC 653. It is highly recommended that such a framework be established before development. This is important for the success of concurrent engineering. The framework provides an infrastructure for general system services and is designed for flexibility to support a spiral development effort.
Author
*Architecture (Computers); Concurrent Engineering; Design Analysis; Software Engineering; Interprocessor Communication; Astrionics; Systems Integration; Systems Engineering*

## 20
## 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*.

**20070018747** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Accuracy Quantification of the Loci-CHEM Code for Chamber Wall Heat Fluxes in a G02/GH2 Single Element Injector Model Problem**
West, Jeff; Westra, Doug; Lin, Jeff; Tucker, Kevin; [2006]; 18 pp.; In English; 3rd International Workshop on Rocket Combustion Modeling, 12-15 Mar. 2006, Paris, France; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018747

A robust rocket engine combustor design and development process must include tools which can accurately predict the multi-dimensional thermal environments imposed on solid surfaces by the hot combustion products. Currently, empirical methods used in the design process are typically one dimensional and do not adequately account for the heat flux rise rate in the near-injector region of the chamber. Computational Fluid Dynamics holds promise to meet the design tool requirement, but requires accuracy quantification, or validation, before it can be confidently applied in the design process. This effort

presents the beginning of such a validation process for the Loci- CHEM CPD code. The model problem examined here is a gaseous oxygen (GO2)/gaseous hydrogen (GH2) shear coaxial single element injector operating at a chamber pressure of 5.42 MPa. The GO2/GH2 propellant combination in this geometry represents one the simplest rocket model problems and is thus foundational to subsequent validation efforts for more complex injectors. Multiple steady state solutions have been produced with Loci-CHEM employing different hybrid grids and two-equation turbulence models. Iterative convergence for each solution is demonstrated via mass conservation, flow variable monitoring at discrete flow field locations as a function of solution iteration and overall residual performance. A baseline hybrid grid was used and then locally refined to demonstrate grid convergence. Solutions were also obtained with three variations of the k-omega turbulence model.
Author
*Rocket Engine Design; Combustion Chambers; Computational Fluid Dynamics; Propellants; Thermal Environments; Heat Flux; Flow Distribution*

**20070018765** NASA Johnson Space Center, Houston, TX, USA
**A Facility for Testing High-Power Electric Propulsion Systems in Space: A Design Study**
Petro, Andrew J.; July 10, 2005; 3 pp.; In English; Joint Propulsion Conference, 10-13 Jul. 2005, Tucson, AZ, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018765

This paper will describe the results of the preliminary phase of a NASA design study for a facility to test high-power electric propulsion systems in space. The results of this design study are intended to provide a firm foundation for a subsequent detailed design and development activities leading to the deployment of a valuable space facility supporting the new vision of space exploration. The objectives for human and robotic exploration of space can be accomplished affordably, safely and effectively with high-power electric propulsion systems. But, as thruster power levels rise to the hundreds of kilowatts and up to megawatts, their testing will pose stringent and expensive demands on existing Earth-based vacuum facilities. These considerations and the access to near-Earth space provided by the International Space Station (ISS) have led to a renewed interest in space testing. The ISS could provide an excellent platform for a space-based test facility with the continuous vacuum conditions of the natural space environment and no chamber walls to modify the open boundary conditions of the propulsion system exhaust. The platform would be designed to accommodate the side-by-side testing of multiple types of electric thrusters currently under development and thus provide a strong basis for comparing their relative performance. The utility of testing on the station is further enhanced by the human presence, enabling close interaction with and modification of the test hardware in a true laboratory environment. These conditions facilitate rapid development and flight certification at potentially lower cost than with conventional Earth-bound facilities. As an added benefit, the propulsive effect of these tests could provide some drag compensation for the station, reducing the re-boost cost for the orbital facility. While it is expected that the ISS will not be capable of generating continuous levels of high power, the utilization of state-of-the-art energy storage media would be sufficient to achieve very high power levels over intervals short enough to be feasible and long enough to provide ample demonstration of steady-state operation. This paper will outline the results of the preliminary phase of the design study with emphasis on the requirements that will dictate the system design.
Derived from text
*Electric Propulsion; Test Facilities; Systems Engineering; International Space Station; Technology Utilization; Spacecraft Propulsion*

**20070018796** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Development of High Fidelity, Fuel-Like Thermal Simulators for Non-Nuclear Testing**
Bragg-Sitton, S. M.; Farmer, J.; Dixon, D.; Kapernick, R.; Dickens, R.; Adams, M.; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 'Space Renaissance Inspiring the Next Generation', 11-15 Feb. 2007, Albuquerque, NM, USA; No Copyright; Avail.: Other Sources; Abstract Only

Non-nuclear testing can be a valuable tool in development of a space nuclear power or propulsion system. In a non-nuclear test bed, electric heaters are used to simulate the heat from nuclear fuel. Work at the NASA Marshall Space Flight Center seeks to develop high fidelity thermal simulators that not only match the static power profile that would be observed in an operating, fueled nuclear reactor, but to also match the dynamic fuel pin performance during feasible transients. Comparison between the fuel pins and thermal simulators is made at the fuel clad surface, which corresponds to the sheath surface in the thermal simulator. Static and dynamic fuel pin performance was determined using SINDA-FLUINT analysis, and the performance of conceptual thermal simulator designs was compared to the expected nuclear performance. Through a series of iterative analysis, a conceptual high fidelity design will be developed, followed by engineering design, fabrication, and testing to validate the overall design process. Although the resulting thermal simulator will be designed for a specific

reactor concept, establishing this rigorous design process will assist in streamlining the thermal simulator development for other reactor concepts.
Author
*Thermal Analysis; Simulators; Spacecraft Power Supplies; Solar Generators; Test Stands; Cladding; Fabrication; Nuclear Fuels; Nuclear Propulsion; Heaters*

**20070018816** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Electromagnetic Pumps for Liquid Metal-Fed Electric Thrusters**
Polzin, Kurt A.; Markusic, Thomas E.; [2007]; 17 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNM05AA25C; NAS7-03001; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018816

Prototype designs of two separate pumps for use in electric propulsion systems with liquid lithium and bismuth propellants are presented. Both pumps are required to operate at elevated temperatures, and the lithium pump must additionally withstand the corrosive nature of the propellant. Compatibility of the pump materials and seals with lithium and bismuth were demonstrated through proof-of-concept experiments followed by post-experiment visual inspections. The pressure rise produced by the bismuth pump was found to be linear with input current and ranged from 0-9 kPa for corresponding input current levels of 0-30 A, showing good quantitative agreement with theoretical analysis.
Author
*Propulsion System Configurations; Bismuth; Liquid Lithium; Electromagnetic Pumps; Propellants; Propulsion System Performance*

**20070018819** Gray Research, Inc., Huntsville, AL, USA
**Application of Solar-Electric Propulsion to Robotic Missions in Near-Earth Space**
Woodcock, Gordon R.; Dankanich, John; [2007]; 12 pp.; In English; Space Technology and Applications International Forum (STAIF), 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Interest in applications of solar electric propulsion (SEP) is increasing. Application of SEP technology is favored when: (1) the mission is compatible with low-thrust propulsion, (2) the mission needs high total delta V such that chemical propulsion is disadvantaged; and (3) performance enhancement is needed. If all such opportunities for future missions are considered, many uses of SEP are likely. Representative missions are surveyed and several SEP applications selected for analysis, including orbit raising, lunar science and robotic exploration, and planetary science. These missions span SEP power range from 10 kWe to about 100 kWe. A SEP design compatible with small inexpensive launch vehicles, and capable of lunar science missions, is presented. Modes of use and benefits are described, and potential SEP evolution is discussed.
Author
*Solar Electric Propulsion; Lunar Exploration; Robotics; Launch Vehicles*

**20070018862** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Modular, Reconfigurable, High-Energy Technology Development**
Carrington, Connie; Howell, Joe; Oct. 20, 2006; 18 pp.; In English; IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains black and white illustrations
Report No.(s): IEEEAC Paper 1118; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018862

The Modular, Reconfigurable High-Energy (MRHE) Technology Demonstrator project was to have been a series of ground-based demonstrations to mature critical technologies needed for in-space assembly of a highpower high-voltage modular spacecraft in low Earth orbit, enabling the development of future modular solar-powered exploration cargo-transport vehicles and infrastructure. MRHE was a project in the High Energy Space Systems (HESS) Program, within NASA's Exploration Systems Research and Technology (ESR&T) Program. NASA participants included Marshall Space Flight Center (MSFC), the Jet Propulsion Laboratory (JPL), and Glenn Research Center (GRC). Contractor participants were the Boeing Phantom Works in Huntsville, AL, Lockheed Martin Advanced Technology Center in Palo Alto, CA, ENTECH, Inc. in Keller, TX, and the University of AL Huntsville (UAH). MRHE's technical objectives were to mature: (a) lightweight, efficient, high-voltage, radiation-resistant solar power generation (SPG) technologies; (b) innovative, lightweight, efficient thermal management systems; (c) efficient, 100kW-class, high-voltage power delivery systems from an SPG to an electric thruster system; (d) autonomous rendezvous and docking technology for in-space assembly of modular, reconfigurable spacecraft; (e)

robotic assembly of modular space systems; and (f) modular, reconfigurable distributed avionics technologies. Maturation of these technologies was to be implemented through a series of increasingly-inclusive laboratory demonstrations that would have integrated and demonstrated two systems-of-systems: (a) the autonomous rendezvous and docking of modular spacecraft with deployable structures, robotic assembly, reconfiguration both during assembly and (b) the development and integration of an advanced thermal heat pipe and a high-voltage power delivery system with a representative lightweight high-voltage SPG array. In addition, an integrated simulation testbed would have been developed containing software models representing the technologies being matured in the laboratory demos. The testbed would have also included models for non-MRHE developed subsystems such as electric propulsion, so that end-to-end performance could have been assessed. This paper presents an overview of the MRHE Phase I activities at MSFC and its contractor partners. One of the major Phase I accomplishments is the assembly demonstration in the Lockheed Martin Advanced Technology Center (LMATC) Robot-Satellite facility, in which three robot-satellites successfully demonstrated rendezvous & docking, self-assembly, reconfiguration, adaptable GN&C, deployment, and interfaces between modules. Phase I technology maturation results from ENTECH include material recommendations for radiation hardened Stretched Lens Array (SLA) concentrator lenses, and a design concept and test results for a hi-voltage PV receiver. UAH's accomplishments include Supertube heatpipe test results, which support estimates of thermal conductivities at 30,000 times that of an equivalent silver rod. MSFC performed systems trades and developed a preliminary concept design for a 100kW-class modular reconfigurable solar electric propulsion transport vehicle, and Boeing Phantom Works in Huntsville performed assembly and rendezvous and docking trades. A concept animation video was produced by SAIC, wllich showed rendezvous and docking and SLA-square-rigger deployment in LEO.
Author
*Modularity; High Voltages; Technology Utilization; Spacecraft Design; Spacecraft Configurations; Solar Electric Propulsion*

**20070019345** NASA Stennis Space Center, Stennis Space Center, MS, USA
**Smart Sensor Node Development, Testing and Implementation for Rocket Propulsion Systems**
Mengers, Timothy R.; Shipley, John; Merrill, Richard; Eggett, Leon; Johnson, Mont; Morris, Jonathan; Figueroa, Fernando; Schmalzel, John; Turowski, Mark P.; Aug. 6, 2007; 1 pp.; In English; Integrated Systems Health Management Conference, 6-9 Aug. 2007, CIncinnati, OH, USA
Contract(s)/Grant(s): NNS06AB89A
Report No.(s): SSTI-2200-0080; Copyright; Avail.: Other Sources; Abstract Only

Successful design and implementation of an Integrated System Health Management (ISHM) approach for rocket propulsion systems requires the capability improve the reliability of complex systems by detecting and diagnosing problems. One of the critical elements in the ISHM is an intelligent sensor node for data acquisition that meets specific requirements for rocket motor testing including accuracy, sample rate and size/weight. Traditional data acquisition systems are calibrated in a controlled environment and guaranteed to perform bounded by their tested conditions. In a real world ISHM system, the data acquisition and signal conditioning needs to function in an uncontrolled environment. Development and testing of this sensor node focuses on a design with the ability to self check in order to extend calibration times, report internal faults and drifts and notify the overall system when the data acquisition is not performing as it should. All of this will be designed within a system that is flexible, requiring little re-design to be deployed on a wide variety of systems. Progress in this design and initial testing of prototype units will be reported.
Author
*Rocket Engines; Systems Integration; Complex Systems; Sensors; Systems Health Monitoring; Smart Structures*

## 23
## 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*.

**20070018761** NASA Johnson Space Center, Houston, TX, USA
**An Approach to Evaluate Precision and Inter-Laboratory Variability of Flammability Test Methods for Aerospace Materials**
Hirsch, David; Beeson, Harold D.; [2005]; 4 pp.; In English; 35th International Conference on Environmental Systems (ICES), 11-14 Jul. 2005, Rome, Italy
Report No.(s): 05ICES-21; Copyright; Avail.: CASI: A01, Hardcopy

Materials selection for spacecraft is based on conventional flammability or ignition sensitivity acceptance tests. Current procedures for determining the inter-laboratory repeatability and reproducibility of aerospace materials flammability tests are not considering the dependence of data variability on test conditions and consequently attempts to characterize the precision of these methods were not successful. The inter-laboratory data variability is determined with tests conducted under arbitrary conditions, which consequently may not provide sufficient information to enable adequate determination of a method's precision. For evaluating the precision of NASA's flammability test methods, the protocol recommended includes selecting critical parameters and determining the 50% failure point by considering the specific failure criteria of each method using the critical parameter as a variable. Upon performing inter-laboratory round robin testing using this approach, the laboratories' performance could be evaluated by comparing the repeatability of the 50% failure point and/or the repeatability of critical conditions where the probabilities of passing and failing are unity, i.e., the transition zone repeatability. When a sufficient amount of data has been acquired with this method, an adequate estimation of precision of aerospace materials flammability test methods will be possible.

Author

*Flammability; Materials Selection; Spacecraft Construction Materials; Performance Tests*

**20070018987** Naval Research Lab., Washington, DC USA

**Low Friction, High Endurance Ion-Beam Deposited Pb-Mo-S Coatings**

Wahl, K J; Seitzman, L E; Bolster, R N; Singer, I L; Jan 1995; 9 pp.; In English

Report No.(s): AD-A465258; XB-NRL/MR/6170; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465258

Thin solid lubricating coatings of Pb-Mo-S were deposited on steel substrates via ion-beam deposition. Coating endurance and friction coefficients under dry air sliding conditions were monitored with ball-on-disk tests; additional tribological testing was performed using a ball-on-flat reciprocating test rig to investigate intermediate sliding distances (100-32000 cycles). Rutherford backscattering spectrometry (RBS), X-ray diffraction (XRD), scanning Auger microscopy, and micro-Raman spectroscopy were used to examine structure, composition, and chemistry of the coatings. Worn surfaces were characterized with optical microscopy and micro-Raman spectroscopy. Average endurance (at 1.4 GPa stress) of ion-beam deposited (IBD) Pb-Mo-S coatings 160-830 nm thick containing from 4-26 at.% Pb was 160000 revolutions, more than 2 times that of IBAD (ion-beam-assisted deposition) MoS2 coatings. Additionally, the IBD Pb-Mo-S coatings had friction coefficients between 0.005 and 0.02, similar to the IBAD MoS2 coatings. Friction coefficients were monitored as a function of contact stress and found to obey the Hertzian contact model; measured interfacial shear strengths (So~12 MPa) were similar to those observed for MoS2 coatings. Although XRD and micro-Raman spectroscopy indicated that the IBD Pb-Mo-S coatings were initially amorphous, micro-Raman spectroscopy showed that crystalline MoS2 was produced both in the wear tracks on coatings and in the transfer films on balls after as few as 100 sliding cycles. The wear resistance and low friction properties of IBD Pb-Mo-S coatings are attributed to the combination of dense, adherent coatings and formation of easily-sheared, MoS2-containing sliding surfaces.

DTIC

*Coatings; Deposition; Friction; Ion Beams; Lead Compounds; Molybdenum Compounds; Sliding Friction*

**20070019018** Naval Research Lab., Washington, DC USA

**Effects of Ion Implantation on Microstructure, Endurance and Wear Behavior of IBAD MoS2**

Wahl, K J; Dunn, D N; Singer, I L; Jan 2000; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465309; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465309

Thin MoS2 coatings were prepared on steel and Si substrates via ion-beam assisted deposition using conditions known to produce dense, basal oriented microstructures. After deposition, the coated substrates were irradiated with 180 keV Ar++ ions at doses of 1x10(exp 15), 1x10(exp 16), and 5x10(exp 16) ions/sq cm. Microstructures of as-deposited and ion irradiated MoS2 coatings were examined using x-ray diffraction, high resolution transmission electron microscopy, and micro-Raman spectroscopy. Friction, wear and endurance were examined under both unidirectional and reciprocating sliding conditions in dry air. The lowest ion irradiation dose altered the initial microstructure, producing basal oriented, nearly defect-free crystalline domains of MoS2 in an amorphous matrix; at the highest dose the coatings were nearly amorphous, but the remaining MoS2 showed mixed orientation. Ion irradiation of the MoS2 coatings did not significantly modify the friction behavior, and only at the highest dose was the endurance altered, decreasing by more than 75%. Two changes in wear behavior

were observed in the highest dosed coatings: 1) accelerated wear of the coating and 2) elimination of solid lubricant reservoirs. Destruction of the solid lubricant replenishment process resulted in premature failure of the highest dosed coating.
DTIC
*Coatings; Ion Implantation; Ion Irradiation; Microstructure; Molybdenum Disulfides; Sliding Friction; Solid Lubricants; Wear*

**20070019050** Library of Congress, Washington, DC USA
**Strategic Petroleum Reserve**
Bamberger, Robert; May 31, 2005; 20 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465376; CRS-IB87050; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465376

The House passed H.R. 6, the Energy Policy Act of 2005, on April 21, 2005 (249- 183). The legislation would permanently authorize the Strategic Petroleum Reserve (SPR) and require, as expeditiously as practicable, expansion of the SPR to its authorized maximum of 1 billion barrels. A comprehensive bill ordered reported from the Senate Committee on Energy and Natural Resources on May 26, 2005, includes a similar provision. Congress authorized the Strategic Petroleum Reserve (SPR) in the Energy Policy and Conservation Act (EPCA, P.L. 94-163) to help prevent a repetition of the economic dislocation caused by the 1973-74 Arab oil embargo. The program is managed by the Department of Energy (DOE). Physically, the SPR comprises five underground storage facilities, hollowed out from naturally occurring salt domes in Texas and Louisiana. The SPR, with a capacity of 727 million barrels, currently holds roughly 692 million barrels. In mid-November 2001, President Bush ordered fill of the SPR to its current capacity of roughly 700 million barrels, principally through oil acquired as royalty-in-kind (RIK) for production from federal offshore leases. This level will be attained during FY2005. However, the Bush Administration has been periodically criticized for continuing to fill the SPR with RIK crude as crude prices have continued to rise and be volatile. An amendment was accepted during the House Energy and Commerce markup, and included in the bill passed by the House on April 21, 2005, that would suspend RIK fill until the price of crude drops below $40/barrel (bbl) for two weeks. The immediate impact of this provision will depend upon whether comprehensive energy legislation is enacted quickly, or whether the Administration continues RIK fill beyond the 700 million barrel level stipulated in the President's November 2001 order. It has not indicated that fill will continue, for the moment, beyond 700 million barrels.
DTIC
*Crude Oil; Resources Management*

**20070019123** Universal Technology Corp., Dayton, OH USA
**A Study of Stress Distribution in Layered and Gradient Tribological Coatings (Preprint)**
Kang, Young Sup; Sharma, Shashi K; Sanders, Jeffrey H; Voevodin, Andrey A; Nov 2006; 33 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-03-D-5801; Proj-4349
Report No.(s): AD-A465564; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465564

A numerical model was used to determine the stress distribution in layered and gradient coatings. A parametric study was performed to investigate the effect of various critical parameters such as thickness, composition, applied load, material properties, and interfacial friction on the stress distribution in the layered and gradient coatings and the 440C steel substrate. Layered and gradient Ti/TiC coatings consisted of a titanium bond layer and titanium carbide (TiC) gradient layers. The Ti sub (1-x) C sub x gradient coatings (0\h or =x\h or =1) were assumed as a series of perfectly bonded layers with unique material properties and layer thickness. The importance of the material, geometrical and mechanical effects on the magnitude and location of peak stresses were investigated. The results of this study can be used to optimize layered and gradient coating composition and thickness for the best tribological performance at specified contact loading conditions.
DTIC
*Coatings; Gradients; Stress Distribution; Titanium Compounds; Tribology*

**20070019144** Universal Technology Corp., Dayton, OH USA
**Unlubricated Gross Slip Fretting Wear of Metallic Plasma Sprayed Coatings for Ti6A14V Surfaces**
Hager, Jr , Carl H; Sanders, Jeffrey H; Sharma, Shashi K; Nov 2006; 37 pp.; In English
Contract(s)/Grant(s): F33615-03-D-5801; Proj-4349
Report No.(s): AD-A465612; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465612

Plasma sprayed Al-bronze (Al-Br) or CuNiIn coatings are often applied to protect against fretting wear and extend the operational life of Ti-alloy compressor blades in turbine engines. In order to develop a fundamental understanding of how these coating systems perform under gross slip fretting conditions, bench level fretting wear tests were conducted at room temperature to simulate cold engine startup. Alternative coatings such as plasma sprayed molybdenum and nickel were also evaluated because of their potential for reducing fretting wear under certain simulated engine conditions. The combination of scanning electron microscopy (SEM), surface profilometry, surface chemistry (EDS), and friction analysis were used to study coating performance and evaluate the interfacial wear mechanisms. In this study it was determined that all coatings caused significant damage to the mating Ti6A14V surfaces.
DTIC
*Fretting; Metal Coatings; Metallic Plasmas; Plasma Spraying; Sprayed Coatings; Titanium Alloys; Wear*

**20070019170** Air Force Research Lab., Edwards AFB, CA USA
**Interior and Exterior Laser-Induced Fluorescence and Plasma Measurements within a Hall Thruster (Postprint)**
Hargus, Jr , W A; Cappelli, M A; Feb 2002; 11 pp.; In English
Contract(s)/Grant(s): Proj-1011
Report No.(s): AD-A465667; No Copyright; Avail.: Defense Technical Information Center (DTIC)
We describe results of a study of emissive-probe-based plasma potential measurements and laser-induced fluorescence velocimetry of neutral and singly ionized xenon in the plume and interior portions of the acceleration channel of a Hall thruster plasma discharge operating at powers ranging from 250 to 725 W. Axial ion and neutral velocity profiles for four discharge voltage conditions (100, 160, 200, and 250V) are measured as are radial ion velocity profiles in the near-field plume. Axial ion velocity measurements both inside and outside the thruster as well as radial velocity measurements outside the thruster are performed using laser-induced fluorescence with nonresonant signal detection. Neutral axial velocity measurements are similarly performed in the interior of the Hall thruster with resonance fluorescence collection. Optical access to the interior of the Hall thruster is provided by a 1-mm-wide axial slot in the outer insulator wall. The majority of the ion velocity measurements used partially saturated fluorescence to improve the signal-to-noise ratio. Probe-based plasma potential measurements extend from 50 mm outside the thruster exit plane to the near anode region for all but the highest discharge voltage condition. For each condition, the axial electric field is calculated from the plasma potential, and the local electron temperature is determined from the difference between the floating and plasma potentials. These two sets of measurements delineate the structure of the plasma and indicate that the ionization and acceleration regions are somewhat separated. Also, these measurements indicate a region of low electric field near the thruster exit, especially at the higher discharge voltages. This region of near constant potential (low electric field) may be a result of oscillations, which enhance the local plasma conductivity.
DTIC
*Hall Thrusters; Laser Induced Fluorescence; Plasma Oscillations; Plasmas (Physics)*

**20070019377** NASA White Sands Test Facility, NM, USA
**Test 6, Test 7, and Gas Standard Analysis Results: Data Compiled by NASA Johnson Space Center White Sands Test Facility**
Handley, T. Burk, et al.; April 4, 2005; 17 pp.; In English; NASA/JAXA Technical Interchange Meeting, 4-8 April 2005, Tsukuba, Japan; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy
This viewgraph presentation reviews the data compiled by the White Sands Test Facility in reference to toxic offgassing of a film from aluminized Mylar.
CASI
*Aluminum; Gas Analysis; Mylar (Trademark); Quantitative Analysis*

**20070019380** NASA Johnson Space Center, Houston, TX, USA
**Materials Safety - Not just Flammability and Toxic Offgassing**
Pedley, Michael D.; May 14, 2007; 1 pp.; In English; Second IAASS Conference - Space Safety in a Global World, 14-16 May 2007, Chicago, IL, USA
Contract(s)/Grant(s): 667560.05.02; No Copyright; Avail.: Other Sources; Abstract Only
For many years, the safety community has focused on a limited subset of materials and processes requirements as key to safety: Materials flammability, Toxic offgassing, Propellant compatibility, Oxygen compatibility, and Stress-corrosion cracking. All these items are important, but the exclusive focus on these items neglects many other items that are equally

important to materials safety. Examples include (but are not limited to): 1. Materials process control -- proper qualification and execution of manufacturing processes such as structural adhesive bonding, welding, and forging are crucial to materials safety. Limitation of discussions on materials process control to an arbitrary subset of processes, known as 'critical processes' is a mistake, because any process where the quality of the product cannot be verified by inspection can potentially result in unsafe hardware 2 Materials structural design allowables -- development of valid design allowables when none exist in the literature requires extensive testing of multiple lots of materials and is extremely expensive. But, without valid allowables, structural analysis cannot verify structural safety 3. Corrosion control -- All forms of corrosion, not just stress corrosion, can affect structural integrity of hardware 4. Contamination control during ground processing -- contamination control is critical to manufacturing processes such as adhesive bonding and also to elimination foreign objects and debris (FOD) that are hazardous to the crew of manned spacecraft in microgravity environments. 5. Fasteners -- Fastener design, the use of verifiable secondary locking features, and proper verification of fastener torque are essential for proper structural performance This presentation discusses some of these key factors and the importance of considering them in ensuring the safety of space hardware.

Author

*Hazardous Materials; Materials Handling; Aerospace Safety; Materials Science; Structural Analysis; Contamination; Environment Effects*

## 24
## COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

**20070018753** NASA Langley Research Center, Hampton, VA, USA

**Quasi-Static Analysis of LaRC THUNDER Actuators**

Campbell, Joel F.; May 2007; 24 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 810031.07.03

Report No.(s): NASA/TM-2007-214872; L-19355; LAR-15827; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018753

An analytic approach is developed to predict the shape and displacement with voltage in the quasi-static limit of LaRC Thunder Actuators. The problem is treated with classical lamination theory and Von Karman non-linear analysis. In the case of classical lamination theory exact analytic solutions are found. It is shown that classical lamination theory is insufficient to describe the physical situation for large actuators but is sufficient for very small actuators. Numerical results are presented for the non-linear analysis and compared with experimental measurements. Snap-through behavior, bifurcation, and stability are presented and discussed.

Author

*Numerical Analysis; Nonlinearity; Adhesives; Piezoelectric Actuators; Laminates*

**20070018935** NASA Glenn Research Center, Cleveland, OH, USA

**Advanced Polymers Containing the Phenyltrifluoroethylidene Connecting Group**

Alstron, William B.; Sivko, Gloria S.; October 2006; 50 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): WBS 22-714-30-01

Report No.(s): NASA/TM-2006-214235; ARL-TR-3504; E-15029; Copyright; Avail.: CASI: A03, Hardcopy

A new, lower cost fluorinated dianhydride based on the phenyltrifluoroethylidene (3F) connecting linkage was invented by the principal author in the early 1980's. New 3F condensation and addition cured polyimides were synthesized with the newly discovered 3F dianhydride and the previously known 3F diamine. As controls, polyimides based on the somewhat analogous higher cost hexafluoroisopropylidene (6F) linkage were also prepared. The short term thermal oxidative stability (TOS), determined by thermal gravimetric analysis (TGA), and the glass transition temperatures (Tg) of 3F dianhydride polyimides were found to be similar to 6F dianhydride polyimides, but the Tg was slightly higher for 3F diamine polyimides than 6F diamine polyimides. Unfortunately, in real time testing, long term TOS of 3F polymers was clearly inferior to 6F polymers. This was due to a 3 to 5 fold greater rate of loss of trifluoromethyl group from 3F versus 6F linkages. However, at shorter times or lower temperatures, 3F TOS was almost comparable to 6F TOS. The wide scope of the 3F technology was also demonstrated to have distinct unique advantages over 6F technology through the use of the 3F pendant phenyl ring as a synthetic site to introduce other functional groups. These groups have been used for the control or modification of polymer properties; an advantage lacking within 6F technology. The synthetic ease by which 3F can be introduced into various types

of monomers has lead to the explosion of advanced 3F polyimides and other high performance advanced 3F polymers in the prior decade of 3F polymer literature as cited herein; covering polyimides, substituted polyimides, at least ten types of nonpolyimide 3F polymer modifications, and also the government's nine 3F U.S. patents and corporations' nine 3F U.S. patents.
Author
*Glass Transition Temperature; Polyimides; Thermal Stability; Monomers; Quantitative Analysis; Addition Resins; Diamines; High Polymers; Anhydrides*

**20070019065** Arizona State Univ., Tempe, AZ USA
**Structural Health Monitoring for Heterogeneous Systems**
Chattopadhyay, Aditi; Jun 30, 2006; 55 pp.; In English
Contract(s)/Grant(s): F49620-03-1-0174
Report No.(s): AD-A465429; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465429

A hierarchical framework has been developed for damage characterization, detection and quantification in composite laminates. The procedure includes accurate analysis, optimal sensor placement algorithm and advanced signal processing technique. A refined global/local laminate analysis technique, including fully coupled electro-mechanical constitutive relations, has been used for predicting the dynamic response of composite laminates in the presence of delaminations. The methodology accounts for the nonlinear 'breathing phenomenon' or sublaminate contacts during vibration. Damage identification is conducted using elastic waves and miniaturized piezoelectric sensors. A new design methodology for optimal sensor placement has been developed based on the requirements of sensing certainty and sensor density. An analytical method has been developed to model the material attenuation of the composite medium to formulate a relationship between sensing region, sensor observation angle, fiber orientation, and damage size. A signal processing technique based on the matching pursuit decomposition has been further extended to extract newly generated spectral components due to the nonlinearity in the received signal. Time-of-flight analysis has been performed on decomposed components of transient datasets to quantify defect. An advanced machine-learning based classifier, known as Support Vector Machines, has also been developed to detect and classify the signature characteristics due to the presence of various types of defects like delaminations, drilled holes, notches, saw-cut, etc., such that the state of the structure can be assessed. Experiments have been conducted using a variety of nondestructive evaluation (NDE) techniques, including pulse echo thermography, to validate the developed methodologies.
DTIC
*Composite Materials; Damage Assessment; Health; Heterogeneity; Laminates*

**20070019381** NASA Johnson Space Center, Houston, TX, USA
**NASA-STD-(I)-6016, Standard Materials and Processes Requirements for Spacecraft**
Pedley, Michael; Griffin, Dennis; September 11, 2006; 56 pp.; In English; Second IAASS COnference - Space Safety in a Global World, 14-16 May 2007, Chicago, IL, USA; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019381

This document is directed toward Materials and Processes (M&P) used in the design, fabrication, and testing of flight components for all NASA manned, unmanned, robotic, launch vehicle, lander, in-space and surface systems, and spacecraft program/project hardware elements. All flight hardware is covered by the M&P requirements of this document, including vendor designed, off-the-shelf, and vendor furnished items. Materials and processes used in interfacing ground support equipment (GSE); test equipment; hardware processing equipment; hardware packaging; and hardware shipment shall be controlled to prevent damage to or contamination of flight hardware.
Author
*Fabrication; Spacecraft Construction Materials; Spacecraft Components; Requirements; Materials Tests*

## 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 Astrophysics*.

**20070018994** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**The Effect of Orthophosphate as a Copper Corrosion Inhibitor in High Alkalinity Drinking Water Systems**
Grace, Stephen; Mar 2007; 97 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465275; AFIT/GES/ENV/07-M2; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465275

The purpose of this research was to investigate orthophosphate as a corrosion inhibitor for copper pipe in a high-alkalinity drinking water system. Specifically, this thesis sought to answer three research questions regarding the impact of orthophosphate treatment, the nature of the mechanism by which orthophosphate controls copper corrosion, and the value of equilibrium modeling in predicting orthophosphate?s effects. The research questions were answered through a comprehensive literature review and experimental methodology integrating laboratory jar tests, water sampling and analysis from a field investigation, qualitative solids analysis, and equilibrium model application. This study analyzed field data obtained over the course of a year from a high alkalinity water system into which orthophosphate was added to control copper concentrations. This field research generally supports results previously reported in the literature: in high alkalinity, neutral pH water, a dosage of 3 ? 4 mg/L orthophosphate can reduce copper levels in a drinking water system from over 2 mg/L to below the 1.3 mg/L USEPA action level. While surface solid analysis did not provide conclusive evidence confirming the nature of orthophosphate?s control mechanisms, jar tests and equilibrium solubility models were demonstrated to provide useful quantitative predictions of how orthophosphate reduces copper concentrations in various waters.
DTIC
*Alkalinity; Copper; Corrosion Prevention; Hydroxides; pH Factor; Potable Water; Qualitative Analysis; Supplying; Water*

**20070019037** Naval Research Lab., Washington, DC USA
**Investigation of Third Body Processes by In Vivo Raman Tribometry (Preprint)**
Singer, Irwin L; Dvorak, S D; Wahl, Kathryn J; Jun 14, 2000; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465339; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465339

A Raman tribometer has been used to study third body processes and friction during sliding against two low friction coatings: annealed boron carbide and Mo-S-Pb, a MoS2-based coating. Reciprocating sliding tests were performed in either dry or humid air with transparent hemispheres (glass or sapphire) loaded against the coatings. Videos and Raman spectra of the sliding contact were recorded during the tests. For annealed boron carbide, friction was controlled by a mix of H3BO3 and carbon; for amorphous Mo-S-Pb, friction was controlled by MoS2 generated by sliding. Friction changes in the former were correlated to the relative amount of the two materials; in the latter, the rise in friction was ascribed to a change in interfacial shear strength of MoS2, inferred from the deformation of transferred debris particles. For both coatings, interfacial sliding was the dominant mode of velocity accommodation in the sliding interface.
DTIC
*Chemical Reactions; In Vivo Methods and Tests; Physiology; Sliding Friction; Surface Reactions*

**20070019040** Naval Research Lab., Washington, DC USA
**Role of the Third Body in Life Enhancement of MoS2**
Wahl, K J; Singer, I L; Jan 1996; 8 pp.; In English
Report No.(s): AD-A465344; XB-NRL/MR/6170; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465344

A lubrication replenishment process that accounts for the long life of MoS2 coatings worn heavily early in sliding is described and quantified. Reciprocating sliding of a steel ball against MoS2 coated flats was performed using a new test methodology called stripe testing to monitor wear evolution. Worn surfaces were characterized with optical (Nomarski) and Michelson (interference) microscopy, as well as energy dispersive X-ray spectroscopy. Two important third-bodies, the ball transfer films and compacted debris patches at track turnaround points, were identified. Material transfer between the track and

ball surfaces acts as a reservoir of solid lubricant and plays an important role in sustaining lubricated sliding of MoS2. Dynamics of the process were inferred from measurements of third-body material loss and buildup on track and ball surfaces.
DTIC
*Augmentation; Coatings; Molybdenum Disulfides*

**20070019077** Naval Research Lab., Washington, DC USA
**In Situ Analysis of the Tribochemical Films Formed by SiC Sliding Against Mo in Partial Pressures of SO2, O2, and H2S Gases**
Singer, I L; Le Mogne, T; Donnet, C; Martin, J M; Feb 1996; 9 pp.; In English
Report No.(s): AD-A465454; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465454

X-ray photoelectron spectroscopy (XPS) and Auger electron spectroscopy (AES) were used to identify gas reaction layers and tribochemical films formed during reciprocating sliding tests in an ultrahigh vacuum (UHV) tribometer. Tests were performed on UHV cleaned SiC pins and Mo flats during or after exposure to SO2, O2, or H2S gas at pressures around 40 Pa. XPS identified the gas reaction layers on Mo to be chemisorbed MoS2 and/or MoO2 phases less than 1 nm thick. AES of Mo wear tracks showed tribochemical films similar in composition to, but thicker than, the reaction layers. AES of SiC wear scars in all three gases indicated tribochemical films containing Si oxide and/or Si sulfide and possibly graphite. In addition, transfer films of Mo oxysulfide and Mo oxide were found in SO2 and O2 tests, respectively, but no transfer films were detected in H2S tests. Thermochemical calculations of stable reaction products of the gas solid reactions were in good agreement with the phases inferred from XPS and AES. An explanation for the agreement between thermochemical predictions and tribochemical results is given.
DTIC
*Chemical Reactions; Gases; Hydrogen Sulfide; In Situ Measurement; Molybdenum; Oxygen; Partial Pressure; Silicon Carbides; Sliding; Sulfur Dioxides*

**20070019109** Georgia Inst. of Tech., Atlanta, GA USA
**ZnS-Based Photonic Crystal Phosphors Fabricated Using Atomic Layer Deposition**
King, J S; Neff, C W; Blomquist, S; Forsythe, E; Morton, D; Summers, C J; Jan 2004; 5 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAA19-01-1-0603
Report No.(s): AD-A465524; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465524

The infiltration by atomic layer deposition of three-dimensional opal structures has been investigated as a means of fabricating photonic crystal phosphors. ZnS:Mn infiltrated and inverse opals have been demonstrated with filling fractions \g95%. Characterization of these structures by scanning electron microscopy, specular reflectance, and photoluminescence is reported. Specular reflectance measurements confirm successful infiltration, and demonstrate modification of the electromagnetic density of states consistent with calculated photonic (111) pseudo band gaps. Photoluminescence measurements reveal modification of emission by the photonic crystal consistent with angular dependent specular reflectance measurements. These results reveal a flexible and convenient route for fabricating high performance photonic crystal structures and optical microcavities.
DTIC
*Atoms; Crystals; Deposition; Emission; Fabrication; Phosphors; Photoluminescence; Zinc Sulfides*

**20070019132** Dayton Univ. Research Inst., OH USA
**The Effect of Hard Coated Metals on the Thermo-Oxidative Stability of a Branched Perfluoropolyalklyether Lubricant (Preprint)**
Hellman, Patrick T; Zabinski, Jeffrey S; Gschwender, Lois J; Snyder, Carl E; Korenyi-Both, Andras L; Oct 2006; 39 pp.; In English
Contract(s)/Grant(s): Proj-4347
Report No.(s): AD-A465584; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465584

M-50 and carburized Pyrowear 675(registered) steel coupons deposited with commercially available physical vapor deposited (PVD) TiN, TiCN, TiAlCN, TiCrCN/TiB4C multilayer, electroless Ni (E-Ni) TiN, and E-Ni TiCN coatings were immersed in a branched perfluoropolyalklyether (PFPAE), Krytox AC(registered), in an oxidative environment at temperatures ranging from 315 to 360 deg C for a duration of 24 hours and compared to uncoated coupons. Coated and uncoated Pyrowear 675(registered) coupons demonstrated superior corrosion resistance compared to coated and uncoated M-50, respectively. The coatings most resistant to chemical attack in the PFPAE fluid were TiCN, E-Ni TiN, and E-Ni TiCN.
DTIC
*Coatings; Lubricants; Metals; Solid Lubricants; Stability*

**20070019168** Georgia Inst. of Tech., Atlanta, GA USA
**Stabilization and Carbonization of Gel Spun Polyacrylonitrile/Single Wall Carbon Nanotube Composite Fibers**
Kumar, Satish; Chae, Han G; Minus, Marilyn; Rasheed, Asif; Feb 2007; 28 pp.; In English
Contract(s)/Grant(s): FA9550-06-1-0122
Report No.(s): AD-A465660; No Copyright; Avail.: CASI: A03, Hardcopy

Gel spun polyacrylonitrile (PAN) and PAN/single wall carbon nanotube (SWNT) composite fibers have been stabilized in air and subsequently carbonized in argon at 1100 degrees C. Differential scanning calorimetry (DSC) and infrared spectroscopy suggests that the presence of single wall carbon nanotube affects PAN stabilization. Carbonized PAN/SWNT fibers exhibited 10 to 30 nm diameter fibrils embedded in brittle carbon matrix, while the control PAN carbonized under the same conditions exhibited brittle fracture with no fibrils. High resolution transmission electron microscopy and Raman spectroscopy suggests the existence of well-developed graphitic regions in carbonized PAN/SWNT and mostly disordered carbon in carbonized PAN. Tensile modulus and strength of the carbonized fibers were as high as 250 N/tex and 1.8 N/tex for the composite fibers and 168 N/tex and 1.1 N/tex for the control PAN based carbon fibers, respectively. The addition of 1 wt% carbon nanotubes enhanced the carbon fiber modulus by 49% and strenath bv 64%.
DTIC
*Carbon Fibers; Carbon Nanotubes; Carbonization; Composite Materials; Gels; Nitriles; Polyacrylonitrile; Walls*

**20070019195** Georgia Inst. of Tech., Atlanta, GA USA
**Near Net-Shape, Ultra-High Melting, Recession-Resistant ZrC/W-Based Rocket Nozzle Liners via the Displacive Compensation of Porosity (DCP) Method (POSTPRINT)**
Dickerson, M B; Wurm, P J; Schorr, J R; Hoffman, W P; Wapner, P G; Sandhage, K H; Jan 2004; 12 pp.; In English
Contract(s)/Grant(s): F49620-02-1-0349; Proj-1011
Report No.(s): AD-A465720; No Copyright; Avail.: CASI: A03, Hardcopy

Dense, near net-shaped ZrC/W-based composites have been fabricated at modest temperatures and at ambient pressure by a reactive infiltration process known as the Displacive Compensation of Porosity (DCP) method. Porous WC preforms with hourglass shapes (for rocket nozzle liners) were produced by gel casting, whereas simple bar-shaped preforms were produced by uniaxial pressing. The porous preforms were exposed to molten Zr2Cu at 1200-1300 deg C and ambient pressure. The Zr2Cu liquid rapidly infiltrated into the preforms and underwent a displacement reaction with the WC to yield a more voluminous mixture of solid products, ZrC and W. This displacement reaction-induced increase in internal solid volume filled the prior pore spaces of the preforms ('displacive compensation of porosity') to yield dense, ZrC/W-based composites. Because the preforms remained rigid during reactive infiltration, the final composites retained the external shapes and dimensions of the starting preforms. A DCP-derived, ZrC/W-based nozzle insert was found to be resistant to the severe thermal shock and erosive conditions of a Pi-K rocket motor test. The DCP process enables dense, ceramic/refractory metal composites to be fabricated in complex and near net shapes without the need for high-temperature or high-pressure densification or for extensive machining (i.e., relatively expensive processing steps are avoided).
DTIC
*Linings; Melting; Nozzle Inserts; Porosity; Recession; Rocket Nozzles; Shapes; Zirconium Carbides*

**20070019200** Georgia Inst. of Tech., Atlanta, GA USA

**High-Filling-Fraction Inverted ZnS Opals Fabricated by Atomic Layer Deposition**

King, J S; Neff, C W; Summers, C J; Park, W; Blomquist, S; Forsythe, E; Morton, D; Sep 29, 2003; 4 pp.; In English

Contract(s)/Grant(s): DAAD19-01-1-0603

Report No.(s): AD-A465733; No Copyright; Avail.: CASI: A01, Hardcopy

The infiltration of three-dimensional opal structures has been investigated by atomic layer deposition. Demonstrations using ZnS:Mn show that filling fractions \g95% can be achieved and that the infiltrated material is of high-quality crystalline material as assessed by photoluminescence measurements. These results demonstrate a flexible and practical pathway to attaining high-performance photonic crystal structures and optical microcavities.

DTIC

*Atoms; Deposition; Fabrication; Inversions; Zinc Sulfides*

**20070019213** Weston (Roy F.), Inc., West Chester, PA USA

**Decontamination Methods for Explosives-Contaminated Lagoon Rock**

Salacka,; Frye, Russell W; Martino, Joseph F; Lowe, William L; Feb 1994; 100 pp.; In English

Contract(s)/Grant(s): DACA31-91-D-0079

Report No.(s): AD-A465780; No Copyright; Avail.: CASI: A05, Hardcopy

The U.S. Army Environmental Center has conducted a field demonstration of composting explosives-contaminated soils from Explosives Washout Lagoons at Umatilla Depot Activity (UMDA) in Hermiston, Oregon. The lagoons are lined with gravel and rocks which may have to be separated from soils prior to composting. Consequently, USAEC conducted this study to evaluate methods for decontaminating lagoon gravel and rocks. This testing was conducted in two phases. In the first test phase, aqueous washing using spray/screen and tumbler methods was evaluated. In the second phase, the potential enhancement achievable by the use of chemical washing solutions (aqueous solutions of surfactants or other reagents) was evaluated. The results of Phase I testing showed that aqueous washing alone could remove the majority of explosives contamination from lagoon gravel and rock. Hot washwater (140 degrees F) may be more effective than lower temperature washwater (70 degrees F) in removing explosives from the rock. The site specific cleanup criteria for UMDA (30 mg/kg TNT and 30 mg/kg RDX) were not achieved by water washing alone. However, testing in Phase II showed that a variety of chemical reagents, including biodegradable surfactants, could be used following initial water washing to achieve the lower required explosives levels on the rock and gravel. Initial explosives levels were lower in Phase 2 than in Phase 1. In addition to these rock and gravel washing tests, a preliminary desk top evaluation of Hot Gas Decontamination for contaminated rock and gravel was conducted. This evaluation indicated that several existing equipment configurations may be adaptable to this use. Further testing of candidate equipment may be useful in confirming performance and developing design and operating criteria.

DTIC

*Contamination; Decontamination; Explosives; Lagoons; Rocks*

**20070019225** Air Force Research Lab., Wright-Patterson AFB, OH USA

**Supersonic Combustion Experiments with a Cavity-Based Fuel Injector (Postprint)**

Mathur, Tarun; Gruber, Mark; Jackson, Kevin; Donbar, Jeff; Donaldson, Wayne; Jackson, Thomas; Billig, Fred; Nov 2001; 10 pp.; In English

Contract(s)/Grant(s): Proj-3012

Report No.(s): AD-A465803; AFRL-PR-WP-TP-2006-271; No Copyright; Avail.: CASI: A02, Hardcopy

Recent results from combustion experiments in a direct-connect supersonic combustor are presented. Successful ignition and sustained combustion of gaseous ethylene have been achieved using an injector/flameholder concept with low-angle, flush-wall fuel injection upstream of a wall cavity. Two interchangeable facility nozzles (Mach 1.8 and 2.2) were used to obtain combustor inlet flow properties that simulate flight conditions between Mach 4 and 6 at a dynamic pressure of 47.9 kPa. Mainstream combustion was achieved at equivalence ratios between 0.25 and 0.75 using only a spark plug and no other external ignition aids. Delta-force levels between 667 and 1779 N were measured, with corresponding combustor pressure ratios between 3.1 and 4.0. Video records of the flame zone show an intensely active combustion zone with rapid flame spreading. One-dimensional performance analysis of the test data indicates a combustion efficiency around 80% with an average combustor skin friction coefficient of 0.0028.

DTIC

*Cavities; Combustion Chambers; Flame Holders; Fuel Injection; Supersonic Combustion*

## 26
## METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

**20070018826** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Layered Metals Fabrication Technology Development for Support of Lunar Exploration at NASA/MSFC**
Cooper, Kenneth G.; Good, James E.; Gilley, Scott D.; [2007]; 8 pp.; In English; Space Technology and Applications International Forum (STAIF 2007), 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

NASA's human exploration initiative poses great opportunity and risk for missions to the Moon and beyond. In support of these missions, engineers and scientists at the Marshall Space Flight Center are developing technologies for ground-based and in-situ fabrication capabilities utilizing provisioned and locally-refined materials. Development efforts are pushing state-of-the art fabrication technologies to support habitat structure development, tools and mechanical part fabrication, as well as repair and replacement of ground support and space mission hardware such as life support items, launch vehicle components and crew exercise equipment. This paper addresses current fabrication technologies relative to meeting targeted capabilities, near term advancement goals, and process certification of fabrication methods.
Author
*Lunar Exploration; Metals; Life Support Systems; Fabrication; Habitats*

**20070019138** Virginia Univ., Charlottesville, VA USA
**NiAl Bond Coats Made by a Directed Vapor Deposition Approach**
Yu, Z; Hass, D D; Wadley, H N; Oct 2004; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-00-1-0438
Report No.(s): AD-A465600; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465600

Intermetallic, nickel aluminide alloys are widely used as bond coat materials in thermal barrier coating systems applied to nickel base super alloy components. They are usually synthesized by a solid-state reaction diffusion heat treatment following the chemical vapor deposition of aluminum on the nickel rich substrate. Here, an electron beam directed vapor deposition (EB-DVD) technique is used to simultaneously evaporate nickel and aluminum and then reactively deposit NiAl bond coats that are structurally and chemically homogeneous and well bonded to the superalloy substrate. The approach utilizes individual nickel and aluminum sources placed within a rarefied helium gas jet with flow conditions that promote vapor phase intermixing. By adjusting the electron beam current applied to each elemental source, we show that the coating layer composition can be precisely controlled. Fully dense, homogeneous, -phase NiAl coating layers with a relatively sharp compositional interface with the substrate have been deposited. The extent of the substrate interdiffusion zone is controlled by the deposition conditions.
DTIC
*Joints (Junctions); Protective Coatings; Thermal Insulation; Vapor Deposition; Vapor Phases*

## 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*.

**20070019021** Dayton Univ. Research Inst., OH USA
**Power and Thermal Technology for Air and Space. Delivery Order 0006: Nano-filled Polymers for Electrical Insulation**
Klosterman, Donald A; Galaska, Mary; Oct 2006; 17 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8650-04-D-2403-0006; Proj-3145
Report No.(s): AD-A465312; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465312

The objective of this delivery order was to conduct research aimed at developing nano-filled polymers for electrical insulation. Improved polymers could be used in wiring, cabling, potting compounds, and capacitors. Specifically, this effort involved research in areas such as nano-filler dispersion, bulk sample fabrication, and thin film processing. These activities are designed to contribute to the improvement of highly stressed electrical insulation with a goal of improved mean time before

failure. This program focused exclusively on the addition of Polyhedral Oligomeric Silsesquioxane (POSS) nanoparticles into epoxy resin. A procedure was developed to incorporate POSS nanoparticles into a common epoxy/amine resin system at loadings over 5 wt%, where the solubility limit seems to be between 5 and 10 wt%. Dispersion of the particles was excellent in regards to optical clarity.
DTIC
*Electrical Insulation; Epoxy Resins; Nanotechnology; Polymers*

**20070019085** Army Tank-Automotive Research and Development Command, Warren, MI USA
**Evaluation of Storage Effects on Commercial, Biodegradable, Synthetic or Biosourced Hydraulic Fluid**
Brosnan, Bridget; Apr 21, 2006; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465479; TARDEC-15742-RC; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465479

In 2001-2002, testing was conducted to determine if commercially available, biodegradable, bio-based hydraulic fluid could meet or exceed the performance requirements in military combat/tactical hydraulic fluid specifications MIL-PRF 46170 & MIL-PRF 6083. In 2005, the TARDEC Fuels and Lubricants Technology Team evaluated the same bio-based, biodegradable hydraulic fluid to determine the effects of long term storage.
DTIC
*Biodegradability; Biotechnology; Hydraulic Fluids*

**20070019214** Pennsylvania State Univ., University Park, PA USA
**Fluid Film Bearing Dynamic Coefficients and Their Application to Structural Finite Element Models**
Campbell, R L; Aug 1, 2003; 30 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465781; PSU/ARL-TR-03-007; No Copyright; Avail.: Defense Technical Information Center (DTIC)

A review of methods currently employed for modeling static and dynamic characteristics of fluid film bearings is provided. In nearly all cases, the literature discusses the use of dynamic coefficients for low-order rotor-dynamics models in which a single stiffness and damping matrix is used to connect an individual rotor node to an individual stator/bearing node along the shaft centerline. The focus of the present work is on developing dynamic coefficients for high-order structural finite element models, which use a distribution of the coefficients over the journal circumference. While the methods presented here are applicable to many bearing types, the focus is on the most common bearing, the plain and tilting pad bearing designs. A numerical study is provided to show the importance of properly implementing the bearing coefficients by comparing the results for two methods of coefficient implementation for a rotor model. The results show differences in rotor-to-stator transfer accelerance, resonance frequencies, and damping levels.
DTIC
*Attitude (Inclination); Coefficients; Finite Element Method; Fluid Films; Journal Bearings; Models*

**20070019354** Academy of Sciences (USSR), Moscow, Russian Federation
**A Study of Pre-Stress Effect on Dynamic Failure of Transparent Brittle Materials**
Kanel, G I; Razorenov, S V; Savinykh, A S; Bezruchko, G S; Garkushin, G V; Ivanchikhina, G E; Mar 2007; 19 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): RUE2-1615-MO-06
Report No.(s): AD-A465438; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465438

The report presents results of studying the pre-stress effect on dynamic failure of K8 crown glass, K14 crown glass, fused quartz and sapphire crystals. A technology of radial pre-compression of glass samples has been worked out. Controlled confinement pressure on the specimen in a range of 150 MPa to 550 MPa was provided by installing a shrink-fit metal sleeve on the lateral surface of the glass specimen disk. Results of measurements of the particle velocity histories of sock-loaded free and pre-stressed glasses confirm our expectation of influence of transversal stress upon the failure wave propagation and the failure threshold: for all pre-stressed glasses we observed earlier break of the failure wave propagation at unloading from shock-compressed state. However, sensitivity of the failure threshold to the confinement stress value is not as high as it could be expected. Large heterogeneity of inelastic deformation and scatter in the Hugoniot elastic limit of sapphire have not allowed

us to determine an influence of pre-stressing on the HEL value of this material. However, the experiments unambiguously demonstrate growth of viscosity of inelastic compression of the sapphire as a result of pre-stressing.
DTIC
*Brittle Materials; Brittleness; Deformation; Failure; Glass; Sapphire; Transparence; Wave Propagation*

## 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*.

**20070019036** Library of Congress, Washington, DC USA
**World Oil Demand and Its Effect on Oil Prices**
Pirog, Robert; Jun 9, 2005; 24 pp.; In English
Report No.(s): AD-A465337; CRS-RL32530; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465337

The price of oil began rising in October 2003 and reached record levels in 2004 and again in 2005. As a result of these price increases, consumers' budgets have been under pressure, business costs have risen, and oil producers profits have increased. The 109th Congress is considering broad energy legislation (H.R. 6), that addresses conditions in the oil and petroleum products markets. A long term explanatory factor for increasing oil prices could be the decline of the world reserve base. The reserves to production ratio is the measure which indicates the world's ability to maintain current production, based on proved reserves. Over the past decade there has been little change in the reserve to production ratio, suggesting that, at least for now, long term forces are not driving up the price of oil.
DTIC
*Cost Analysis; Fuel Oils; Oils*

**20070019054** Library of Congress, Washington, DC USA
**Oil and Gas: Supply Issues After Katrina**
Bamberger, Robert L; Kumins, Lawrence; Sep 6, 2005; 7 pp.; In English
Report No.(s): AD-A465389; CRS-RS22233; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465389

Hurricane Katrina made landfall on August 29, 2005, leaving behind considerable devastation. Some onshore refineries were shut down in advance of the storm; others remain down now because of the widespread interruption of electric power and flooding. Assessment of damage to oil and gas production rigs, as well as refineries, continues. Some operating refineries whose crude supply has been interrupted are borrowing crude from the Strategic Petroleum Reserve (SPR). On September 2, the International Energy Agency (IEA) announced a coordinated drawdown of European and Asian stocks totaling 60 million barrels to be released at the rate of 2 million barrels daily. Some refineries have resumed operation, but at reduced runs. A number of major refineries remain shut. The Louisiana Offshore Oil Port (LOOP) resumed operation late September 1, and is accepting crude oil imports. The Colonial pipeline, which supplies refined products to regions of the South and Northeast, has resumed operation and is at 100% of pumping capacity. The industry advises that it may be months before the area's oil and gas production and refining are fully restored. Spot and futures prices for gasoline and middle distillates rose sharply in the days following the storm, but prices began to fall early the week of September 5. This report will be updated.
DTIC
*Crude Oil; Natural Gas; Oils; Supplying*

**20070019108** Southwest Research Inst., San Antonio, TX USA
**Oxygenates for Advanced Petroleum-Based Diesel Fuels**
Naegeli, David W; Moulton, Stan; Owens, Edwin C; Frame, Edwin A; Feb 2001; 98 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAE-07-99-C-L053; DAAK-70-92-C-0059; Proj-03-3227; Proj-3-5137
Report No.(s): AD-A465522; TFLRF-357; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465522

Oxygenates for diesel fuel are organic compounds such as alcohols ethers and ketones that contain a relatively high

concentration of oxygen, The purpose of adding oxygenates to diesel fuel is to reduce the emissions of particulate matter (PM) in the exhaust, The goal of this project was to select two candidate oxygenate compounds that will be used in a full-scale engine test program to determine which oxygenate will give the greatest improvement in exhaust emissions and performance when blended with conventional diesel. The literature was reviewed for impact of oxygenates on PM emissions to compile oxygenate properties and select test fuel oxygen level. A hypothesis of the mechanism of oxygenate effect on PM formation was developed. Physicochemical properties of oxygenate candidates were collected. Property data was used to screen oxygenates for use in diesel fuel. Oxygenates were ranked according to toxicity and biodegradability. The economics of oxygenate production was estimated. Eight oxygenates were selected for making oxygenate diesel fuel blends for emission testing in a 2.2L diesel engine at a single operating condition (Mode 6). The two most promising oxygenates were recommended for making oxygenate diesel fuel blends for future emission testing.
DTIC
*Crude Oil; Diesel Engines; Diesel Fuels; Organic Compounds*

## 29
## SPACE PROCESSING

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy*.

**20070018774** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Materials Research Conducted Aboard the International Space Station: Facilities Overview, Operational Procedures, and Experimental Outcomes**
Grugel, Richard N.; Luz, Paul; Smith, Guy; Spivey, Reggie; Jeter, Linda; Gillies, Donald; Hua, Fay; Anikumar, A. V.; [2007]; 1 pp.; In English; Acta Astronautica; Copyright; Avail.: Other Sources; Abstract Only

The Microgravity Science Glovebox (MSG) and Maintenance Work Area (MWA) are facilities aboard the International Space Station (ISS) that were used to successfully conduct experiments in support of, respectively, the Pore Formation and Mobility Investigation (PFMI) and the In-Space Soldering Investigation (ISSI). The capabilities of these facilities are briefly discussed and then demonstrated by presenting 'real-time' and subsequently down-linked video-taped examples from the abovementioned experiments. Data interpretation, ISS telescience, some lessons learned, and the need of such facilities for conducting work in support of understanding materials behavior, particularly fluid processing and transport scenarios, in low-gravity environments is discussed.
Author
*International Space Station; Microgravity; Materials Science; General Overviews; Spaceborne Experiments*

**20070019293** NASA Johnson Space Center, Houston, TX, USA
**The International Space Station: Stepping-stone to Exploration**
Gerstenmaier, William H.; Kelly, Brian K.; Kelly, Brian K.; October 17, 2005; 1 pp.; In English; 56th International Astronautical Congress, 17-21 October 2005, Fukuoka, Japan; No Copyright; Avail.: Other Sources; Abstract Only

As the Space Shuttle returns to flight this year, major reconfiguration and assembly of the International Space Station continues as the USA and our 5 International Partners resume building and carry on operating this impressive Earth-orbiting research facility. In his January 14, 2004, speech announcing a new vision for America's space program, President Bush ratified the USA' commitment to completing construction of the ISS by 2010. The current ongoing research aboard the Station on the long-term effects of space travel on human physiology will greatly benefit human crews to venture through the vast voids of space for months at a time. The continual operation of ISS leads to new knowledge about the design, development and operation of system and hardware that will be utilized in the development of new deep-space vehicles needed to fulfill the Vision for Exploration. This paper will provide an overview of the ISS Program, including a review of the events of the past year, as well as plans for next year and the future.
Author
*International Space Station; Space Exploration; Space Shuttles; Space Missions*

## 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*.

**20070018972** Air Force Research Lab., Wright-Patterson AFB, OH USA
**Air Force Laboratory's 2005 Technology Milestones**
Jan 1, 2005; 172 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465230; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465230

AFRL Technology Milestones highlight significant scientific and technical accomplishments for visually-coupled acquisition and targeting systems for our warfighter to automatic spoken language translators for our international warriors. AFRL, headquartered at Wright-Patterson AFB, Ohio is the Air Force's largest employer of scientist and engineers, with partnerships in industry and academia, working to develop and transition affordable integrated technologies to support a broad range of future capabilities. This Technology Milestones book includes stories from the following categories: Support to the Warfighter; Sustainment; Emerging Technologies; Technology Transfer; and Awards Recognition.
DTIC
*Aeronautical Engineering; Research Management*

**20070019013** Academy of Sciences of the Ukraine, Kharkov, Ukraine
**Methodology of Accelerated Life-Time Tests For Stirling-Type 'Bae-Co'-Made Cryocoolers Against Displacer-Blockage by Cryo-Pollutant Deposits**
Getmanits, Vladimir; Jan 2000; 35 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F61775-99-W-E096
Report No.(s): AD-A465301; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465301

This report results from a contract tasking R&D Bureau of the Institute for Low Temperature Physics and Engineering as follows: The contractor will investigate techniques for accelerated testing of cryocooler technology. During this phase of the effort the contractor will perform a detailed design of the equipment needed to conduct accelerated testing. Details are contained in the proposal statement of work designated as Tasks II and IIA.
DTIC
*Accelerated Life Tests; Blocking; Contaminants; Coolers; Cryogenic Cooling; Cryogenics; Deposits; Stirling Cycle*

**20070019083** Florida Univ., Gainesville, FL USA
**Quantitative Imaging of Nanoscale Mechanical Properties Using Hybrid Nanoindentation and Force Modulation**
Asif, S A; Wahl, K J; Colton, R J; Warren, O L; Aug 1, 2001; 10 pp.; In English
Report No.(s): AD-A465474; XB-NRL/MR/6170; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465474

In this article, we present a quantitative stiffness imaging technique and demonstrate its use to directly map the dynamic mechanical properties of materials with nanometer-scale lateral resolution. For the experiments, we use a 'hybrid' nanoindenter, coupling depth-sensing nanoindentation with scanning probe imaging capabilities. Force modulation electronics have been added, enhancing instrument sensitivity and enabling measurements of time dependent materials properties (e.g., loss modulus and damping coefficient) not readily obtained with quasi-static indentation techniques. Tip-sample interaction stiffness images are acquired by superimposing a sinusoidal force (~1 muN) onto the quasi-static imaging force (1.5-2 muN), and recording the displacement amplitude and phase as the surface is scanned. Combining a dynamic model of the indenter (having known mass, damping coefficient, spring stiffness, resonance frequency, and modulation frequency) with the response of the tip-surface interaction, creates maps of complex stiffness. We demonstrate the use of this approach to obtain quantitative storage and loss stiffness images of a fiber-epoxy composite, as well as directly determine the loss and storage moduli from the images using Hertzian contact mechanics. Moduli differences as small as 20% were resolved in the images at loads two orders of magnitude lower than with indentation, and were consistent with measurements made using conventional quasi-static depth-sensing indentation techniques.
DTIC
*Imaging Techniques; Mechanical Properties; Modulation; Nanoindentation*

**20070019149** Army Tank-Automotive Research and Development Command, Warren, MI USA
**Combat Vehicle Engine Selection Methodology Based on Vehicle Integration Considerations**
Raffa, Charles; Schwarz, Ernest; Tasdemir, John; Apr 13, 2005; 19 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465619; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465619

These briefing charts show the definition of the propulsion system for military applications, advanced integrated propulsion system (AIPS) power pack, assessment of the overall system power density potential: cooling system and parasitic fan power sizing, inlet and exhaust system impact, mission fuel determination and propulsion system volume estimates.
DTIC
*Combat; Propulsion System Configurations; Propulsion System Performance; Selection*

**20070019158** Maryland Univ., College Park, MD USA
**Development of a Flow-Through SQUID System for Non-Destructive Evaluation of MRI Wire**
Wellstood, Frederick C; Mar 23, 2007; 3 pp.; In English
Contract(s)/Grant(s): FA9550-05-1-0028
Report No.(s): AD-A465649; FRS-01-5-28399; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465649

This project developed techniques to detect small defects in NbTi magnet wire at room-temperature using a flow-through high-transition temperature (Tc) superconducting quantum interference device (SQUID) system. The ability to detect small defects in km-long sections of NbTi magnet wire could improve the production yield of high-field magnets for power and medical applications. Such magnets are wound from continuous sections of wire up to 1 km long, and a single small defect in the wire can limit the field the magnet produces, making it unsuitable. It is highly desirable to be able to locate defects in wire using non-destructive evaluation (NDE) of the wire before the magnet is wound. Ideally, the NDE system must be able to detect small buried defects due to yields (wire stretched beyond elastic limit) and occlusions (non-conducting impurity grain introduced into the wire). Such defects have proven to be difficult to find using visual inspection or conventional eddy current detection, and better techniques are needed.
DTIC
*Eddy Currents; Nondestructive Tests; SQUID (Detectors); Superconductivity; Systems Analysis; Wire*

**20070019218** Air Force Research Lab., Edwards AFB, CA USA
**Laser-Induced Fluorescence Measurements of Velocity within a Hall Discharge**
Hargus, Jr , W A; Cappelli, M A; Jan 2001; 10 pp.; In English
Contract(s)/Grant(s): Proj-1011
Report No.(s): AD-A465789; AFRL-PR-ED-JA-2007-033; No Copyright; Avail.: CASI: A02, Hardcopy

The results of a study of laser-induced fluorescence velocimetry of neutral and singly ionized xenon in the plume and interior portions of the acceleration channel of a Hall thruster plasma discharge operating at powers ranging from 250 to 725 W are described. Axial ion and neutral velocity profiles for four discharge voltage conditions (100V, 160V, 200V, 250V) are measured as are radial ion velocity profiles in the near-field plume.
DTIC
*Laser Induced Fluorescence; Measurement*

## 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*.

**20070018975** Naval War Coll., Newport, RI USA
**Protecting America's Maritime Domain -- An Interagency Command and Control Structure to Achieve Unity of Effort**
Thomas, Jeffery W; Feb 14, 2005; 22 pp.; In English
Report No.(s): AD-A465239; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465239

Protection of the nation's maritime domain is vital to the U.S. economy. The vast area and free flowing nature of ships,

their cargo, and international crews make this a unique challenge for the myriad of government agencies assigned to protect America's maritime domain. Following the attacks of 9/11, government reorganization and implementation of newly created government regulations have reduced the vulnerability of the U.S. maritime domain to terrorist attacks. However, a 'seam' of ambiguity exists within the maritime domain that terrorists may seek to exploit. The existing relationship between the Departments of Homeland Security and Defense and the ambiguity associated with the terms 'homeland security' and 'homeland defense' has created this 'seam' as well as an environment that violates the principle of unity of effort. To achieve unity of effort within the maritime domain, a national Joint Interagency Task Force (JIATF) should be created. A national JIATF would ensure one commander and one unified effort to fight the global war on terrorism within the nation's maritime domain.
DTIC
*Coasts; Command and Control; Control Systems Design; Controllers; Coordination; Defense Program; Industries; Protection; Security*

**20070018986** Naval Research Lab., Washington, DC USA
**Analytical Approach to Calculation of Probability of Bit Error and Optimum Thresholds in Free-Space Optical Communication**
Namazi, Nader; Burris, Ray; Gilbreath, G C; Jan 2005; 16 pp.; In English
Report No.(s): AD-A465257; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465257

Based on the wavelet transformation and adaptive Wiener Filtering, a new method was presented by the authors to perform the synchronization and detection of the binary data from the Free-Space Optical (FSO) signal [1]. It was shown in [1] that the Haar wavelet with a fixed scale is an excellent choice for this purpose. The output of the filter is zero-mean and is closely related to the derivative of the binary data. In this effort an analysis of the work in [1] is presented to obtain the probability of bit error using a Bayesian ternary hypotheses testing. The analysis also results in determining optimum thresholds for the detection of binary data.
DTIC
*Error Analysis; Free-Space Optical Communication; Optical Communication*

**20070019033** Naval Research Lab., Washington, DC USA
**Compact, Lightweight Payload for Covert Data Link using a Multiple Quantum Well Modulating Retro-Reflector on a Small Rotary-Wing Unmanned Airborne Vehicle**
Gilbreath, G C; Rabinovich, W S; Meehan, T J; Vilcheck, M J; Mahon, R; Burris, Ray; Ferraro, M; Sokolsky, I; Vasquez, J A; Bovais, C S; Jan 2000; 12 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465333; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465333

In this paper, we describe progress in the development of the NRL Multiple Quantum Well modulating retroreflector 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 NRL multiple quantum well modulating retro-reflector. Modulating retro-reflector systems couple an optical retro-reflector, 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 up to 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. The multiple quantum well modulating retro-reflector 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 a unmanned aerial vehicle in flight at a range of 100-200 feet is shown. Near real-time compressed video is also demonstrated at the Mbps level.
DTIC
*Data Links; Modulation; Optical Communication; Payloads; Quantum Wells; Reflectors; Retroreflectors; Rotary Wings*

**20070019045** Library of Congress, Washington, DC USA
**Spectrum Policy: Public Safety and Wireless Communications Interference**
Moore, Linda K; Feb 6, 2006; 11 pp.; In English
Report No.(s): AD-A465362; CRS-RL32408; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465362

In mid-2005, wireless communications managers commenced the process of moving selected public safety radio channels to new frequencies. This is the first step in a three-year plan to move public safety users to new channels in order to mitigate persistent problems with interference to their radio communications. The interference usually takes the form of dropped calls or dead spaces with radio transmissions primarily to or from first responders in certain frequencies. The majority of documented incidents of interference have been attributed to the network operated by Nextel Communications, Inc. Nextel in 2005 completed a merger with Sprint Corporation, creating the U.S.'s third-largest mobile company. Its new corporate name is Sprint Nextel. As part of an agreement originally made between Nextel and the Federal Communications Commission, some public safety wireless users will be moved to new frequencies, with the wireless company paying all or part of the cost. This agreement is not affected by the merger. In return for these expenditures, and reflecting the value of spectrum that Sprint Nextel will be relinquishing, the FCC will assign new spectrum to the wireless company. The rebanding plan is being implemented by the 800 MHz Transition Administrator (TA), created by the FCC for this purpose. The TA is to set priorities, establish schedules, and oversee reimbursement to parties for eligible expenses associated with relocation. Disagreements about the implementation of the plan that the TA cannot resolve on its own or through mediation will in most cases be referred to the FCC. There are ongoing debates about the transition plan, such as maintaining interoperability, scheduling, and reimbursement for costs incurred. If resolution of problems created by the rebanding appears unacceptable, public safety and others that use the affected frequencies could seek assistance from Congress.
DTIC
*Frequencies; Policies; Radio Frequencies; Radio Transmission; Relocation; Safety; Spectra; Wireless Communication*

**20070019089** Naval Research Lab., Washington, DC USA
**Protocols using Anonymous Connections: Mobile Applications**
Reed, Michael G; Syverson, Paul F; Goldschlag, David M; Jan 1997; 12 pp.; In English
Report No.(s): AD-A465486; XB-NRL/MR/5540; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465486
This paper describes security protocols that use anonymous channels as primitive, much in the way that key distribution protocols take encryption as primitive. This abstraction allows us to focus on high level anonymity goals of these protocols much as abstracting away from encryption clarifies and emphasizes high level security goals of key distribution protocols. The contributions of this paper are (1) a notation for describing such protocols, and (2) two protocols for location protected communication over a public infrastructure.
DTIC
*Protocol (Computers)*

**20070019151** Space and Naval Warfare Systems Command, San Diego, CA USA
**Knowledge Management for Command and Control**
Ceruti, Marion G; Wilcox, Dwight R; Power, Brenda J; Jun 2004; 36 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465622; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465622
This paper highlights some major trends and developments in knowledge management with particular emphasis on knowledge capturing and authoring, and how this technology can be combined with intelligent agents to produce advanced capabilities for command and control systems. Past trends, present accomplishments and future work in knowledge management systems are covered. We also describe an in-house effort to accumulate, validate, and integrate the results of the Defense Advanced Research Projects Agency (DARPA) Rapid Knowledge Formation (RKF) program with a view toward the recommendation of specific technologies for transition to operational command centers. This technology will permit scientific, technical, and military experts, such as command-center and intelligence-center personnel to encode massive amounts of knowledge into reusable knowledge bases for application in many different tasks. This paper also presents current and future uses of adaptive and mobile intelligent agents to increase the dependability of FORCEnet by improving network-centric warfare in general, and the battlefield single integrated picture (SIP) in particular. Applications of mobile and adaptive intelligent agents are described. Further research is planned in the area of ontologies, expert systems, knowledge management, intelligent agents and user-interfaces for subject-matter experts under this program.
DTIC
*Command and Control; Information Management; Warfare*

**20070019152** Military Academy, Brno, Czech Republic

**The Czech Army C2 and Simulation Systems and Decision Making Support Architecture**

Burita, Ladislav; Hopjan, Miroslav; Jun 2004; 34 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465623; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465623

The paper consists of three parts. The first part characterizes the Command and Control (C2) system of the Army of the Czech Republic (ACR) that was developed by the Czech contractor DELINFO. The second part describes the simulation technology and simulation systems (ESA), used in the ACR. The most important is the tactical simulator ModSAF in simulation center of Military Academy (MA) in Brno. The third chapter deals with current ways of C2 and ESA systems cooperation, also possible future solutions and new ideas are discussed.

DTIC

*Command and Control; Decision Making; Simulation*

**20070019215** Department of Defense, Washington, DC USA

**A Real-Time Community-of-Interest Framework for Command-and-Control Applications**

Paul, Ray; Tsai, W T; Jun 2004; 19 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465784; No Copyright; Avail.: CASI: A03, Hardcopy

The paper presents a real-time Community of Interest (COI) framework for Command and Control (C2) applications. The overall goal is to support superior decision making, COIs flexible synchronization and collaboration, and real-time communication. The extended service-oriented architecture (SOA) based framework consists of three layers including mission layer, COI service layer and support layer. Mission service layer consists of a set of mission/tactical services. COI service layer provides COI coordinator service, policy specification/evaluation services, situation awareness and dynamic reconfiguration services. Overall scenarios of COI's services are described to illustrate the relationships among the services. The support service layer consists of discovery services, messaging services, security service, scenario specification services, quality-of-assurance service, data storage/retrieval services, and maintenance services. This paper focuses on COI service layer. A prototype is developed to demonstrate the main proposed techniques, approaches and the process using an example COI of bookstores and publishers. It has three layers including data collection/filter layer, analysis layer and presentation layer.

DTIC

*Command and Control; Decision Making; Real Time Operation*

**20070019258** Naval Research Lab., Washington, DC USA

**Anonymous Connections and Onion Routing**

Reed, Micheal G; Syverson, Paul F; Goldschlag, David M; Jan 1998; 16 pp.; In English

Report No.(s): AD-A465335; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465335

Onion Routing is an infrastructure for private communication over a public network. It provides anonymous connections that are strongly resistant to both eavesdropping and traffic analysis. Onion routing's anonymous connections are bidirectional and near real time, and can be used anywhere a socket connection can be used. Any identifying information must be in the data stream carried over an anonymous connection. An onion is a data structure that is treated as the destination address by onion routers; thus, it is used to establish an anonymous connection. Onions themselves appear differently to each onion router as well as to network observers. The same goes for data carried over the connections they establish. Proxy aware applications, such as web browsing and e-mail, require no modification to use onion routing, and do so through a series of proxies. A prototype onion routing network is running between our lab and other sites. This paper describes anonymous connections and their implementation using onion routing. This paper also describes several application proxies for onion routing, as well as configurations of onion routing networks.

DTIC

*Communication Networks; Data Flow Analysis; Prototypes; Computer Information Security*

**20070019261** Naval Research Lab., Washington, DC USA

**Tor: The Second-Generation Onion Router**

Dingledine, Roger; Mathewson, Nick; Syverson, Paul; Jan 2004; 18 pp.; In English

Report No.(s): AD-A465464; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465464

We present Tor, a circuit-based low-latency anonymous communication service. This second-generation Onion Routing system addresses limitations in the original design by adding perfect forward secrecy, congestion control, directory servers, integrity checking, configurable exit policies, and a practical design for location-hidden services via rendezvous points. Tor works on the real-world Internet, requires no special privileges or kernel modifications, requires little synchronization or coordination between nodes, and provides a reasonable tradeoff between anonymity, usability, and efficiency. We briefly describe our experiences with an international network of more than 30 nodes. We close with a list of open problems in anonymous communication.
DTIC
*Communication Networks; Circuits*

**20070019264** Wright State Univ., Dayton, OH USA
**Choosing Colors for Work-Centered Support Systems for Command and Control Using a Visual Search Task**
Thomas-Myers, Gina; Nagy, Allen; Kuper, Samuel; Wampler, Jeffrey; Jun 2004; 46 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465795; No Copyright; Avail.: CASI: A03, Hardcopy

The use of information technology to support work and aid in decision making has brought about new ways of displaying information on computer screens. The more information required, the more complex those displays have become. Goals of this research project were to 1) develop and test basic methodology for recommending complex display color coding and 2) to use results from that methodology to recommend specific changes to the Work-Centered Support System for Global Weather Management (WCSS-GWM) application. The on-going research shows how a simple laboratory search technique may be used to recommend chromaticities and other characteristics for use in current and future systems.
DTIC
*Color; Command and Control; Decision Making; Display Devices; Support Systems; Visual Tasks*

**20070019266** Engineering Management and Integration, Inc., Herndon, VA USA
**Using the C4ISR Architectural Framework as a Tool for Assigning Management and Technical Responsibilities**
Clemens, Nicholas; Jun 2004; 33 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465807; No Copyright; Avail.: CASI: A03, Hardcopy

Architectural views, as defined by the Department of Defense's (DoD) Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR) framework, are used as a prism to develop a management structure for implementing programs distributed across multiple organizations. This structure is also useful in managing smaller efforts within an evolutionary acquisition program. The paper recommends a matrix that defines management tasking across multiple management layers, and in terms of the three C4ISR architectural views. The matrix provides a template for assigning technical and programmatic responsibilities across organization levels and suggests where stakeholders should place their primary focus. Individual projects also are shown to each have zones of optimal technical enhancement that form a continuous improvement band in which systems may evolve and technology may be inserted to enhance system wide performance. The author applies this template to the Joint Tactical Radio System (JTRS) Joint Program Office (JPO) and discusses appropriate management focus within the context of the JTRS JPO's primary role as an integrating program management office charged with directing an evolutionary acquisition program.
DTIC
*Command and Control; Reconnaissance; Surveillance*

**20070019286** Human Effectiveness Directorate, Wright-Patterson AFB, OH USA
**Smart Systems for Logistics Command and Control (SSLC2)**
Faas, Paul; Swartzmiller, Justin; Jun 2004; 25 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465688; No Copyright; Avail.: CASI: A03, Hardcopy

The US Air Force has a requirement to be aware of the state of its weapon systems and the support equipment within real-time or at least near real-time, however, the means to offer this visibility does not currently exist. The Air Force Research Laboratory (AFRL) has started a new Research & Development (R&D) program to investigate what it would require to meet the warfighter needs. This 6.3 Applied Technology project is called Smart Systems for Logistics Command and Control (SSLC2). The goal of the program is to develop a cross-cutting capability to passively collect critical logistics information required to manage wing level resources, and process it into a form that supports quality decision making by wing level commanders. Additionally, this information should be capable of flowing upward to support daily situational reports at the

theater level. The AFRL researchers will take advantage of the successful Logistics Control Information and Support (LOCIS) program. The LOCIS program showed how wing level logisticians can be more productive if fed the status of the wing's logistics resources. Portions of the LOCIS program relied on canned databases during their testing because the means to generate real-time status information did not exist.
DTIC
*Command and Control; Decision Making; Logistics*

## 33
## 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*.

**20070018806** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Radiation Hardened Electronics for Extreme Environments**
Keys, Andrew S.; Watson, Michael D.; [2007]; 4 pp.; In English; GOMACTech 2007 - Conference Proceedings to be published, 19-22 Mar. 2007, Lake Buena Vista, FL, USA; Original contains color illustrations; No Copyright; Avail.:
CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018806

The Radiation Hardened Electronics for Space Environments (RHESE) project consists of a series of tasks designed to develop and mature a broad spectrum of radiation hardened and low temperature electronics technologies. Three approaches are being taken to address radiation hardening: improved material hardness, design techniques to improve radiation tolerance, and software methods to improve radiation tolerance. Within these approaches various technology products are being addressed including Field Programmable Gate Arrays (FPGA), Field Programmable Analog Arrays (FPAA), MEMS Serial Processors, Reconfigurable Processors, and Parallel Processors. In addition to radiation hardening, low temperature extremes are addressed with a focus on material and design approaches.
Author
*Aerospace Environments; Radiation Hardening; Parallel Processing (Computers); Microelectromechanical Systems; Systems Engineering*

**20070018844** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**SpaceWire Plug and Play**
Rakow, Glenn; McGuirk, Patrick; Kimmery, Clifford; Jaffe, Paul; November 1, 2006; 8 pp.; In English; IEEE Aerospace Conference 2007, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains color and black and white illustrations
Report No.(s): IEEEAC Paper 1211; Copyright; Avail.: Other Sources

The ability to rapidly deploy inexpensive satellites to meet tactical goals has become an important goal for military space systems. In fact, Operationally Responsive Space (ORS) has been in the spotlight at the highest levels. The Office of the Secretary of Defense (OSD) has identified that the critical next step is developing the bus standards and modular interfaces. Historically, satellite components have been constructed based on bus standards and standardized interfaces. However, this has not been done to a degree, which would allow the rapid deployment of a satellite. Advancements in plug-and-play (PnP) technologies for terrestrial applications can serve as a baseline model for a PnP approach for satellite applications. Since SpaceWire (SpW) has become a de facto standard for satellite high-speed (greater than 200Mbp) on-board communications, it has become important for SpW to adapt to this Plug and Play (PnP) environment. Because SpW is simply a bulk transport protocol and lacks built-in PnP features, several changes are required to facilitate PnP with SpW. The first is for Host(s) to figure out what the network looks like, i.e., how pieces of the network, routers and nodes, are connected together; network mapping, and to receive notice of changes to the network. The second is for the components connected to the network to be understood so that they can communicate. The first element, network topology mapping & change of status indication, is being defined (topic of this paper). The second element describing how components are to communicate has been defined by ARFL with the electronic data sheets known as XTEDS. The first element, network mapping, is recent activities performed by Air Force Research Lab (ARFL), Naval Research Lab (NRL), NASA and US industry (Honeywell, Clearwater, FL, and others). This work has resulted in the development of a protocol that will perform the lower level functions of network mapping and Change Of Status (COS) indication required by Plug 'n' Play over SpaceWire. This work will be presented to the SpaceWire working group for standardization under European Cooperation for Space Standardization (ECSS) and to obtain a permanent

Protocol ID (see SpaceWire Protocol ID: What Does it Mean to You; IEEE Aerospace Conference 2006). The portion of the Plug 'n' Play protocol that will be described in this paper is how the Host(s) of a SpaceWire network map the network and detect additions and deletions of devices on a SpaceWire network.
Author
*Aerospace Systems; Communication Networks; Protocol (Computers); Packets (Communication); Military Technology; Electrical Engineering*

**20070018938** Analex Corp., Brook Park, OH, USA
**Hydrogen Generation Through Renewable Energy Sources at the NASA Glenn Research Center**
Colozza, Anthony; Prokopius, Kevin; April 2007; 43 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-02150
Report No.(s): NASA/CR-2007-214682; E-15832; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018938

An evaluation of the potential for generating high pressure, high purity hydrogen at the NASA Glenn Research Center (GRC) was performed. This evaluation was based on producing hydrogen utilizing a prototype Hamilton Standard electrolyzer that is capable of producing hydrogen at 3000 psi. The present state of the electrolyzer system was determined to identify the refurbishment requirements. The power for operating the electrolyzer would be produced through renewable power sources. Both wind and solar were considered in the analysis. The solar power production capability was based on the existing solar array field located at NASA GRC. The refurbishment and upgrade potential of the array field was determined and the array output was analyzed with various levels of upgrades throughout the year. The total available monthly and yearly energy from the array was determined. A wind turbine was also sized for operation. This sizing evaluated the wind potential at the site and produced an operational design point for the wind turbine. Commercially available wind turbines were evaluated to determine their applicability to this site. The system installation and power integration were also addressed. This included items such as housing the electrolyzer, power management, water supply, gas storage, cooling and hydrogen dispensing.
Author
*Renewable Energy; High Pressure; Hydrogen Production; Electrolysis*

**20070018948** Virginia Univ., Charlottesville, VA USA
**The Visual Vulnerability Spectrum: Characterizing Architectural Vulnerability for Graphics Hardware**
Sheaffer, Jeremy W; Luebke, David P; Skadron, Kevin; Jan 2006; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W911NF-04-1-0288; CCF0429765
Report No.(s): AD-A465187; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465187

With shrinking process technology, the primary cause of transient faults in semiconductors shifts away from high energy cosmic particle strikes and toward more mundane and pervasive causes power fluctuations, crosstalk, and other random noise. Smaller transistor features require a lower critical charge to hold and change bits, which leads to faster microprocessors, but which also leads to higher transient fault rates. Current trends, expected to continue, show soft error rates increasing exponentially at a rate of 8% per technology generation. Existing transient fault research in general-purpose architecture, like the well-established architectural vulnerability factor (AVF), assume that all computations are equally important and all errors equally intolerable. However, we observe that the effect of transient faults in graphics processing can range from imperceptible, to bothersome visual artifacts, to critical loss of function. We therefore extend and generalize the AVF by introducing the Visual Vulnerability Spectrum (VVS). We apply the VVS to analyze the effect of increased transient error rate on graphics processors. With this analysis in hand, we suggest several targeted, inexpensive solutions that can mitigate the most egregious of soft error consequences.
DTIC
*Computer Graphics; Crosstalk; Vulnerability*

**20070018967** Missouri Univ., Columbia, MO USA
**Rep-Rate Jitter and Electrode Erosion of a High Pressure Flowing Oil Switch**
Norgard, P; Curry, R D; Apr 2006; 8 pp.; In English
Contract(s)/Grant(s): F33615-01-C-2191; Proj-3145
Report No.(s): AD-A465225; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465225

A repetition rate switch has been developed at the University of Missouri for long service life applications at moderate energy levels. The switch was designed to study the effects of pressure, flow and charge voltage upon the breakdown performance of a synthetic avionics dielectric coolant known as poly-olefin. Experimental results at pressures from 3.45 to 10.34 MPa (500 to 1,500 psig) and flow rates from 0.315 to 0.694 L's-l (5 to 11 gpm) indicate the range of parameters chosen for examination does not limit the switch breakdown performance at a repetition rate of 15 pps. The electrodes were examined at 106 shots in order to estimate an electrode lifetime. The material removed, although significant, was not found to limit the performance of the switch over its test lifetime and with gap-spacing adjustments the switch was found to perform similarly to the performance observed early in the electrode lifetime. The electrodes are expected to last for more than 10^7 shots.
DTIC
*Electrodes; Erosion; High Pressure; Oils; Pressure Switches; Switches; Vibration*

**20070018977** Florida Univ., Gainesville, FL USA
**An 18-GHz, 10.9-dBm Fully-Integrated Power Amplifier with 23.5% PAE in 130-nm CMOS**
Cao, Changhua; Xu, Haifeng; Su, Yu; O, Kenneth K; Sep 2005; 5 pp.; In English
Contract(s)/Grant(s): N66001-03-1-8901
Report No.(s): AD-A465241; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465241

An 18-GHz fully integrated class-E power amplifier with 10.9-dBm saturated output power and 23.5% maximum power added efficiency (PAE) was fabricated in the UMC 130-nm digital complementary metal-oxide semiconductor (CMOS) process. At the saturated output the required input power level is -5dBm and the power amplifier consumes 35mA from V(sub DD)=1.5V. The amplifier is single-ended and includes a 2-stage pre-amplifier and a driver stage. A mode-locking technique exploiting the instability of the driver amplifier is used to improve the drive for the gate of output stage. The mode-locking improves PAE by approximately 3% and reduces the required input power level by approximately 6dB to get the same output level. The performance of the power amplifier in this work is compared to that of previously reported power amplifiers operating near 20GHz. The results show that this power amplifier shows significantly higher efficiency and lower input requirements than that of the CMOS power amplifiers operating at 20GHz. The research suggests that CMOS technology is a viable candidate for building a fully integrated transmitter near 20GHz.
DTIC
*CMOS; Fabrication; Power Amplifiers; Radio Transmitters*

**20070019006** Defence Science and Technology Organisation, Edinburgh, Australia
**The Generation of Situational Awareness within Autonomous Systems - A Near to Mid term Study - Analysis**
Hew, Patrick C; Jul 2006; 85 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465290; DSTO-TR-1896; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465290

This study aims to clarify and capture the nature of electronic situational awareness and its interface with electro/mechanical systems. It argues that 'autonomous situation awareness' is about the sufficiency of awareness for autonomy in the situation at hand. The approach is calibrated through historical case studies, and the study then considers the potential from near to mid term technology.
DTIC
*Autonomy; Electromechanical Devices; Situational Awareness*

**20070019039** Naval Research Lab., Washington, DC USA
**Nanoscale Surface Mechanical Property Measurements: Force Modulation Techniques Applied to Nanoindentation (Preprint)**
Asif, S A; Colton, R J; Wahl, K J; Jan 2000; 19 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465343; XB-NRL/MR/6170; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465343

Mechanical properties of surfaces and interfaces are important for understanding the behavior of adhesive and sliding contacts, where changes in interfacial properties can result from surface treatments, sliding processes, or contaminants. Recent advances combining nanoindentation, atomic force microscopy and force modulation techniques enable examination of surface mechanical properties with substantially improved force and spatial resolution, and enable quantitative, dynamic measurements of surface mechanical properties of nanoscale contacts. We present examples demonstrating quantitative,

surface sensitive nanomechanics of thin films and compliant polymers, damping losses and the effects of water vapor. Additionally, we present a new, quantitative stiffness imaging technique for mechanical properties mapping at the nanoscale.
DTIC
*Mechanical Properties; Modulation; Nanoindentation; Nanotechnology; Surface Properties*

**20070019172** Naval Postgraduate School, Monterey, CA USA
**The Effects of Isothermal Deformation and Annealing on the Microstructure of Nickel-Aluminum-Bronze Propeller Material**
Nabach, William A; Jun 2003; 63 pp.; In English
Report No.(s): AD-A465673; No Copyright; Avail.: CASI: A04, Hardcopy

This thesis is a study of annealing and deformation characteristics of cast Nickel-Aluminum Bronze (NAB) in relation to Friction Stir Processing (FSP) of this material. Cast NAB is widely utilized by the U.S. Navy as material used in the production of propellers for surface vessel and submarines. FSP is a novel method of deformation processing that is conducted by use of a rotating tool that is forced onto the surface of a material under load such that sliding and sticking friction result in a combination of frictional and adiabatic heating due to plastic deformation. A stirring effect results in the formation of a zone of severe shear deformation and local temperatures approaching 90% of the melting temperature. FSP results in local homogenization of the cast microstructure and conversion of it to a wrought condition, but also in steep strain, strain rate and temperature gradients. In this thesis microstructures achieved through controlled isothermal deformation and annealing processes will be compared with microstructures resulting from FSP. The use of Friction Stir Processing is envisioned as a way to improve the surface characteristics of the material through localized microstructural modification. Studies of warm rolling, channel die compression and various annealing schedules were completed.
DTIC
*Aluminum; Annealing; Bronzes; Deformation; Friction Stir Welding; Microstructure; Nickel; Propellers*

**20070019179** Georgia Inst. of Tech., Atlanta, GA USA
**Microsystems for the Fabrication of Nano-Scale Structures**
Courcimault, C G; Kercher, D S; Allen, M G; Jan 2003; 5 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465693; No Copyright; Avail.: CASI: A01, Hardcopy

This paper describes fabrication and testing of microsystems which can be utilized for in-situ deposition control and direct patterning of structures with micron and submicron lateral and vertical dimensions. An electrostatically-driven microactuator acts as an addressable active shutter and shadow mask in a Physical Vapor Deposition system. The displacement of the actuator is controlled in the nano-scale range, without using electrical sensing circuitry, by means of stoppers fabricated as integral parts of the structure. The deposition of metals through the real-time-actuated microsystem allowed control of the three dimensional shape of the deposited patterns as verified by AFM measurements.
DTIC
*Actuators; Electrostatics; Fabrication; Microinstrumentation; Nanostructures (Devices); Vapor Deposition*

**20070019194** Georgia Inst. of Tech., Atlanta, GA USA
**Fabrication of a Fully Integrated Passive Module for Filter Application Using MCM-D Compatible Processes**
Bhattacharya, Swapan K; Park, Jae Y; Tummala, Rag R; Allen, Mark G; Jan 2000; 7 pp.; In English
Contract(s)/Grant(s): F33615-96-2-1838; EEC-9402723
Report No.(s): AD-A465718; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Integral passive is an emerging technology which is currently perceived as a possible alternative to the discrete passive technology in fulfilling the next generation packaging needs. Although discrete surface mount passive components (resistors, capacitors, and inductors) have been well characterized, the development of integral passive components suitable for co-integration on the board level is relatively recent. Since in some applications the number of passive components can exceed the number and the area of tC chips on a circuit board or in a package, such integration of passive components would be necessary to substantially eliminate part count and reduce device area. To address these issues, integration technology for passive elements in the same manner as for transistors is necessary. In addition, the fabrication sequence of all integral passive components should be mutually compatible for co-integration on the same substrate. In this paper, materials and fabrication issues for passive elements such as resistors (R), capacitors (C), and inductors (l) and the feasibility of integration of these fabricated passive components on glass substrates have been addressed. An active filter circuit has been selected for a case study for R, L, and C cointegration. This passive module contains eleven resistors, four capacitors, and four inductors, and

is fabricated using MCM-D (multichip module-deposited) compatible processes. A variety of materials appropriate for fabrication of integral passives in a mutually compatible fashion were investigated, including chromium and nickel-chromium resistors, composites of high dielectric constant materials in epoxies for capacitor dielectrics, and composites of magnetic ferrite particles in polyimides for inductor core and shielding.
DTIC
*Dielectric Properties; Fabrication; Substrates; Systems Integration*

**20070019201** Nikulin (Vladimir V.), Endicott, NY USA
**Hybrid Steering Systems for Free-Space Quantum Communication**
Nikulin, Vladimir V; Mar 2007; 50 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8750-06-1-0248; Proj-558B
Report No.(s): AD-A465734; No Copyright; Avail.: CASI: A03, Hardcopy

The proposed research will utilize a mechanical gimbal for extended range of optical connectivity, and a fast beam deflector to create a hybrid beam steering system capable of exercising a very high positioning bandwidth over a full hemisphere of steering angles. System design process will include the solution of such underlying problems as the development of the mechanical and optical subsystems, mathematical description of the hybrid device, optimal task distribution between the mechanical and non-mechanical positioning components, and coordination of the operation of the coarse and fine system controllers. This work will hybrid two separate technologies using the advantages of each.
DTIC
*Beam Steering; Quantum Communication; Steering*

**20070019285** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Towards Terahertz MMIC Amplifiers: Present Status and Trends**
Samoska, Lorene; September 10, 2006; 17 pp.; In English; European Microwave Conference, Workshop: New Horizons for Radion Astronomy Technologies, 10-15 Sep. 2006, Manchester, UK; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39887

This viewgraph presentation surveys the fastest Monolithic Millimeter-wave Integrated Circuit (MMIC) amplifiers to date; summarize previous solid state power amp results to date; reviews examples of MMICs, reviews Power vs. Gate periphery and frequency; Summarizes previous LNA results to date; reviews Noise figure results and trends toward higher frequency
CASI
*Frequencies; Integrated Circuits; Microwave Circuits; Power Amplifiers*

**20070019369** NASA Johnson Space Center, Houston, TX, USA
**SEU Performance of TAG Based Flip Flops**
Shuler, Robert L.; Kouba, Coy; O'Neill, Patrick M.; [2005]; 5 pp.; In English; Meeting held in Seattle, WA on July 11-15, 2005; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019369

We describe heavy ion test results for two new SEU tolerant latches based on transition nand gates, one for single rail asynchronous and the other for dual rail synchronous designs, implemented in AMI 0.5microprocess.
Author
*Single Event Upsets; Heavy Ions; Gates (Circuits); Flip-Flops*

**20070019375** NASA Johnson Space Center, Houston, TX, USA
**A High-power Electric Propulsion Test Platform in Space**
Petro, Andrew J.; Reed, Brian; Chavers, D. Greg; Sarmiento, Charles; Cenci, Susanna; Lemmons, Neil; October 31, 2005; 2 pp.; In English; International Electric Propulsion Conference, 31 October - 4 November 2005, Princeton, NJ, USA
Contract(s)/Grant(s): 6179120AA E0730; Copyright; Avail.: CASI: A01, Hardcopy

This paper will describe the results of the preliminary phase of a NASA design study for a facility to test high-power electric propulsion systems in space. The results of this design study are intended to provide a firm foundation for subsequent detailed design and development activities leading to the deployment of a valuable space facility. The NASA Exploration Systems Mission Directorate is sponsoring this design project. A team from the NASA Johnson Space Center, Glenn Research

Center, the Marshall Space Flight Center and the International Space Station Program Office is conducting the project. The test facility is intended for a broad range of users including government, industry and universities. International participation is encouraged. The objectives for human and robotic exploration of space can be accomplished affordably, safely and effectively with high-power electric propulsion systems. But, as thruster power levels rise to the hundreds of kilowatts and up to megawatts, their testing will pose stringent and expensive demands on existing Earth-based vacuum facilities. These considerations and the human access to near-Earth space provided by the International Space Station (ISS) have led to a renewed interest in space testing. The ISS could provide an excellent platform for a space-based test facility with the continuous vacuum conditions of the natural space environment and no chamber walls to modify the open boundary conditions of the propulsion system exhaust. The test platform could take advantage of the continuous vacuum conditions of the natural space environment. Space testing would provide open boundary conditions without walls, micro-gravity and a realistic thermal environment. Testing on the ISS would allow for direct observation of the test unit, exhaust plume and space-plasma interactions. When necessary, intervention by on-board personnel and post-test inspection would be possible. The ISS can provide electrical power, a location for diagnostic instruments, data handling and thermal control. The platform will be designed to accommodate the side-by-side testing of multiple types of electric thrusters. It is intended to be a permanent facility in which different thrusters can be tested over time. ISS crews can provide maintenance for the platform and change out thruster test units as needed. The primary objective of this platform is to provide a test facility for electric propulsion devices of interest for future exploration missions. These thrusters are expected to operate in the range of hundreds of kilowatts and above. However, a platform with this capability could also accommodate testing of thrusters that require much lower power levels. Testing at the higher power levels would be accomplished by using power fiom storage devices on the platform, which would be gradually recharged by the ISS power generation system. This paper will summarize the results of the preliminary phase of the study with an explanation of the user requirements and the initial conceptual design. The concept for test operations will also be described. The NASA project team is defining the requirements but they will also reflect the inputs of the broader electric propulsion community including those at universities, commercial enterprises and other government laboratories. As a facility on the International Space Station, the design requirements are also intended to encompass the needs of international users. Testing of electric propulsion systems on the space station will help advance the development of systems needed for exploration and could also serve the needs of other customers. Propulsion systems being developed for commercial and military applications could be tested and certification testing of mature thrusters could be accomplished in the space environment.

Author

*Electric Propulsion; Test Facilities; Electrical Engineering; Exhaust Systems*

## 34
## 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*.

**20070018751** NASA Langley Research Center, Hampton, VA, USA, Science Applications International Corp., Hampton, VA, USA

**Preliminary Analysis of Ares I Alternate Launch Abort System (ALAS) Configurations Tested in the Boeing Polysonic Wind Tunnel**

Paulson, John W., Jr.; April 2007; 18 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNL04AA02Z; WBS 843515.02.01.07.03.01.04

Report No.(s): NASA/CR-2007-214877; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018751

A wind tunnel investigation was conducted to investigate the effects of Alternate Launch Abort System (ALAS) Configurations on the aerodynamic characteristics of the Ares I launch vehicle. Recent studies conducted by the ALAS Feasibility Study (Phase I) team headed by Scotti and Camarda, and reported on 5 December 2006, investigated possible alternatives to the baseline Launch Abort System (LAS) for the Orion vehicle. These ALAS configurations are based on developing alternate load paths to transfer the thrust of the abort rocket motor into the base of the Command Module (CM) rather than into the top of the CM.

Author

*Aerodynamic Configurations; Ares 1 Launch Vehicle; Wind Tunnel Tests; Command Modules; Transonic Wind Tunnels; Computational Fluid Dynamics; Abort Trajectories*

**20070018992** Leninetz Holding Co., Saint Petersburg, Russian Federation

**Investigation of Magnetohydrodynamic (MHD) Controlled Inlet with Nonequilibrium MHD Generator**

Kuranov, Alexander L; Dec 2006; 73 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-03-D-0001-0012

Report No.(s): AD-A465270; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465270

This report results from a contract tasking Leninetz Holding Company, NIPGS as follows: The contractor will analytically investigate applying magneto hydrodynamic (MHD) generators to a generic hypersonic inlet. The inlet geometry will be a two-shock inlet with the total turning angle of 15 and designed for Mach 10. The contractor will evaluate the location and configuration of electromagnet coils and electrodes for the MHD system. Flow fields in the MHD controlled inlet will be calculated in 2D Euler approach. Analysis of elementary processes responsible for flow ionization will be assessed. Space distribution for power density deposited in the flow and for conductivity of flow due to e-beam propagation will be calculated, A mathematical model of the MHD-controlled inlet with non-equilibrium MHD generators using e-beams as the ionizer will be developed. Finally, flow fields in the MHD-controlled inlet will be calculated in a wide range of parameters (altitude, Mach number contraction ratio, MHD and ionizer parameters. The main characteristics of the inlet will be determined such as the air mass flow-rate flow compression and total pressure recovery. Requirements for the magnetic system and ionizer, which ensure efficient control of inlet at off-design conditions, will be formulated.

DTIC

*Hypersonic Flow; Magnetohydrodynamic Generators; Magnetohydrodynamics; Nonequilibrium Flow*

**20070018993** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium

**Testing of UHTC Samples in the VKI Plasmatron**

Fletcher, Douglas G; Asma, C; Thoemel, J; Collin, P; Marschall, Jochen; Oct 25, 2006; 22 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-06-1-3078

Report No.(s): AD-A465271; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465271

This report results from a contract tasking Von Karman Institute for Fluid Dynamics (VKI) as follows: The proposed activity involves testing of Ultra-High Temperature Ceramic (UHTC) material samples in the VKI Plasmatron, which is an Inductively-Coupled Plasma (ICP) facility. ICP facilities are electrondeless, so the plasma stream produced for material testing and characterization is of very high purity. The VKI Plasmatron has the largest installed power capability of this type of facility in the world. Test conditions are chosen such that the supersonic atmospheric (re-)entry boundary layer test conditions are replicated in the subsonic flow of the ICP stream. Total enthalpy, pitot pressure, and velocity gradient are the important parameters that are matched to ensure the test condition fidelity. Test condition requirements for the UHTC sample tests are heat flux of approximately 4 MW/squared. pressure of 5000 Pa. and surface temperatures on the order of 1800 C or greater. The actual conditions will be determined using a spare sample to verify the surface temperature. A pitot probe will be used to set the pressure condition and a water-cooled calorimetric probe will be used to measure the fully catalytic cold-wall heat flux, which will be used as the reference heat flux condition for the tests. The supplier of the samples for testing, and the PI for the investigation is Dr. Jochen Marschall of SRI.

DTIC

*Ceramics; Plasmatrons*

**20070019060** Army Tank-Automotive and Armaments Command, Warren, MI USA

**Energy Absorber for Vehicle Occupant Safety and Survivability**

Fox, David M; Mar 22, 2006; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465405; TACOM-15624; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465405

(U) A DESIGN WAS DEVELOPED FOR A NEW TYPE of IMPACT ENERGY ABSORBER. THIS DEVICE WOULD BE EXPECTED to DEMONSTRATE FAVORABLE APPLICATION to VEHICLE OCCUPANT SAFETY IN CRASH and SECONDARY IMPACT EVENTS. SIMULATION DATA INVOLVING IMPACTS BETWEEN AN ANTHROPOMETRIC DUMMY HEAD and THE ABSORBER IS PRESENTED to ILLUSTRATE OCCUPANT PROTECTION PERFORMANCE UNDER VARIOUS IMPACT LOADING CONDITIONS.

DTIC

*Anthropometry; Energy Absorption; Motor Vehicles; Safety*

**20070019199** Southwest Research Inst., San Antonio, TX USA

**Coupled Simulation of Vehicle Dynamics and Tank Slosh**

Thomassy, F A; Wendel, G R; Green, S T; Jank, A C; Sep 2003; 63 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAE07-99-C-L053-WD14

Report No.(s): AD-A465728; TFLRF NO. 368; No Copyright; Avail.: CASI: A04, Hardcopy

Computer simulation of vehicle dynamics has become a valuable tool in the design of vehicles. However it is unable to simulate the complex dynamics of fluid 'sloshing' in a tank on the vehicle. Computational Fluid Dynamics (CFD) analysis software is available that can predict fluid slosh however it does not facilitate computation of the vehicle's mechanical system. This is the second phase of a multiphase program to develop and demonstrate the use of CFD analysis coupled with vehicle dynamics analysis to more accurately predict the dynamics of a fluid transport system. The first phase validated that CFD analysis predicts slosh dynamics of a tank subjected to motions of a vehicle encountering typical maneuvers. The results of this study (phase 2) demonstrated the successful development of subroutines that are integrated into vehicle dynamic and CFD simulation codes.

DTIC

*Computational Fluid Dynamics; Computerized Simulation; Liquid Sloshing; Simulation*

**20070019211** Combustion Research and Flow Technology, Inc., Pipersville, PA USA

**Ship Airwake Sensitivities to Modeling Parameters**

Shipman, Jeremy; Arunajatesan, Srinivasan; Menchini, Christopher; Sinha, Neeraj; Jan 2005; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N68335-03-C-0114

Report No.(s): AD-A465775; No Copyright; Avail.: CASI: A03, Hardcopy

Accurate models for the prediction of ship airwake flowfields are critical to the development of realistic flight simulation tools for aircraft carrier launch and recovery operations. The accurate computation of the ship airwake can be very challenging due to the complexity of the ship geometry, the size of and difficulty in generating a suitable computational mesh, and the large range of length and time scales present in the unsteady flowfield. The present paper investigates the sensitivity of the airwake solution to several modeling parameters, including geometric complexity and the resolution of boundary layers, with the aim of determining the level of fidelity required to obtain an accurate solution. Results are compared to wind tunnel experimental measurements. The results of these studies show that, in general, a majority of the airwake flow features are characterized by bluff body shedding from the larger geometric entities that comprise the ship geometry. Depending on the requirements and intended use of the solution, a certain tradeoff can be reached between solution turn-around/grid generation time and solution accuracy.

DTIC

*Flow Distribution; Independent Variables; Models; Ships; Wakes*

**20070019212** Combustion Research and Flow Technology, Inc., Pipersville, PA USA

**Scramjet Propulsive Flowpath Prediction Improvements Using Recent Modeling Upgrades**

Ott, James D; Kannepalli, C; Brinckman, K; Dash, S M; Jan 2005; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465776; No Copyright; Avail.: CASI: A03, Hardcopy

Reynolds Averaged Navier Stokes simulations have been performed to examine modeling upgrades for scramjet flowpath predictions. A flush, non-reacting hydrogen fuel injector flowfield was used as the model problem, and an LES simulation of the problem was used for comparison purposes. Calculations were first performed examining the effect of Schmidt number with a constant Prandtl number. Next the effect of the compressibility correction used was examined. These findings indicated that for this injector configuration, the effect of the compressibility had a major impact on the solution, and that the average Schmidt number of about 0.45 compared closely to the LES simulation results. Next, a new scalar fluctuation model was used to obtain local values of Prandtl and Schmidt number whose values were found to vary significantly across the fuel jet mixing layer. The turbulent Prandtl number was found to vary between 0.4 to 0.9, and the turbulent Schmidt number varied from 0.6 to 1.2. Finally, a comparison was performed using an unstructured flow solver with grid adaptation. This technique is now being used to obtain grid resolved solutions in a systematic and straightforward manner in our design studies.

DTIC

*Flow Distribution; Models; Supersonic Combustion Ramjet Engines*

**20070019295** NASA Langley Research Center, Hampton, VA, USA

**Wall Boundary Layer Measurements for the NASA Langley Transonic Dynamics Tunnel**

Wieseman, Carol D.; Bennett, Robert M.; April 2007; 136 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): WBS 561581.02.08

Report No.(s): NASA/TM-2007-214867; L-19248; No Copyright; Avail.: CASI: A07, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019295

Measurements of the boundary layer parameters in the NASA Langley Transonic Dynamics tunnel were conducted during extensive calibration activities following the facility conversion from a Freon-12 heavy-gas test medium to R-134a. Boundary-layer rakes were mounted on the wind-tunnel walls, ceiling, and floor. Measurements were made over the range of tunnel operation envelope in both heavy gas and air and without a model in the test section at three tunnel stations. Configuration variables included open and closed east sidewall wall slots, for air and R134a test media, reentry flap settings, and stagnation pressures over the full range of tunnel operation. The boundary layer thickness varied considerably for the six rakes. The thickness for the east wall was considerably larger that the other rakes and was also larger than previously reported. There generally was some reduction in thickness at supersonic Mach numbers, but the effect of stagnation pressure, and test medium were not extensive.

Author

*Boundary Layers; Transonic Wind Tunnels; Wind Tunnel Walls; Test Chambers*

## 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*.

**20070018749** NASA Marshall Space Flight Center, Huntsville, AL, USA

**JWST Lightweight Mirror TRL-6 Results**

Stahl, H. Philip; [2007]; 13 pp.; In English; 2007 IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018749

Mirror technology for a Primary Mirror Segment Assembly (PMSA) is a system of components: reflective coating; polished optical surface; mirror substrate; actuators, mechanisms and flexures; and reaction structure. The functional purpose of a PMSA is to survive launch, deploy and align itself to form a 25 square meter collecting area 6.5 meter diameter primary mirror with a 131 nm rms wavefront error at temperatures less than 50K and provide stable optical performance for the anticipated thermal environment. At the inception of JWST in 1996, such a capability was at a Technology Readiness Level (TRL) of 3. A highly successful technology development program was initiated including the Sub-scale Beryllium Mirror Demonstrator (SBMD) and Advanced Mirror System Demonstrator (AMSD) projects. These projects along with flight program activities have matured mirror technology for JWST to TRL-6. A directly traceable prototype (and in some cases the flight hardware itself) has been built, tested and operated in a relevant environment.

Author

*Mirrors; Technology Assessment; James Webb Space Telescope; Fabrication*

**20070018756** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Fourier-Kelvin Stellar Interferometer (FKSI) Nulling Testbed II: Closed-loop Path Length Metrology And Control Subsystem**

Frey, B. J.; Barry, R. K.; Danchi, W. C.; Hyde, T. T.; Lee, K. Y.; Martino, A. J.; Zuray, M. S.; [2006]; 8 pp.; In English; SPIE Astronomical Telescopes and Instruments Conference, 24-31 May 2006, Orlando, FL, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018756

The Fourier-Kelvin Stellar Interferometer (FKSI) is a mission concept for an imaging and nulling interferometer in the near to mid-infrared spectral region (3-8 microns), and will be a scientific and technological pathfinder for upcoming missions including TPF-I/DARWIN, SPECS, and SPIRIT. At NASA's Goddard Space Flight Center, we have constructed a symmetric Mach-Zehnder nulling testbed to demonstrate techniques and algorithms that can be used to establish and maintain the 10(exp 4) null depth that will be required for such a mission. Among the challenges inherent in such a system is the ability to acquire

and track the null fringe to the desired depth for timescales on the order of hours in a laboratory environment. In addition, it is desirable to achieve this stability without using conventional dithering techniques. We describe recent testbed metrology and control system developments necessary to achieve these goals and present our preliminary results.
Author
*Control Systems Design; Feedback Control; Metrology; Interferometers; Fourier Analysis; Imaging Techniques*

**20070018805** NASA Marshall Space Flight Center, Huntsville, AL, USA
**James Webb Space Telescope: The First Light Machine**
Stahl, H. Philip; [2007]; 12 pp.; In English; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018805

Scheduled to begin its 10 year mission no sooner than 2013, the James Webb Space Telescope (JWST) will search for the first luminous objects of the Universe to help answer fundamental questions about how the Universe came to look like it does today. At 6.5 meters in diameter, JWST will be the world's largest space telescope. This talk reviews science objectives for JWST and how they drive the JWST architecture, e.g. aperture, wavelength range and operating temperature. Additionally, the talk provides an overview of the JWST primary mirror technology development and fabrication status.
Author
*James Webb Space Telescope; Fabrication; Technology Utilization; Space Missions*

**20070018851** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Temperature-dependent Absolute Refractive Index Measurements of Synthetic Fused Silica**
Leviton, Douglas B.; Frey, Bradley J.; [2006]; 11 pp.; In English; SPIE Astronomical Telescopes and Instruments Conference, 24-31 May 2006, Orlando, FL, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018851

Using the Cryogenic, High-Accuracy Refraction Measuring System (CHARMS) at NASA's Goddard Space Flight Center, we have measured the absolute refractive index of five specimens taken from a very large boule of Corning 7980 fused silica from temperatures ranging from 30 to 310 K at wavelengths from 0.4 to 2.6 microns with an absolute uncertainty of plus or minus 1 x 10 (exp -5). Statistical variations in derived values of the thermo-optic coefficient (dn/dT) are at the plus or minus 2 x 10 (exp -8)/K level. Graphical and tabulated data for absolute refractive index, dispersion, and thermo-optic coefficient are presented for selected wavelengths and temperatures along with estimates of uncertainty in index. Coefficients for temperature-dependent Sellmeier fits of measured refractive index are also presented to allow accurate interpolation of index to other wavelengths and temperatures. We compare our results to those from an independent investigation (which used an interferometric technique for measuring index changes as a function of temperature) whose samples were prepared from the same slugs of material from which our prisms were prepared in support of the Kepler mission. We also compare our results with sparse cryogenic index data from measurements of this material from the literature.
Author
*Refractivity; Silica Glass; Temperature Dependence; Cryogenics; Photometers*

**20070019153** Air Force Research Lab., Wright-Patterson AFB, OH USA
**Helmet Tracker Requirements and Measurement Verification**
Martinsen, Gary; Shattuck, Judson; Craig, Jeffrey; Feb 2007; 22 pp.; In English
Contract(s)/Grant(s): Proj-7184
Report No.(s): AD-A465624; AFRL-HE-WP-TR-2007-0017; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465624

A helmet tracker is a critical element in the path that delivers targeting and other sensor data to the user of a helmet-mounted display (HMD) in a military aircraft. This paper reviews helmet tracker technology with respect to use in military aviation. The human factors limitations of helmet tracker systems for delivering both targeting and flight reference information to a military pilot are also discussed. This paper also presents data collected from the Dynamic Tracker Test Apparatus (DTTA). The DTTA was designed by the Helmet Mounted Sensory Technology (HMST) laboratory to accurately measure azimuth rotation in both static and dynamic conditions.
DTIC
*Dynamic Tests; Helmet Mounted Displays; Helmets; Human Factors Engineering; Position Sensing*

## 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*.

**20070018766** Massachusetts Inst. of Tech., Cambridge, MA, USA
**1.9 THz Quantum-cascade Lasers with One-well Injector**
Kumar, Sushil; Williams, Benjamin S.; Hu, Qing; Reno, John L.; Applied Physics Letters; March 24, 2006; ISSN 0003-6951; Volume 88; 6 pp.; In English
Contract(s)/Grant(s): DE-AC04-94AL85000; NNG04GC11G; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1063/1.2189671

We report terahertz quantum-cascade lasers operating predominantly at 1.90 THz with side modes as low as 1.86 THz (lambda approx. equal to 161 micrometers, planck's constant omega approx. equal to 7.7 meV). This is the longest wavelength to date of any solid-state laser that operates without assistance of a magnetic field. Carriers are injected into the upper radiative state by using a single quantum-well injector, which resulted in a significant reduction of free-carrier losses. The laser operated up to a heat-sink temperature of 110 K in pulsed mode, 95 K in continuous wave (cw) mode, and the threshold current density at 5 K was approx. 140 A per square centimeters.
Author
*Injectors; Quantum Cascade Lasers; Quantum Wells; Continuous Radiation*

**20070019004** European Office of Aerospace Research and Development, FPO New York, NY USA
**Towards Resonant-State THz Laser Based on Strained p-Ge and SiGe QW Structures**
Solomonovich, Kagan M; Jul 2006; 57 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465287; ISTC-2206P; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465287

The main focus of the project is to investigate the possibilities for population inversion between two-dimensional (2D) acceptor states and THz lasing in strained selectively doped SiGe quantum well (QW) structures, as well as the microscopic mechanism of a population inversion in resonant-state p-Ge laser (RSL) and conditions for continuous-wave (cw) operation of RSL and its parameters (the radiation spectrum, the range of frequency tuning, the output power, and the interval of working temperature) in this regime. For this purpose it is proposed: 1. to study the formation of resonant acceptor states; to determine energy spectrum of 2D shallow acceptor states in QWs (as a function of electric field, QW width, doping level, alloy composition, and impurity center position), and 3D resonant acceptor states in p-Ge under stress (as a function of strain); 2. to study radiative transitions between resonant and localized shallow acceptor states split by size quantization and strain in 2D and by stress in 3D; to investigate the possibilities for population inversion between split-off and ground states; 3. to study effect of electric field heating of holes on transport phenomena and THz luminescence; 4. to calculate carrier life times of resonant states, the probability of coherent capture and re-emission processes by resonant states as well as elastic resonant scattering in doped strained 2D structures and in strained bulk p-Ge; to calculate the probabilities of optical transitions between 2D resonant and local states of impurities; 5. to calculate hot-carrier distribution function taking into account resonant-state scattering and to develop theoretical models of population inversion.
DTIC
*Lasers; Lasing; Quantum Wells; Resonance*

## 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*.

**20070018745** NASA Glenn Research Center, Cleveland, OH, USA
**Investigation of Current Methods to Identify Helicopter Gear Health**
Dempsey, Paula J.; Lewicki, David G.; Le, Dy D.; [2007]; 14 pp.; In English; Aging Aircraft 2007, 16-19 Apr. 2007, Palm Springs, CA, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018745

This paper provides an overview of current vibration methods used to identify the health of helicopter transmission gears. The gears are critical to the transmission system that provides propulsion, lift and maneuvering of the helicopter. This paper reviews techniques used to process vibration data to calculate conditions indicators (CI s), guidelines used by the government aviation authorities in developing and certifying the Health and Usage Monitoring System (HUMS), condition and health indicators used in commercial HUMS, and different methods used to set thresholds to detect damage. Initial assessment of a method to set thresholds for vibration based condition indicators applied to flight and test rig data by evaluating differences in distributions between comparable transmissions are also discussed. Gear condition indicator FM4 values are compared on an OH58 helicopter during 14 maneuvers and an OH58 transmission test stand during crack propagation tests. Preliminary results show the distributions between healthy helicopter and rig data are comparable and distributions between healthy and damaged gears show significant differences.
Author
*Helicopter Propeller Drive; Gears; Crack Propagation; Transmissions (Machine Elements); Systems Health Monitoring; Flight Tests; Damage; Certification; Vibration*

**20070018754** NASA Langley Research Center, Hampton, VA, USA
**Blocked Force and Loading Calculations for LaRC THUNDER Actuators**
Campbell, Joel F.; May 2007; 19 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): WU 810031.07.03
Report No.(s): NASA/TM-2007-214875; L-19356; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018754

An analytic approach is developed to predict the performance of LaRC Thunder actuators under load and under blocked conditions. The problem is treated with the Von Karman non-linear analysis combined with a simple Raleigh-Ritz calculation. From this, shape and displacement under load combined with voltage are calculated. A method is found to calculate the blocked force vs voltage and spring force vs distance. It is found that under certain conditions, the blocked force and displacement is almost linear with voltage. It is also found that the spring force is multivalued and has at least one bifurcation point. This bifurcation point is where the device collapses under load and locks to a different bending solution. This occurs at a particular critical load. It is shown this other bending solution has a reduced amplitude and is proportional to the original amplitude times the square of the aspect ratio.
Author
*Critical Loading; Numerical Analysis; Piezoelectric Actuators; Nonlinear Equations; Blocking*

**20070018755** NASA Glenn Research Center, Cleveland, OH, USA
**Innovative Multi-Environment, Multimode Thermal Control System**
Singh, Bhim S.; Hasan, Mohammad H.; [2007]; 5 pp.; In English; International Conference on Environmental Systems, 9-12 Jul. 2007, Chicago, IL; Original contains color illustrations
Contract(s)/Grant(s): WBS 119103.04.01.03.03
Report No.(s): 07ICES-53; Copyright; Avail.: Other Sources

Innovative multi-environment multimode thermal management architecture has been described that is capable of meeting widely varying thermal control requirements of various exploration mission scenarios currently under consideration. The proposed system is capable of operating in a single-phase or two-phase mode rejecting heat to the colder environment, operating in a two-phase mode with heat pump for rejecting heat to a warm environment, as well as using evaporative phasechange cooling for the mission phases where the radiator is incapable of rejecting the required heat. A single fluid loop can be used internal and external to the spacecraft for the acquisition, transport and rejection of heat by the selection of a working fluid that meets NASA safety requirements. Such a system may not be optimal for each individual mode of operation but its ability to function in multiple modes may permit global optimization of the thermal control system. The architecture also allows flexibility in partitioning of components between the various Constellation modules to take advantage of operational requirements in various modes consistent with the mission needs. Preliminary design calculations using R-134 as working fluid show the concept to be feasible to meet the heat rejection requirements that are representative of the Crew Exploration Vehicle and Lunar Access Module for nominal cases. More detailed analyses to establish performance under various modes and environmental conditions are underway.
Author
*Temperature Control; Control Systems Design; Multiphase Flow; Modes; Thermal Environments; Spacecraft Environments*

**20070018847** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Design of Low Power CMOS Read-Out with TDI Function for Infrared Linear Photodiode Array Detectors**

Vizcaino, Paul; Ramirez-Angulo, Jaime; Patel, Umesh D.; [2007]; 4 pp.; In English; 2007 International Symposium on Circuits and Systems, 27-30 May 2007, New Orleans, LA, USA; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

A new low voltage CMOS infrared readout circuit using the buffer-direct injection method is presented. It uses a single supply voltage of 1.8 volts and a bias current of 1uA. The time-delay integration technique is used to increase the signal to noise ratio. A current memory circuit with faulty diode detection is used to remove dark current for background compensation and to disable a photodiode in a cell if detected as faulty. Simulations are shown that verify the circuit that is currently in fabrication in 0.5ym CMOS technology.

Author

*CMOS; Fabrication; Linear Arrays; Photodiodes; Readout; Low Voltage; Mechanical Engineering; Time Lag; Infrared Detectors; Infrared Radiation*

**20070018867** NASA Johnson Space Center, Houston, TX, USA

**International Space Station (ISS) Carbon Dioxide Removal Assembly (CDRA) Desiccant/Adsorbent Bed (DAB) Orbital Replacement Unit (ORU) Redesign**

Reysa, Richard P.; Lumpkin, John P.; Sherif, Dian El; Kay, Robert; Williams, David E.; [2007]; 8 pp.; In English; 37th International Conference on Environmental, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): 401769.06.01.01.01

Report No.(s): 07ICES-307; Copyright; Avail.: Other Sources

The Carbon Dioxide Removal Assembly (CDRA) is a part of the International Space Station (ISS) Environmental Control and Life Support (ECLS) system. The CDRA provides carbon dioxide (CO2) removal from the ISS on-orbit modules. Currently, the CDRA is the secondary removal system on the ISS, with the primary system being the Russian Vozdukh. Within the CDRA are two desiccant/adsorbent beds (DAB), which perform the carbon dioxide removal function. The DAB adsorbent containment approach required improvements with respect to adsorbent containment. These improvements were implemented through a redesign program and have been implemented on units returning from orbit. This paper presents a DAB design modification implementation description, a hardware performance comparison between the unmodified and modified DAB configurations, and a description of the modified DAB hardware implementation into the on-orbit CDRA.

Author

*Adsorbents; Carbon Dioxide Removal; Desiccants; International Space Station; Beds (Process Engineering); Mechanical Engineering; Technology Utilization*

**20070018943** Georgia Inst. of Tech., Atlanta, GA USA

**Magnetic Induction Machines Embedded in Fusion-Bonded Silicon**

Arnold, David P; Cros, Florent; Zana, Iulica; Allen, Mark G; Das, Sauparna; Lang, Jeffrey H; Jun 2004; 5 pp.; In English

Contract(s)/Grant(s): DAAD19-01-2-0010; DAAG55-98-1-0292

Report No.(s): AD-A465137; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465137

This paper presents the design, fabrication, and characterization of laminated, magnetic induction machines intended for high-speed, high-temperature, high-power-density microengine power generation systems. Innovative fabrication techniques were used to embed electroplated materials (Cu, Ni80Fe20, Co65Fe18Ni17) within etched and fusion-bonded silicon to form the machine structure. The induction machines were characterized in motoring mode using tethered rotors, and exhibited a maximum measured torque of 2.5 N m and a projected torque density of 340 N-m/m3.

DTIC

*Embedding; Magnetic Induction; Silicon*

**20070019276** Research and Technology Organization, Neuilly-sur-Seine, France

**Performance Prediction and Simulation of Gas Turbine Engine Operation for Aircraft, Marine, Vehicular, and Power Generation**

FROM; February 2007; 652 pp.; In English; Original contains color illustrations

Report No.(s): RTO-TR-AVT-036; AC/323(AVT-036)TP/106; Copyright; Avail.: CASI: C01, CD-ROM: A99, Hardcopy

A Technical Team of the NATO RTO has created a report on gas turbine simulation, ranging from applications to latest methodology of modeling techniques for gas turbine propulsion applications. The report includes examples of how gas turbine numerical simulations have been utilized for aircraft, marine, and vehicular propulsion applications. The major numerical simulation presented in the report is the gas turbine engine cycle code which provides performance for both steady state and transient operation. In addition to examples of how cycle codes are used, an in-depth discussion of how cycle codes are constructed and what basic assumptions are involved is given in the report. Additional higher order and specific numerical simulations for component design and operation are presented in the appendices to this report. Present computer platforms in use for such models are reviewed, and an outlook on development is given. The report aims at increasing the use and the value of engine computer simulations in NATO Nations and NATO s design and use of engines.
Author
*Computerized Simulation; Gas Turbine Engines; Performance Prediction; Propulsive Efficiency; Mathematical Models*

## 39
## STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

**20070018866** NASA Langley Research Center, Hampton, VA, USA
**Structural Analysis of the Redesigned Ice/Frost Ramp Bracket**
Phillips, D. R.; Dawicke, D. S.; Gentz, S. J.; Roberts, P. W.; Raju, I. S.; [2007]; 26 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS1-00135
Report No.(s): AIAA Paper 2007-2271; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018866

This paper describes the interim structural analysis of a redesigned Ice/Frost Ramp bracket for the Space Shuttle External Tank (ET). The proposed redesigned bracket consists of mounts for attachment to the ET wall, supports for the electronic/instrument cables and propellant repressurization lines that run along the ET, an upper plate, a lower plate, and complex bolted connections. The eight nominal bolted connections are considered critical in the summarized structural analysis. Each bolted connection contains a bolt, a nut, four washers, and a non-metallic spacer and block that are designed for thermal insulation. A three-dimensional (3D) finite element model of the bracket is developed using solid 10-node tetrahedral elements. The loading provided by the ET Project is used in the analysis. Because of the complexities associated with accurately modeling the bolted connections in the bracket, the analysis is performed using a global/local analysis procedure. The finite element analysis of the bracket identifies one of the eight bolted connections as having high stress concentrations. A local area of the bracket surrounding this bolted connection is extracted from the global model and used as a local model. Within the local model, the various components of the bolted connection are refined, and contact is introduced along the appropriate interfaces determined by the analysts. The deformations from the global model are applied as boundary conditions to the local model. The results from the global/local analysis show that while the stresses in the bolts are well within yield, the spacers fail due to compression. The primary objective of the interim structural analysis is to show concept viability for static thermal testing. The proposed design concept would undergo continued design optimization to address the identified analytical assumptions and concept shortcomings, assuming successful thermal testing.
Author
*External Tanks; Frost; Ice; Structural Analysis; Space Shuttles; Mathematical Models; Brackets*

**20070019175** CH2M/Hill, Inc., Salt Lake City, UT USA
**Environmental Assessment for a Two-Story Addition to Building 503 -- Hydraulic Flight Controls Lean Transformation**
Winn, Kay; Hill, Staci; Lee, Josephine; Longley-Cook, Wendy; Johnson, Sam; Mar 2007; 57 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F42620-00-D0028
Report No.(s): AD-A465684; XC-75CEG/CEVOR; No Copyright; Avail.: CASI: A04, Hardcopy

The current configuration of the hydraulic/pneudraulic repair facility at Hill Air Force Base (AFB) is restricted in the types

of weapon systems it supports and the amount of work that can be accomplished there. Hill AFB requires a facility that would accommodate increased workload capacity and adapt to changes in workload mix. The project involves constructing a two-story addition (10,000 square feet per floor) on the north side of Building 503. The addition will be outfitted with state-of-the-art equipment and the repair process and layout will be transformed in accordance with lean manufacturing concepts. Following federal regulations, this Environmental Assessment (EA) has been designed and written to do the following: (1) provide the Air Force with sufficient information to make informed reasoned decisions concerning the construction of the Two-Story Addition to Building 503, and (2) inform members of the affected and interested public of this project so that they may express their opinions to the Air Force. The document has been developed and organized to provide the reader with sufficient information to understand the issues to be addressed, the environment in which these issues arise, and the social and environmental consequences of these actions. The chapters are written so that nontechnical readers can understand the potential environmental consequences of each of the alternatives. The findings of this environmental assessment indicate that the Proposed Action to construct a two-story addition on the north side of Building 503 will not have significant adverse effects on the human environment or any of the environmental resources as described in the environmental assessment. Therefore, it is concluded that the issuance of a Finding of No Significant Impact is justified.
DTIC
*Buildings; Construction; Flight Control; Hydraulic Equipment; Maintenance; Military Air Facilities; Shops*

## 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*.

**20070019370** California Univ., Los Angeles, CA, USA
**Early Archean Spherule Beds: Chromium Isotopes Confirm Origin through Multiple Impacts of Projectiles of Carbonaceous Chondrite Type: Comment and Reply**
Kyte, Frank T.; Geology; November 2003; Volume 31, Issue 6, pp. 282-286; In English
Contract(s)/Grant(s): NAG5-12895; Copyright; Avail.: Other Sources

This is a exchange in the form of a comment and a reply in regards to an earlier article. The authors of the original article, consider it likely that virtually all of the projectile will condense with the silicate fraction, resulting in very little platinum group element fractionation in the final ejecta deposit. Further, we find no evidence in the commentator's, (i.e., Glikson), comment to support vapor fractionation. We note that the Pd/Ir ratios of published data on 2.56 Ga Hamersley Basin spherules are all greater than in chondrites, contrary to the assertion by Glikson. This is consistent with relatively high Pd concentrations (and Pd/Ir ratios) in crustal rocks.
CASI
*Carbonaceous Chondrites; Precambrian Period; Spherules; Projectiles; Meteoritic Composition*

## 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*.

**20070018757** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Spatial and Temporal Distribution of Cloud Properties Observed by MODIS: Preliminary Level-3 Results from the Collection 5 Reprocessing**
King, Michael D.; Platnick, Steven; Hubanks, Paul; Pincus, Robert; [2006]; 1 pp.; In English; AMS 12th Conference on Atmospheric Radiation, 10-14 Jul. 2006, Madison, WI, USA; Copyright; Avail.: Other Sources; Abstract Only

The Moderate Resolution Imaging Spectroradiometer (MODIS) was developed by NASA and launched onboard the Terra spacecraft on December 18, 1999 and Aqua spacecraft on May 4, 2002. It achieved its final orbit and began Earth observations on February 24, 2000 for Terra and June 24, 2002 for Aqua. A comprehensive set of operational algorithms for the retrieval of cloud physical and optical properties (optical thickness, effective particle radius, water path, thermodynamic phase) have recently been updated and are being used in the new 'Collection 5' processing stream being produced by the MODIS Adaptive Processing System (MODAPS) at NASA GSFC. All Terra and Aqua data are undergoing Collection 5 reprocessing with an

expected completion date by the end of 2006. The archived products from these algorithms include 1 km pixel-level (Level-2) and global gridded Level-3 products. The cloud products have applications in climate change studies, climate modeling, numerical weather prediction, as well as fundamental atmospheric research. In this talk, we will summarize the available Level-3 cloud properties and their associated statistical data sets, and show preliminary Terra and Aqua results from the available Collection 5 reprocessing effort. Anticipated results include the latitudinal distribution of cloud optical and radiative properties for both liquid water and ice clouds, as well as joint histograms of cloud optical thickness and effective radius for selected geographical locations around the world.
Author
*Cloud Physics; Spatial Distribution; Temporal Distribution; MODIS (Radiometry); Climate Models*

**20070018849** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Acquiring Comprehensive Observations using an integrated Sensorweb for Early Warning**
Habib, Shahid; Ambrose, Steve; [2006}; 1 pp.; In English; Third International Conference on Early Warning (EWC III), 27-29 Mar. 2006, Bonn, Germany; 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 pre-requisite 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
*Early Warning Systems; Sensors; Systems Integration; Earth Sciences*

**20070018852** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Promoting Lifelong Ocean Education: Shaping Tomorrow's Earth Stewards and the Science and Technology Workforce**
Meeson, Blanche; [2006]; 1 pp.; In English; Education: Weather, Oceans, Climate (EWOC 2006) Conference, 3-7 Jul. 2006, Boulder, CO, USA; No Copyright; Avail.: Other Sources; Abstract Only

The coming ocean observing systems provide an unprecedented opportunity to change both the public perception of our oceans, and to inspire, captivate and motivate our children, our young adults and even our fellow adults to pursue careers allied with the oceans and to become stewards of our Planet's last unexplored environment. Education plans for the operational component, the Integrated Ocean Observing System (IOOS), and for the research component, Ocean Research Interactive Observatory Networks (ORION), are designed to take advantage of this opportunity. In both cases, community recommendations were developed within the context of the following assumptions: 1. Utilize research on how people learn, especially the four-pronged model of simultaneous learner-centered, knowledge-center, assessment-centered and community-centered learning 2. Strive for maximum impact on national needs in science and technology learning 3. Build on the best of what is already in place 4. Pay special attention to quality, sustainability, and scalability of efforts 5. Use partnerships across federal, state and local government, academia, and industry. Community recommendations for 100s and ORION education

have much in common and offer the opportunity to create a coherent education effort allied with ocean observing systems. Both efforts focus on developing the science and technology workforce of the future, and the science and technology literacy of the public within the context of the Earth system and the role of the oceans and Great Lakes in that system. Both also recognize that an organized education infrastructure that supports sustainability and scalability of education efforts is required if ocean observing education efforts are to achieve a small but measurable improvement in either of these areas. Efforts have begun to develop the education infrastructure by beginning to form a community of educators from existing ocean and aquatic education networks and by exploring needs and issues associated with using ocean observing information assets in education. Likewise efforts are underway to address workforce issues by a systematic analysis of current and future workforce and educational needs. These activities will be described as will upcoming opportunities for the community to participate in these efforts.
Author
*Earth Sciences; Education; Oceans; Technologies; Networks; Occupation*

**20070019357** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Skin Temperature Analysis and Bias Correction in a Coupled Land-Atmosphere Data Assimilation System**
Bosilovich, Michael G.; Radakovich, Jon D.; daSilva, Arlindo; Todling, Ricardo; Verter, Frances; August 08, 2006; 55 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A04, Hardcopy

In an initial investigation, remotely sensed surface temperature is assimilated into a coupled atmosphere/land global data assimilation system, with explicit accounting for biases in the model state. In this scheme, an incremental bias correction term is introduced in the model's surface energy budget. In its simplest form, the algorithm estimates and corrects a constant time mean bias for each gridpoint; additional benefits are attained with a refined version of the algorithm which allows for a correction of the mean diurnal cycle. The method is validated against the assimilated observations, as well as independent near-surface air temperature observations. In many regions, not accounting for the diurnal cycle of bias caused degradation of the diurnal amplitude of background model air temperature. Energy fluxes collected through the Coordinated Enhanced Observing Period (CEOP) are used to more closely inspect the surface energy budget. In general, sensible heat flux is improved with the surface temperature assimilation, and two stations show a reduction of bias by as much as 30 Wm(sup -2) Rondonia station in Amazonia, the Bowen ratio changes direction in an improvement related to the temperature assimilation. However, at many stations the monthly latent heat flux bias is slightly increased. These results show the impact of univariate assimilation of surface temperature observations on the surface energy budget, and suggest the need for multivariate land data assimilation. The results also show the need for independent validation data, especially flux stations in varied climate regimes.
Author
*Bias; Atmospheric Correction; Remote Sensing; Land Surface Temperature; Mathematical Models; Data Systems; Skin Temperature (Non-Biological)*

## 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*.

**20070018982** North Carolina State Univ., Raleigh, NC USA
**Collaborative Protection and Control Schemes for Shipboard Electrical Systems**
Baran, Mesut; Mar 26, 2007; 35 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-03-1-0817; Proj-06PR02443-00
Report No.(s): AD-A465251; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465251

This proiect aimed at the development of new protection and configuration management schemes for the next generation DC zonal shipboard electrical systems (DC SES). The research has demonstrated the feasibility of two new options for the protections devices. First approach uses the Voltage Source Converters, and the second approach uses the new solid-state based protection devices (SSPD) for limiting and interrupting the fault currents. Then, a new 'agent' based protection scheme using these new devices has been developed for effective protection of DC SES. It has been shown that these protection agents, which are associated with protection devices, can detect and isolate the faults very fast - less than 3-4 ms. Second part of the research has focused on the main design issues related to configuration management on DC SES after a fault, and a new

scheme has been developed. The method uses the protection agents to localize the fault fast and thus assure continuity of supply to the critical loads even under battle damage conditions.
DTIC
*Configuration Management; Electric Equipment; Protection*

**20070019031** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**Selecting Electricity Generation Sources in Remote Locations**
Kwan, Kelly E; Mar 2007; 159 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465329; AFIT/GEM/ENV/07-M7; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465329

The purpose of this research was to investigate the impact of using a decision analysis technique for the selection of an electrical generation system for remote locations. Specifically, this thesis sought to answer five research questions addressing the types of energy sources used in remote locations, the decision-making processes used to identify these sources, the types of constraints incorporated in such a process, other valued factors, and their level of importance in relation to each other. The research questions were answered through a comprehensive literature review and the 10-Step Value-Focused Thinking Process on a specific case study in the National Park Service. Decision makers comprising of the National Park staff offered their input into the execution of this process. Electrical system manufacturers and distributors were also consulted as subject matter experts. The research identified several electrical alternatives that are currently being used by remote locations around the world. However, the decision process used to make such selections were undisclosed. A value-focused thinking model indicated the highest scoring electrical alternative based on constraints and factors provided decision makers. Limitations and assumptions applied to the model further highlighted the significant details. The culmination of this effort was the introduction of a decision analysis technique to provide valuable information for the selection of electrical systems in remote locations. The implication of this study is the distribution of this technique to inhabitants in other isolated areas for effective decisions.
DTIC
*Electric Generators; Electricity; Position (Location)*

**20070019066** New Mexico Univ., Albuquerque, NM USA
**Basic Research Leading to Compact, Portable Pulsed Power**
Schamiloglu, Edl; Schoenbach, Karl; Vidmari, Robert; Mar 31, 2007; 34 pp.; In English
Contract(s)/Grant(s): F49620-01-1-0354
Report No.(s): AD-A465430; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465430

Pulsed power is a technology that is suited to drive electrical loads requiring very large power pulses in short bursts (high-peak power). Certain applications require technology that can be deployed in small spaces under stressful environments, e.g., on a ship, vehicle, or aircraft. In 2001, the U.S. Department of Defense (DoD) launched a long-range (five-year) Multidisciplinary University Research Initiative (MURI) to study fundamental issues for compact pulsed power. This research program endeavored to: 1) introduce new materials for use in pulsed power systems; 2) examine alternative topologies for compact pulse generation; 3) study pulsed power switches, including pseudospark switches; and 4) investigate the basic physics related to the generation of pulsed power, such as the behavior of liquid dielectrics under intense electric field conditions. This final technical report reviews the advances put forth by the researchers in this consortium and will assess the potential impact for future development of compact pulsed power systems. The progress made over the final 18 months of the program is emphasized.
DTIC
*Pulse Generators; Research*

**20070019154** Carnegie-Mellon Univ., Pittsburgh, PA USA
**Cognitive Approaches to Automated Engineering Design**
Cagan, Jonathan; Kotovsky, Kenneth; Jan 2, 2007; 5 pp.; In English
Contract(s)/Grant(s): FA9550-04-1-0201; Proj-2304
Report No.(s): AD-A465633; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465633

This project set out to explore fundamental cognitive-based mechanisms in design innovation. Its emphasis focused on the organizational basis to support innovation. Our approach combined cognitive studies, agent-based computational

simulations, and modeling of the design process. Fundamentally our work provides the basis to better understand the innovation process and to development methods to improve that process. The original goal of the project was to explore both fundamental cognitive mechanisms for creative design and computational tools that would enable engineers to improve their design process through intelligent agent-based strategies (using some findings from the cognitive work). Due to a reduced budget and new emphasis for the AFOSR program, the cognitive work was de-emphasized while the agent-based work was pursued. An organization's design- the structuring of its resources and flows of knowledge- is an important element determining its effectiveness.
DTIC
*Cognition; Creativity; Electromechanical Devices*

**20070019203** Georgia Inst. of Tech., Atlanta, GA USA
**Optimization of a Microscale, Axial-Flux, Permanent-Magnet Generator**
Arnold, D P; Zana, I; Herrault, F; Galle, P; Park, J; Das, S; Lang, J H; Allen, M G; Jan 2005; 5 pp.; In English
Contract(s)/Grant(s): DAAD19-01-2-0010
Report No.(s): AD-A465738; No Copyright; Avail.: CASI: A01, Hardcopy

This paper presents the design optimization and characterization of a microscale, permanent-magnet (PM) generator, capable of supplying 8 W of DC power to a resistive load at a rotational speed of 305,000 rpm. The generator is a three-phase, axial-flux, PM machine, consisting of a stator with Cu surface windings and a multi-pole SmCo PM rotor. Optimization of the machine geometries have resulted in a 30% improvement in power density over a previously reported machine (at 120,000 rpm). Furthermore, these design improvements in combination with higher rotational speeds has enabled a \g7x improvement in total output power and a net power density of 59 W/cu cm.
DTIC
*Electric Generators; Finite Element Method; Mathematical Models; Optimization; Permanent Magnets*

**20070019265** Georgia Inst. of Tech., Atlanta, GA USA
**A Self-Contained, Flow-Powered Microgenerator System**
Arnold, D P; Galle, P; Herrault, F; Das, S\g; Lang, J H; Allen, M G; Jan 2005; 4 pp.; In English
Contract(s)/Grant(s): DAAD19-01-2-0010
Report No.(s): AD-A465699; No Copyright; Avail.: CASI: A01, Hardcopy

This paper reports the development of a fully functional self-contained microgenerator system which can power various portable electronics using only compressed gas. The system incorporates a previously reported axial-flux. permanent-magnet micromachine. an off-the-shelf air-turbine assembly. and self-powered electronics into a compact, standalone device. The purpose is to demonstrate the migration of a MEMS-based microgenerator from a bench-top laboratory experiment to a self-contained prototype for practical applications.
DTIC
*Generators; Permanent Magnets; Compressed Gas; Prototypes*

**20070019279** Army Tank-Automotive Research and Development Command, Warren, MI USA
**U.S. Army RDECOM/TARDEC Fuel Cell Overview**
Dobbs, Jr, Herbert H; Jan 26, 2006; 7 pp.; In English
Report No.(s): AD-A465527; TARDEC-15520; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465527

Fuel Cell Strategy Summary: Emphasis on inter-service, inter-agency cooperation and coordination; Fuel cell auxiliary power units (APU); Reforming of JP-8 (jet fuel) single battlefield fuel; Demonstrate commercial fuel cell vehicles on military bases; Leverage industry to move fuel cells from civilian uses to military vehicles.
DTIC
*Fuel Cells; General Overviews; Auxiliary Power Sources; Jet Engine Fuels*

## 45
## ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

**20070019156** CH2M/Hill, Inc., Salt Lake City, UT USA
**Environmental Assessment for Enhanced Use Leasing West Side Development, Phase I South, Hill AFB, Utah**
Winn, Kay; Sep 2006; 47 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F42620-00-D-0028
Report No.(s): AD-A465640; XC-75CEG/CEVOR; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465640

This document presents potential environmental and socioeconomic consequences associated with the proposed project called the West Side Development, Phase 1 South, developing approximately 44 acres of currently vacant property. Administrative office space and parking lots comprise the proposed development. Roads and utility infrastructure will be added to the vacant acreage during construction. Structures built during this phase would be used to accommodate administrative personnel who currently work at the base. The findings of this EA indicate that the Proposed Action to construct administrative space east of the Hill AFB West Gate will not have significant adverse effects on the human environment or any of the environmental resources as described in the EA. Therefore, it is concluded that the issuance of a Finding of No Significant Impact is justified.
DTIC
*Construction; Environmental Surveys*

## 46
## 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*.

**20070018752** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Low- to Middle-Latitude X-Ray Emission from Jupiter**
Bhardwaj, Anil; Elsner, Ronald F.; Gladstone, G. Randall; Waite, J. Hunter, Jr.; Branduardi-Raymont, Graziella; Cravens, Thomas E.; Ford, Peter G.; Journal of Geophysical Research; November 22, 2006; ISSN 0148-0227; Volume 111; 16 pp.; In English; Original contains color illustrations; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1029/2006JA011792

The Chandra X-ray Observatory (CXO) observed Jupiter during the period 24-26 February 2003 for approx. 40 hours (4 Jupiter rotations), using both the spectroscopy array of the Advanced CCD Imaging Spectrometer (ACIS-S) and the imaging array of the High-Resolution Camera (HRC-I). Two ACIS-S exposures, each -8.5 hours long, were separated by an HRC-I exposure of approx. 20 hours. The low- to middle-latitude nonauroral disk X-ray emission is much more spatially uniform than the auroral emission. However, the low- to middle-latitude X-ray count rate shows a small but statistically significant hour angle dependence and depends on surface magnetic field strength. In addition, the X-ray spectra from regions corresponding to 3-5 gauss and 5-7 gauss surface fields show significant differences in the energy band 1.26-1.38 keV, perhaps partly due to line emission occurring in the 3-5 gauss region but not the 5-7 gauss region. A similar correlation of surface magnetic field strength with count rate is found for the 18 December 2000 HRC-I data, at a time when solar activity was high. The low- to middle-latitude disk X-ray count rate observed by the HRC-I in the February 2003 observation is about 50% of that observed in December 2000, roughly consistent with a decrease in the solar activity index (F10.7 cm flux) by a similar amount over the same time period. The low- to middle-latitude X-ray emission does not show any oscillations similar to the approx. 45 min oscillations sometimes seen from the northern auroral zone. The temporal variation in Jupiter's nonauroral X-ray emission exhibits similarities to variations in solar X-ray flux observed by GOES and TIMED/SEE. The two ACIS-S 0.3-2.0 keV low- to middle-latitude X-ray spectra are harder than the auroral spectrum and are different from each other at energies above 0.7 keV, showing variability in Jupiter's nonauroral X-ray emission on a timescale of a day. The 0.3-2.0 keV X-ray power emitted at low to middle latitudes is 0.21 GW and 0.39 GW for the first and second ACIS-S exposures, respectively. We suggest that X-ray emission from Jupiter's disk may be largely generated by the scattering and fluorescence of solar X rays in its upper atmosphere, especially at times of high incident solar X-ray flux. However, the dependence of count rate on surface

magnetic-field strength may indicate the presence of some secondary component, possibly ion precipitation from radiation belts close to the planet.
Author
*Jupiter (Planet); Temperate Regions; Solar Flux; Solar Physics; X Ray Spectra*

**20070018846** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Acquiring Comprehensive Observations using an Integrated Sensorweb for Early Warning**
Habib, Shahid; Ambrose, Steve; [2006]; 1 pp.; In English; Third International Conference on Eartly Warming (EWC III), 27-29 Mar. 2006, Bonn, Germany; 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 lass 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 pre-requisite 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
*Early Warning Systems; Systems Integration; Sensors; Expert Systems; Communication Networks; Observation*

**20070018974** Research Support Instruments, Inc., Lanham, MD USA
**Passive Optical Monitor for Atmospheric Turbulence and Windspeed**
Stell, M F; Moore, C I; Burris, H R; Suite, M R; Vilcheck, M J; Davis, R /Mahon, M A; Oh, E; Rabinovich, W S; Gilbreath, G C; Jan 2004; 11 pp.; In English
Report No.(s): AD-A465238; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465238

Measurement of atmospheric turbulence conditions is critical for predicting the performance of a free-space optical laser communication (FSO lasercomm) link. A Cn2 monitor based on angle-of-arrival (AOA) fluctuations has been built for characterization of atmospheric conditions at the NRL FSO Lasercomm Test Facility across the Chesapeake Bay. The monitor used existing lights in various locations as point sources for determining AOA fluctuations. Real time analysis of the AOA fluctuations was performed to determine the power spectrum of the fluctuations every few seconds. This additional power spectrum information allows much greater understanding of atmospheric conditions including estimation of average wind speed based on frequency shifts in the power spectrum distribution. The performance of the monitor was tested over short paths by comparison to a commercial scintillometer. In addition the monitor was used at other sites to determine atmospheric conditions at a variety of locations. Results of these experiments are presented.
DTIC
*Atmospheric Circulation; Atmospheric Turbulence; Monitors; Refractivity; Scintillation; Wind Velocity*

**20070019001** Naval Observatory, Flaggstaff, AZ USA

**Measuring Night-Sky Brightness With a Wild-Field CCD Camera**

Duriscoe, Dan M; Luginbuhl, Christian B; Moore, Chadwick A; Feb 2007; 23 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465284; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465284

We describe a system for rapidly measuring the brightness of the night sky using a mosaic of CCD images obtained with a low-cost automated system. The portable system produces millions of independent photometric measurements covering the entire sky, enabling the detailed characterization of natural sky conditions and light domes produced by cities. The measurements are calibrated using images of standard stars contained within the raw data, producing results closely tracking the Johnson V astronomical standard. The National Park Service has collected hundreds of data sets at numerous parks since 2001 and is using these data for the protection and monitoring of the night-sky visual resource. This system also allows comprehensive characterization of sky conditions at astronomical observatories. We explore photometric issues raised by the broadband measurement of the complex and variable night-sky spectrum, and potential indices of night-sky quality.

DTIC

*Cameras; CCD Cameras; Night Sky; Sky Brightness*

**20070019053** Library of Congress, Washington, DC USA

**Tsunamis: Monitoring, Detection, and Early Warning Systems**

Morrissey, Wayne A; Jun 1, 2005; 22 pp.; In English

Report No.(s): AD-A465385; CRS-RL32739; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465385

Some in Congress are concerned about the possible vulnerability of U.S. coastal areas to tsunamis, and about the adequacy of early warning for coastal areas of the western Atlantic Ocean. This stems from the December 26, 2004, tsunami that devastated many coastal areas around the northern Indian Ocean, where few tsunami early warning systems currently operate. The tsunami was caused by a strong underwater earthquake off the coast of Sumatra, Indonesia. The earthquake and tsunami together are estimated to have claimed as many as 300,000 lives. Affected nations, assisted by others, are pursuing multilateral efforts through the UNESCO Intergovernmental Oceanographic Commission (IOC) to develop a regional tsunami detection and warning network that would guard coastal populations around the Indian Ocean. Those efforts would coincide with the USA goal of upgrading and expanding its tsunami detection and early warning network.

DTIC

*Detection; Early Warning Systems; Tsunami Waves*

**20070019155** Saint Louis Univ., MO USA

**Lithospheric Structure of the Arabian Shield From the Joint Inversion of Receiver Function and Surface-Wave Dispersion Observations**

Herrmann, Robert B; Julia, Jordi; Ammon, Charles J; Jan 2007; 42 pp.; In English

Contract(s)/Grant(s): DAWA01-98-C0-0160; Proj-OS

Report No.(s): AD-A465637; DTRA-TR-03-26; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465637

We estimate lithospheric velocity structure for the Arabian shield by modeling receiver functions and Love and Rayleigh group velocities from event recorded by the 1995-1997 Saudi Arabian Portable Broadband Deployment. Receiver functions are primarily sensitive to shear-wave velocity contrast and vertical travel times and surface-wave dispersion measurements are sensitive to vertical shear-wave velocity averages, so that their combination bridge resolution gaps associated with each individual data set. We incorporate depth-dependent smoothness constraints on the resulting velocity models utilizing a jumping inversion technique. Additional constraints for the upper mantle are placed during inversion to complement those provided in our data set. Our results show a 32-36 km thick crust consisting of a 10-12km thick upper crust containing a rapid velocity increase, a rather constant velocity, a rather constant velocity lower crust of 3.84\(+-O.04 km/s overlayed by a significant velocity gradient above 16-22 km depth. The upper mantle material is shown to have shear velocities ranging from 4.3 to 4.6km/s and the crust-to-mantle transition is imaged as a gradational transition zone (4-12 km thick) rather than a sharp discontinuity. Evidence for lateral variations in both crust and upper mantle is observed at some stations as well.

DTIC

*Arabian Sea; Inversions; Lithosphere; Receivers; Seismic Waves; Surface Waves; Wave Dispersion*

**20070019676** NASA Johnson Space Center, Houston, TX, USA
**Compositions of Spherules and Rock Surfaces at Meridiani**
Mittlefehldt, David W.; Jolliff, B. L.; Clark, B. C.; Gellert, R., et al.; July 9, 2007; 4 pp.; In English; 7th International Conference on Mars, 9-13 July 2007, Pasadena, CA, USA; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

The Alpha Particle X-ray Spectrometers (APXS) on the Mars Exploration Rovers (MER) have proven extremely valuable for analyzing rocks and soils on the surface of Mars. The precision of their compositional measurements has been shown to be phenomenal through analyses of the compositionally very uniform Meridiani soils. Through combined use of the rock abrasion tool (RAT) and the analytical instruments on the in-situ deployment device (IDD), analyses of the interiors of fine-grained and texturally uniform rocks with surfaces ground flat have been made under conditions that are nearly ideal for this mode of analysis. The APXS has also been used frequently to analyze materials whose characteristics, surface morphologies, and sample-detector geometries are less than ideal, but the analyses of which are nonetheless very useful for understanding the makeup of the target materials. Such targets include undisturbed rocks with irregular and sometimes coated surfaces and mixed targets such as soils that include fine-grained components as well as coarse grains and pieces of rocks. Such target materials include the well known hematite-rich concretions, referred to as blueberries because of their multispectral color, size, and mode of occurrence. In addition to non-ideal target geometry, such mixed materials also present a heterogeneous target in terms of density. These irregularities violate the assumptions commonly associated with analyses done in the laboratory to achieve the highest possible accuracy. Here we acknowledge the irregularities and we examine the inferences drawn from specific chemical trends obtained on imperfect targets in light of one of the potential pitfalls of natural materials on the surface of Mars, namely thin dust coatings.
Author
*Rocks; Spherules; X Ray Spectrometers; Mars Surface; Hematite; Abrasion; Coatings; Soils; Mars Exploration*

## 47
## METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

**20070018947** Washington Univ., Seattle, WA USA
**Probabilistic Weather Forecasting for Winter Road Maintenance**
Berrocal, Veronica J; Raftery, Adrian ?E; Gneiting, Tilmann; Steed, Richard C; Apr 3, 2007; 28 pp.; In English
Contract(s)/Grant(s): N00014-01-10745
Report No.(s): AD-A465169; TR-511; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465169

Road maintenance is one of the main problems Departments of Transportation face during winter time. Anti-icing, i.e. applying chemicals to the road to prevent ice formation, is often used to keep the roads free of ice. Given the preventive nature of anti-icing, accurate predictions of road ice are needed. Currently, anti-icing decisions are usually based on deterministic weather forecasts. However the costs of the two kinds of error are highly asymmetric because the cost of a road closure due to ice is much greater than that of taking anti-icing measures. As a result, probabilistic forecasts are needed to optimize decisionmaking.
DTIC
*Forecasting; Maintenance; Probability Theory; Roads; Winter*

**20070019000** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**Assessment of Optical Turbulence Profiles Derived From Probabilistic Climatology**
Wisdom, Brett W; Mar 2007; 117 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465283; AFIT/GEO/ENP/07-02; No Copyright; Avail.: CASI: A06, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465283

This research e ort assesses the performance of the High Energy Laser End-to-End Operational Simulation (HELEEOS) Climatological C2noptical turbulence model. Path-integrated C2nvalues of two HELEEOS optical turbulence pro les at 3 distinct operational altitudes are compared to values determined from measured thermosonde data. HELEEOS desert and mid-latitude sites are selected from the Extreme and Percentile Environmental Reference Tables (ExPERT) database for comparison to the thermosonde data. Statistical equivalence of the two datasets is determined through a Design of Experiments (DOE) factorial test to within 80% con dence. The HELEEOS pro les are shown to be equivalent to the thermosonde data for

a 500 m boundary layer pro le. Deterministic values of the 80% con dence intervals are established. The HELEEOS optical turbulence model is used as the input turbulence model for wave optics simulations. Long-term spot size measurements show that HELEEOS outperforms empirical turbulence models by as much as 17%. Recommendations are made to improve the HELEEOS graphical outputs and reference tables.
DTIC
*Climatology; Optical Equipment; Turbulence*

**20070019003** Woods Hole Oceanographic Inst., MA USA
**The Coupled Ocean-Atmosphere Response to Small-Scale Atmospheric Jets**
Spall, Michael A; Mar 2007; 6 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-05-1-0300
Report No.(s): AD-A465286; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465286

The long-term goal of this project is to better understand the general problem of ocean-atmosphere interaction on small space and time scales. The present study has focused on gaining a better understanding the coupled response to small-scale atmospheric jets and oceanic surface fronts that are commonly observed near orographic features such as islands and mountain passes. The atmospheric response to sharp SST gradients has been explored in the strong wind regime, defined as U/fL\g1, where U is the wind speed, f is the Coriolis parameter, and L is the ocean front width. Adjustments to the atmospheric boundary layer thickness, surface wind speed, and momentum balances are studied for both cold to warm and warm to cold winds. In a second study, it is shown that this feedback between ocean SST and surface winds can either enhance or reduce the growth rate and wavelengths of baroclinically unstable waves in the ocean, depending on wind direction. This coupling is most effective for low latitude, strongly stratified flows.
DTIC
*Air Water Interactions; Boundary Layers*

**20070019056** Library of Congress, Washington, DC USA
**Tax Deductions for Catastrophic Risk Insurance Reserves: Explanation and Economic Analysis**
Brumbaugh, David L; King, Rawle O; Sep 2, 2005; 18 pp.; In English
Report No.(s): AD-A465395; CRS-RL33D60; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465395

The devastation caused by Hurricane Katrina which struck along the Gulf of Mexico and Atlantic coast on August 29, 2005, highlights the fact that the USA continues to be subject to natural hazard risks, primarily weather-related risks such as hurricanes and windstorms, but also seismic risk (earthquakes, tsunami, volcanic eruptions) and flood hazard risks. Such natural disaster risks result in deaths, property damage, and economic dislocation. Federal outlays for disaster victims have been increasing, and the frequency of weather-related natural disasters is generally perceived to be rising. The combination of economic dislocation from natural disasters and high federal and private costs has generated interest in Congress and elsewhere in proposals designed to change the way individuals and communities evaluate and protect themselves against the risk of natural disasters (i.e., financing risk with insurance). Given the increasing concentration of insured property values and sophisticated computer models that suggest an increased frequency of hurricanes and high probable maximum losses (PML) from catastrophic earthquakes, respectively, there has been some sense of urgency in Congress, state legislatures and the private sector to address the nation's financial exposure to catastrophic risks. One widely-discussed proposal would change the tax treatment of catastrophic risk insurance by permitting firms to establish tax-deductible reserve funds for catastrophes.
DTIC
*Disasters; Economic Analysis; Insurance (Contracts); Risk*

**20070019058** Library of Congress, Washington, DC USA
**New Orleans Levees and Floodwalls: Hurricane Damage Protection**
Carter, Nicole T; Sep 6, 2005; 7 pp.; In English
Report No.(s): AD-A465401; CRS-RS22238; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465401

Hurricane Katrina's storm surge breached floodwalls and levees surrounding New Orleans, causing widespread inundation and significant damage and hampering rescue and recovery efforts. Flooding from precipitation and storm surges flowing over levees was anticipated because of the hurricane s intensity; however, structural failure of the floodwalls and

consequent flooding were uncertain. The immediate engineering and the underlying causes of the breaches are the subject of speculation, and likely will be the subject of investigations and congressional oversight. The breaches occurred at the Lake Pontchartrain and Vicinity Project being constructed by the U.S. Army Corps of Engineers and maintained by local levee districts. Those observers questioning why infrastructure providing a greater level of hurricane protection was not available are countered by those arguing that structural protections carry their own risks. This report will be updated as needed to track significant developments.
DTIC
*Damage; Flood Control; Hurricanes; Protection; Storms*

**20070019073** Library of Congress, Washington, DC USA
**Global Climate Change: Federal Research on Possible Human Health Effects**
Simpson, Michael; Feb 10, 2006; 13 pp.; In English
Report No.(s): AD-A465446; CRS-RL31519; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465446

The average global temperature has risen approximately 0.6 degrees C over the past century. Global mean temperatures are projected by recent computer models to increase by 1.8 degrees C to as much as 7.1 degrees C over the next 100 years. It appears likely that global mean temperature increases will continue, and projections into the future predict a variety of possible related impacts, such as more volatile weather patterns, increased incidence of hot spells, and changing precipitation patterns that may include more intense rainfall patterns, as well as changing and intensified drought patterns. Extensive research is underway concerning the links between climate and human health; however, much of this research is being done for reasons unrelated to climate change per se. This report does not address the underlying question of climate change itself. Rather, it identifies the array of climate-relevant human health research and discusses the interconnections. Approximately $57 million each year since FY2005 supports climate change research at the NIH. Health effects research topics are wide-ranging, including studying skin and eye damage from increased ultraviolet radiation, effects of damaged water infrastructure, dynamics of recovering from disasters, and ways to strengthen the capacity in developing countries to deal with infectious diseases. Three conclusions are common to several studies on possible health effects of climate change: the infirm, the elderly, and the poor may be disproportionately impacted if climate change results in more severe and/or more frequent episodes of heat waves and air pollution; the risks of vector- and water-borne diseases may increase with global warming, but countries and regions with adequate sanitation, surveillance, and public health systems may not see significant increases in disease incidence or distribution; and further research is needed to better understand the complex linkages between climate and health.
DTIC
*Climate; Climate Change; Climatology; Greenhouse Effect; Health; United States*

**20070019206** Army Research Lab., White Sands Missile Range, NM USA
**Employing Net Centric Technology for a Mobile Weather Intelligence Capability**
Sauter, David; Torres, Mario; Jun 2004; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465742; No Copyright; Avail.: CASI: A03, Hardcopy

Weather affects personnel, military operations and weapon systems at all echelons, down to the individual soldier level. Knowing what these effects are, as well as when and where they will occur (and if they will affect the enemy to the same extent) can provide the tactical commander with critical intelligence in both the planning and execution phases of a mission. By leveraging ongoing advances in information technology related to tactical networking, communications, and computers (both hardware and software), these weather intelligence products (decision aids, alerts, map overlays, etc) can be made available to the lowest echelons. Client server computing (e.g., web services and Java remote method invocation), the Java computing environment, and wireless communications are some of the pervasive net centric technologies that will be utilized in the development and demonstration of the mobile weather intelligence capability. This capability will contribute to weather related information sharing and enhanced situational awareness at the lower echelons. A mobile computing device (Toshiba e800 personal digital assistant) is being used as the host development hardware platform.
DTIC
*Computer Programs; Intelligence; Military Operations; Weather*

**20070019372** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**What does Reflection from Cloud Sides tell us about Vertical Distribution of Cloud Droplet Sizes?**

Marshak, A.; Martins, J. V.; Zubko, V.; Kaufman, Y. J.; Atmospheric Chemistry and Physics; November 20, 2006; Volume 6, pp. 5295-5305; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

Cloud development, the onset of precipitation and the effect of aerosol on clouds depend on the structure of the cloud profiles of droplet size and phase. Aircraft measurements of cloud profiles are limited in their temporal and spatial extent. Satellites were used to observe cloud tops not cloud profiles with vertical profiles of precipitation-sized droplets anticipated from CloudSat. The recently proposed CLAIM-3D satellite mission (cloud aerosol interaction mission in 3-D) suggests to measure profiles of cloud microphysical properties by retrieving them from the solar and infrared radiation reflected or emitted from cloud sides. Inversion of measurements from the cloud sides requires rigorous understanding of the 3-dimentional(3-D) properties of clouds. Here we discuss the reflected sunlight from the cloud sides and top at two wavelengths: one nonabsorbing to solar radiation (0.67 microns) and one with liquid water efficient absorption of solar radiation (2.1 microns). In contrast to the plane-parallel approximation, a conventional approach to all current operational retrievals, 3-D radiative transfer is used for interpreting the observed reflectances. General properties of the radiation reflected from the sides of an isolated cloud are discussed. As a proof of concept, the paper shows a few examples of radiation reflected from cloud fields generated by a simple stochastic cloud model with the prescribed vertically resolved microphysics. To retrieve the information about droplet sizes, we propose to use the probability density function of the droplet size distribution and its first two moments instead of the assumption about fixed values of the droplet effective radius. The retrieval algorithm is based on the Bayesian theorem that combines prior information about cloud structure and microphysics with radiative transfer calculations.

Author

*Cloud Physics; Aerosols; Drop Size; Clouds (Meteorology); Radiative Transfer; Cloudsat*

**20070019373** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Percentage Contributions from Atmospheric and Surface Features to Computed Brightness Temperatures**

Jackson, Gail Skofronick; [2006]; 1 pp.; In English; American Geophysical Union (AGU) Fall Meeting, 11-15 Dec. 2006, San Farncisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Over the past few years, there has become an increasing interest in the use of millimeter-wave (mm-wave) and sub-millimeter-wave (submm-wave) radiometer observations to investigate the properties of ice particles in clouds. 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. One methodology used since the 1960's to discern the relationship between the physical state observed and the brightness temperature (TB) is through the temperature weighting function profile. In this research, the temperature weighting function concept is exploited to analyze the sensitivity of various characteristics of the cloud profile, such as relative humidity, ice water path, liquid water path, and surface emissivity. In our numerical analysis, we compute the contribution (in Kelvin) from each of these cloud and surface characteristics, so that the sum of these various parts equals the computed TB. Furthermore, the percentage contribution from each of these characteristics is assessed. There is some intermingling/ contamination of the contributions from various components due to the integrated nature of passive observations and the absorption and scattering between the vertical layers, but all in all the knowledge gained is useful. This investigation probes the sensitivity over several cloud classifications, such as cirrus, blizzards, light snow, anvil clouds, and heavy rain. The focus is on mm-wave and submm-wave frequencies, however discussions of the effects of cloud variations to frequencies as low as 10 GHz and up to 874 GHz will also be presented. The results show that nearly 60% of the TB value at 89 GHz comes from the earth's surface for even the heaviest blizzard snow rates. On the other hand, a significant percentage of the TB value comes from the snow in the cloud for 166, and 183 plus or minus 7 GHz for the heavy and medium snow rates. For submm-wave channels, there is no contribution from the surface because these channels cannot probe through clouds, nor normal water vapor amounts in clear air regions. This work is extremely valuable in physically-based retrieval algorithm development research.

Author

*Algorithms; Brightness Temperature; Atmospheric Composition; Clouds (Meteorology); Cloud Physics*

## 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*.

**20070018813** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Microbial Extremophiles in Aspect of Limits of Life**
Pikuta, Elena V.; Hoover, Richard B.; Tang, Jane; [2007]; 53 pp.; In English; Copyright; Avail.: CASI: A04, Hardcopy

During Earth's evolution accompanied by geophysical and climatic changes a number of ecosystems have been formed. These ecosystems differ by the broad variety of physicochemical and biological factors composing our environment. Traditionally, pH and salinity are considered as geochemical extremes, as opposed to the temperature, pressure and radiation that are referred to as physical extremes (Van den Burg, 2003). Life inhabits all possible places on Earth interacting with the environment and within itself (cross species relations). In nature it is very rare when an ecotope is inhabited by a single species. As a rule, most ecosystems contain the functionally related and evolutionarily adjusted communities (consortia and populations). In contrast to the multicellular structure of eukaryotes (tissues, organs, systems of organs, whole organism), the highest organized form of prokaryotic life in nature is the benthic colonization in biofilms and microbial mats. In these complex structures all microbial cells of different species are distributed in space and time according to their functions and to physicochemical gradients that allow more effective system support, self-protection, and energy distribution. In vitro, of course, the most primitive organized structure for bacterial and archaeal cultures is the colony, the size, shape, color, consistency, and other characteristics of which could carry varies specifics on species or subspecies levels. In table 1 all known types of microbial communities are shown (Pikuta et a]., 2005). In deep underground (lithospheric) and deep-sea ecosystems an additional factor - pressure, and irradiation - could also be included in the list of microbial communities. Currently the beststudied ecosystems are: human body (due to the medical importance), and fresh water and marine ecosystems (due to the reason of an environmental safety). For a long time, extremophiles were terra incognita, since the environments with aggressive parameters (compared to the human body temperature, pH, mineralization, and pressure) were considered a priori as a dead zone.
Author
*Microorganisms; Climate Change; Ecosystems; Geochemistry; Marine Environments; Prokaryotes; Geophysics; Human Body*

**20070018823** National Space Science and Technology Center, Huntsville, AL, USA
**The Application of NASA Technology to Public Health**
Rickman, Douglas L.; Watts, C.; March 21, 2007; 1 pp.; In English; Michigan's Public Health Technology Conference: Promoting Public Health Performance with Technology, 20-21 Mar. 2007, East Lansing, MI, USA; No Copyright; Avail.: Other Sources; Abstract Only

NASA scientists have a history of applying technologies created to handle satellite data to human health at various spatial scales. Scientists are now engaged in multiple public health application projects that integrate NASA satellite data with measures of public health. Such integration requires overcoming disparities between the environmental and the health data. Ground based sensors, satellite imagery, model outputs and other environmental sources have inconsistent spatial and temporal distributions. The MSFC team has recognized the approach used by environmental scientists to fill in the empty places can also be applied to outcomes, exposures and similar data. A revisit to the classic epidemiology study of 1854 using modern day surface modeling and GIS technology, demonstrates how spatial technology can enhance and change the future of environmental epidemiology. Thus, NASA brings to public health, not just a set of data, but an innovative way of thinking about the data.
Author
*Public Health; NASA Programs; Technology Utilization; Epidemiology*

**20070018860** Civil Aerospace Medical Inst., Oklahoma City, OK, USA
**Comparison of Amplification Methods to Produce Affymetrix GeneChip Target Material**
Burian, Dennis; White, Vicky; Huggins, Mark; Kupfer, Doris; Canfield, Dennis V.; Whinnery, James E.; April 2007; 9 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): AM-TOXLAB
Report No.(s): DOT/FAA/AM-07/9; No Copyright; Avail.: CASI: A02, Hardcopy

Whole blood from living subjects is a convenient matrix to use as a source of RNA for microarray experiments with human subjects especially when subject material is collected at a location other than the collaborating site conducting the microarray work. Collection methods for whole blood that include stabilization of the RNA are known but suffer from issues of decreased sensitivity due to the large amount of globin RNA present from reticulocyte lysis. The experiments presented here were designed to test a globin-RNA reduction protocol in conjunction with three different amplification methods. Statistical analysis of the six different protocols, coupled with post-hybridization quality assurance methods, revealed that an amplification protocol that yielded a fragmented biotin-labeled cDNA product resulted in the highest Percent Present calls from the Affymetrix analysis software and the least methodology based variability. Based on these results, this amplification protocol is expected to lead to the greatest sensitivity and accuracy for differential expression testing of the six amplification methods tested.
Author
*Amplification; Genes; Ribonucleic Acids; Aerospace Medicine*

**20070018950** Rochester Univ., NY USA
**Chemotherapy Agents and the Inhibition of Neuronal Birthing in the Brain - The Cause of Chemo Brain**
Gross, Robert A; Nov 2006; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAMD17-03-1-0277
Report No.(s): AD-A465198; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465198

Patients undergoing chemotherapy can experience a decline in cognitive abilities. While well described from a clinical perspective, little is known of the neurological substrate for this difficulty, commonly known as chemo brain. We hypothesize that the cognitive difficulties experienced by patients undergoing chemotherapy are the result of impaired neurogenesis, especially in the hippocampus. We further hypothesize that agents that do not cross the blood-brain barrier will not show reduced rates of neurogenesis, in contrast to agents that readily cross into the central nervous system (CNS). Our objective is to compare the effect of drugs that enter the CNS (Cytoxan and 5-FU) with agents that do not (Adriamycin and Taxol) with respect to their ability to impair the birthing of new neurons in the hippocampus of adult mice. By testing whether chemotherapeutic agents that enter the CNS can reduce neurogenesis, we hope to develop an animal model of chemo brain that will allow further studies. Furthermore, if we can show that inhibition of neurogenesis is a correlate of behavioral decline after chemotherapy, we will have provided evidence that modification of chemotherapeutic regimens specifically, using strategies to prevent CNS entry of drugs would be of great importance in improving the quality of life in cancer patients.
DTIC
*Brain; Chemotherapy; Neurophysiology*

**20070018951** California Univ., Los Angeles, CA USA
**The Meaning of Incontinence and Impotence for Low Income African-American and Latino Men with Prostate Cancer**
Maliski, Sally L; Litwin, Mark S; Dec 2005; 28 pp.; In English
Contract(s)/Grant(s): W81XWH-04-1-0117
Report No.(s): AD-A465200; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465200

The purpose of this project is to describe the meaning of prostate cancer treatment-related incontinence and impotence for low income African American and Latino men. Preliminary common categories between the Latino and African American men included erectile dysfunction and incontinence were the price that had to be paid to cure cancer, trusting God as a means of coping, context of incontinence as determinant of its acceptability (e.g. if due to illness, acceptable; if due to drunkenness, not acceptable), and ambivalence toward role of erectile function in masculine identity and transitional masculinity.
DTIC
*Africa; Cancer; Human Beings; Income; Males; Prostate Gland*

**20070018953** Health Research, Inc., Buffalo, NY USA
**Identification of Prostate Cancer-Related Genes Using Inhibition of NMD in Prostate Cancer Cell Lines**
Ionov, Yurij; Jan 2007; 30 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-04-1-0045
Report No.(s): AD-A465202; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465202

A strategy to identify mutant genes using inhibition of nonsense mediated decay (NMD) in cell lines has been proposed by others. Blocking translation with antibiotic emetine has been shown to inhibit the NMD. Stabilization of mutant mRNA following the inhibition of NMD with emetine can be detected using microarray technology, such as Affymetrix genechips, for example. Unfortunately, too many genes that do not contain any mutations show mRNA increase following emetine treatment due to stress response to the inhibition of translation or due to being a natural substrate for NMD, thus complicating the identification of mutant genes. We have developed a modification of the method which includes inhibition of NMD using two alternative methods. First is to inhibit translation with emetine. Second is to block NMD by inhibiting SMG-1 kinase with caffeine and than to block transcription with actinomycin D and either to continue blocking NMD with caffeine or to activate NMD by caffeine withdrawal. Analyzing the mRNA accumulation following emetine treatment as well as mRNA degradation following blocking of transcription in the presence or absence of NMD with the Affymetrix analysis using simple analytical algorithm allows selection of candidate genes for sequencing with high efficiency. Using our method of NMD inhibition we have identified several genes containing bi-allelic inactivating mutation in prostate cancer cell lines.
DTIC
*Cancer; Genes; Oncogenes; Prostate Gland*

**20070018954** Meharry Medical Coll., Nashville, TN USA
**Lycopene Supplementation in the Complementary Management of PSA Failure: A Randomized Placebo-Controlled Trial for Prostate Cancer Survivors**
Ukoli, Flora A; Kucuk, Omer; Fowke, Jay H; Jan 2007; 178 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-05-1-0437
Report No.(s): AD-A465203; No Copyright; Avail.: CASI: A09, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465203

This is a hypothesis driven, double-blind, randomized, controlled Phase II clinical trial to compare the effect of daily 12-month supplementation of 30mgs lycopene as a single nutrient (Lycopene) or whole-food supplement (Lyc-O-Mato(Registered)) in control of biochemical (PSA) failure in 78 African-American prostate cancer survivors treated initially by radical prostatectomy or radiation. Fasting blood samples to measure free and total PSA, lycopene, isoprostane and essential fatty acids will be collected at baseline, 3- 6- and 12-months. Demographic and medical history, clinical and quality of life (QOL) assessment, dietary assessment, body fat measures and adverse event information will be collected at baseline and all follow-up time-points. Clinical endpoints are \g50% PSA reduction from baseline maintained for 2 successive readings 3 months apart, \g25% improvement in QOL scores, and control of distant metastasis. Biomarker endpoints are changes in plasma lycopene, and 8-isoprostane-PGF2alpha, a measure of oxidative stress. The effect of the interventions will be analyzed based on evaluable patients as well as by intent-to-treat.
DTIC
*Cancer; Metastasis; Prostate Gland*

**20070018955** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
**Multifactorial Assessment of Depleted Uranium Neurotoxicity**
Jortner, Bernard S; Dec 2006; 121 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAMD17-01-1-0775
Report No.(s): AD-A465204; No Copyright; Avail.: CASI: A06, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465204

THIS WAS A 5-YEAR PROJECT to EXPERIMENTALLY ASSESS the NEUROTOXICOLOGIC POTENTIAL of EXPOSURE to DEPLETED URANIUM (DU), and THE ROLE of STRESS IN ALTERING the TOXICITY. the PROJECT INVOLVED DETERMINATION of THE TOXICOKINETICS of DU IN the BRAIN, DEVELOPMENT of A RELEVANT STRESS MODEL, and STUDY of NEUROTOXIC EFFFECTS of A SINGLE (ACUTE) EXPOSURE to SOLUBLE DU and TO LONG-TERM EXPOSURE to IMPLANTED PELLETED DU, and THEIR MODIFICATION BY STRESS. MAJOR FINDINGS IN the ACUTE STUDY WERE DOSE-RELATED ELEVATED URANIUM IN BRAIN REGIONS, and TRANSIENT DECREASE IN DOPAMINE IN the STRIATUM ON POST-DOSING DAY 3 IN the HIGH DOSE UNSTRESSED ANIMALS. THERE WERE DU-RELATED DECREASES IN MOTOR ACTIVITY, BODY WEIGHT GAIN and FORELIMB GRIP STRENGTH. TRANSIENT UREMIA FROM DU DOSE-RELATED RENAL TUBULAR NECROSIS WAS ALSO SEEN, and MAY HAVE CONTRIBUTED to THESE CLINICAL FINDINGS. STRESS DID NOT ENHANCE the DU TOXICITY. MAJOR FINDINGS FROM the LONG-TERM DU-IMPLANTATION/STRESS STUDY WERE DU DOSE-RELATED INCREASED URANIUM CONCENTRATIONS IN SERUM, KIDNEY and BRAIN REGIONS IN RATS SACRIFICED 6 MONTHS POST-EXPOSURE, UNAFFECTED BY STRESS. DECREASE IN

DOPAMINE IN the STRIATUM and EPINEPHRINE IN the CEREBELLUM WERE SEEN IN the HIGH DOSE DU GROUP, ALSO UNMODIFIED BY STRESS. THESE STUDIES SHOW THAT URANIUM MOBLIIZED FROM PERIPHERAL SITES CAN ENTER the BRAIN and HAVE ADVERSE NEUROLOGIC EFFECTS.
DTIC
*Clinical Medicine; Neurology; Spent Fuels; Uranium*

**20070018956** Connecticut Univ., Farmington, CT USA
**Methods to Protect from Skeletal Cardiovascular Insufficiency: Improving Soldier Performance in Adverse Environments**
Liang, Bruce T; Azrin, Michael; White, William; Mansoor, George; Karimeddini, Mozafareddin; Dodge, Kimberly; Barry, Marybeth; Tyrell, Pat; Kupiec, Jessica; Wang, Rubio; Nov 2006; 67 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-05-1-0060
Report No.(s): AD-A465206; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465206

The main objective of the project is to study the cardiovascular and skeletal muscle protective actions of purines. The pre-clinical animal work has resulted in the establishment of a quantitative mouse hindlimb model of ischemia-reperfusion injury and elucidation of the role of adenosine receptor subtypes in mediating a skeletal muscle protective effect. The study demonstrated for the first time a novel protective action of the adenosine A3 receptor. It also confirmed, in this model, a protective effect of the adenosine A1 receptor. The significance is that the studies identified the adenosine A3 receptor as a new therapeutic target for the treatment of skeletal muscle ischemia-reperfusion injury. Agonists at the adenosine A3 receptor are potentially novel agents to ameliorating skeletal muscle injury. The clinical works have also begun to test the genetic polymorphism of adenosine transporter and its biological significance. At this point, we have identified several polymorphisms, some are non-synonymous and cause missense mutations.
DTIC
*Adenosines; Cardiovascular System; Heart; Muscles; Musculoskeletal System; Protection; Skeletal Muscle*

**20070018957** California Univ., Los Angeles, CA USA
**The Meaning of Incontinence and Impotence for Low Income African-American and Latino Men with Prostate Cancer**
Maliski, Sally L; Litwin, Mark S; Dec 2006; 16 pp.; In English
Contract(s)/Grant(s): W81XWH-04-1-0117
Report No.(s): AD-A465207; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465207

The purpose of this project is to describe the meaning of prostate cancer treatment-related incontinence and impotence for low income African American and Latino men. Preliminary common categories between the Latino and African American men included erectile dysfunction and incontinence were the price that had to be paid to cure cancer, trusting God as a means of coping, context of incontinence as determinant of its acceptability (e.g. if due to illness, acceptable; if due to drunkenness, not acceptable), and ambivalence toward role of erectile function in masculine identity and transitional masculinity.
DTIC
*Africa; Cancer; Central America; Hormones; Human Beings; Income; Males; Prostate Gland; Radiation Therapy; South America*

**20070018958** Hutchinson (Fred) Cancer Research Center, Seattle, WA USA
**Prostate Expression Databases: Gene Expression Resources for Comparative Studies of Prostate Carcinogenesis**
Nelson, Peter S; Jan 2007; 8 pp.; In English
Contract(s)/Grant(s): W81XWH-05-1-0110
Report No.(s): AD-A465208; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465208

This proposal aims to test the hypothesis that integrating observations derived from mouse model systems with observations from human prostate cancers will define relevant and consistent molecular alterations critical to the development and progression of prostate carcinoma. The research accomplished to date has: 1) assembled the requisite mouse models to enable the generation of tumor gene expression data; 2) produced a second-generation mouse prostate microarray that will allow for deeper profiling of mouse prostate gene expression; 3) identified a specific gene (osteopontin) commonly associated with multiple mouse prostate cancer models; 4) developed the methods/techniques that will enable precise dissection of mouse

prostate epithelium; 5) expanded the Prostate Expression Database to archive microarray data; 6) determined strain-specific gene expression differences in the mouse prostate that could contribute to phenotypic differences on prostate cancer development and progression; and 7) identified developmental pathways altered in the Pten-/- prostate cancer model that could contribute to the process of carcinogenesis.
DTIC
*Cancer; Carcinogens; Clinical Medicine; Data Bases; Epithelium; Gene Expression; Genes; Prostate Gland; Resources*

**20070018959** Vanderbilt Univ., Nashville, TN USA
**A Myc-Driven in Vivo Model of Human Prostate Cancer**
Hayward, Simon W; Oct 2006; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-04-1-0867
Report No.(s): AD-A465209; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465209

The long-term goal of the work proposed here is to generate, characterize and interrogate human epithelial cell-based in vivo models of prostatic carcinogenesis. These models will allow an examination of processes involved in carcinogenesis, tumor growth and metastasis. Since the tumors are themselves of human origin hey represent an in vivo test bed to examine both tumor biology and the application of therapeutic agents. In the second year of funding we have made a thorough study of the profiles of metastatic spread of human prostatic epithelium from the sub-renal and orthotopic graft sites and have found that the orthotopic site shows spread patterns and mechanisms which closely profile the human disease and apparently result from similar migration routes. We have developed a novel method of intraductal orthotopic grafting which enhances the efficiency of tumorigenesis and metastasis at the orthotopic site. We have further explored the use of lower dose Myc expressing constructs and have investigated the combination of lower levels of Myc with other genes commonly changed in prostate cancer to make more clinically relevant models. Tet- regulated Myc constructs have been used to develop tumors with suitable profiles in mice.
DTIC
*Cancer; In Vivo Methods and Tests; Prostate Gland*

**20070018960** Cold Spring Harbor Lab., New York, NY USA
**Functional Analysis of Human NF1 in Drosophila**
Zhong, Yi; Jan 2007; 21 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-05-1-0142
Report No.(s): AD-A465210; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465210

Neurofibromatosis type 1 (NFI) is characterized by benign but disfiguring skin tumors, pigmentation defects and learning disabilities, as well as increased risk of brain tumors. The NF1 tumor suppressor protein (neurofibromin) inhibits Ras, a protein that is overactive in a wide variety of human cancers. NF1 also controls levels of cyclic AMP, an important intracellular messenger involved in cell growth and learning. Over last year, we continue to examine the structural basis for its role in controlling multiple signal transduction pathways and roles in learning and memory formation. In addition to previously identified GAP related domain, we showed that the C-terminal is critical in mediating G protein dependent activation of adenylyl cyclase. We are now examining the functional roles of these two domains in learning and memory.
DTIC
*Brain; Cancer; Computer Storage Devices; Drosophila; Functional Analysis; Learning*

**20070018961** Tulsa Univ., OK USA
**An Exploratory Study of Cavity Ringdown Spectroscopy as a Noninvasive Breath Diagnostic for Breast Cancer**
Miller, George P; Mar 2006; 33 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAMD17-03-1-0757
Report No.(s): AD-A465211; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465211

Every woman over 50 is recommended to have mammograms to monitor for breast cancer. The goal is to detect breast cancer as early as possible. The problems with the technique are well known and range from the exposure to X-rays to the difficulty of analysis, to patient resistance. Normal human breath contains a complex mixture of volatile organic compounds (VOCs). A number of these VOCs have been identified as candidate markers of various cancers (e.g. formaldehyde in breast

cancer). Although breath analysis has been shown to have great potential as a diagnostic tool, most of the compounds of interest are exhaled in picomolar concentrations. Real-time breath analysis for these compounds is not possible with existing technology. Cavity ringdown spectroscopy (CRDS) is a measurement of the rate of absorption of a sample within a closed optical cavity, rather than the standard measurement of the absorbed signal strength over a given sample path. It maintains much of the simplicity of classical absorption spectroscopy, but has been demonstrated to provide an increase in sensitivity of up to 10,000 times. The objective is to evaluate the potential of CRDS to provide real-time formaldehyde concentrations in exhaled breath for the purpose of the detection of breast cancer.
DTIC
*Breast; Cancer; Cavities; Mammary Glands; Spectroscopy*

**20070018963** Medicine and Dentistry Univ. of New Jersey, Newark, NJ USA
**A Novel siRNA-Based Approach to Study Mechanisms of Resistance/Action of a New Drug in Treatment of Breast Cancer. Addendum**
Bertino, Joseph R; Krouse-Mandola, Jennifer; Budak-Alpdogan, Tulin; Banerjee, Debabarata; Aug 2006; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-04-1-0692
Report No.(s): AD-A465214; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465214

The mechanism by which ET-743 (YondelisTM, trabectedin) exerts its antitumor activity is not understood. The goal of this study was to study the mechanism of action/resistance of ET-743 in breast cancer cells using a novel siRNA-based approach. Two primers representing the sense and anti-sense DNA template of the random siRNA inserts were cloned into the linearized pFIV-H1/U6 siRNA expression vector. Out of 33 siRNA sequences obtained from vector transformed E.coli colonies, predicted that 67% of the siRNA template sequences would generate functional siRNA sequences and that 82% of the functional siRNA sequences were random. A pool of plasmids encoding the random siRNAs (with a possible 105 to 106different siRNAs), either transduced with pseudo- lentiviral particles or transfected with electroporation, were tested in the MCF-7 breast cancer cell line. The cell line was then treated with a lethal dose of ET-743 and cytarabine, however no resistant colonies were obtained. Further scaling-up is required to fufill the goals of this project.
DTIC
*Breast; Cancer; Chemotherapy; Drugs; Genes; Mammary Glands; Ribonucleic Acids*

**20070018968** Wisconsin Univ., Madison, WI USA
**Sanguinarine: A Novel Agent Against Prostate Cancer**
Ahmad, Nihal; Feb 2007; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-04-1-0220
Report No.(s): AD-A465226; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465226

The traditional therapeutic and surgical approaches have not been successful in the management of prostate cancer (CaP). Natural plant-based products have shown promise as anticancer agents. Sanguinarine, a benzophenanthridine alkaloid derived from the root of Sanguinaria Canadensis, has been shown to possess anti-microbial, antioxidant and anti-inflammatory properties. Our earlier studies suggested that sanguinarine may be developed as an agent for the management of prostate cancer. Based on this rationale, funded by the DOD (Award - W81XWH-04-1-0220), we initiated a study to investigate the hypothesis that sanguinarine will impart antiproliferative effects against prostate cancer via a modulation in NF-kB-pathway-mediated apoptosis. In the last three years, we have made reasonable progress towards our goals. However, the progress during this reporting period was hampered due to several unforeseen circumstances. Because of this reason, a one-year extension of the grant was obtained in January 2007. So far, the key accomplishments of our project are as follows. We have shown that sanguinarine possesses chemopreventive/anti-proliferative effects against CaP in an athymic nude mice xenograft model. Further, our data also suggested that sanguinarine-caused effects are mediated via modulations in NF-kB pathway and cki-cyclin-cdk machinery. At present, the studies are ongoing to assess the chemopreventive/therapeutic effects of sanguinarine on CaP development in transgenic TRAMP model.
DTIC
*Alkaloids; Cancer; Prostate Gland*

**20070018969** Utah Univ., Salt Lake City, UT USA

**The University of Utah Clinical Genetics Research Program as an NF1 Consortium Site**

Viskochil, David H; Stevenson, David; Carey, John; Feb 2007; 13 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0030

Report No.(s): AD-A465227; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465227

The University of Utah Clinical Genetics Research Program (CGRP) provided the infrastructure for our site to perform clinical trials within the scope of a consortium to treat multiple medical complications of neurofibromatosis type 1. The U of Utah site executed aims of the overall consortium by attending 2 meetings of the consortium (November, 2005 and April, 2006), participating in all teleconference calls, and active engagement in the development a The University of Utah Clinical Genetics Research Program (CGRP) provided the infrastructure for our site to perform clinical trials within the scope of a consortium to treat multiple medical complications of neurofibromatosis type 1. The U of Utah site executed aims of the overall consortium by attending 2 meetings of the consortium (November, 2005 and April, 2006), participating in all teleconference calls, and active engagement in the development and submission of a clinical trials application to the Department of Defense in August, 2006. David Viskochil served as vice-chair of the Biology Committee, and he organized a symposium of investigators and clinicians who were part of a MPNST (malignant peripheral nerve sheath tumor) Consortium and the MPNST Committee of the NF1 Consortium that convened as a satellite meeting of the full NF1 Consortium meeting in Atlanta in April, 2006. A study coordinator has been hired through the CGRP at the U of Utah to assist in the development of material submitted in the clinical trials grant proposal. No data has been collected.

DTIC

*Clinical Medicine; Genetics; Organizations*

**20070018970** Wales Univ., Swansea, UK

**Titanium Dioxide Photo-Catalyzed Degradation Of Polyurethanes**

Worsley, David A; Oct 10, 2006; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-05-1-3030

Report No.(s): AD-A465228; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465228

This report results from a contract tasking University of Wales Swansea as follows: This project aims to harness new techniques developed to assess the mechanisms and kinetics of paint failure in short term exposure to the results from traditional weathering experiments. This will enable a rapid test system to be developed for polyurethane coatings which currently are showing premature failures.

DTIC

*Catalysis; Coatings; Degradation; Kinetics; Polyurethane Resins; Titanium Oxides*

**20070018979** Wayne State Univ., Detroit, MI USA

**Sam68 and Breast Cancer**

Reddy, Thipparthi R; Aug 2006; 5 pp.; In English

Contract(s)/Grant(s): W81XWH-05-1-0529

Report No.(s): AD-A465244; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465244

Sam68 is a target for Src kinase. It is involved in HIV-1 RNA export. However, the role of Sam68 in cellular mRNA export is unknown. It has been well documented that patients have either lost or have mutations in BRCA1 or BRCA2 tumor suppressor genes are at high risk of developing breast cancers. Thus, the goal of this application is to investigate whether Sam68 is involved in the export of BRCA1 mRNA. To test this objective, we have generated stable Sam68 knockdown MCF7 cells. These reagents are critical to objectively test the role of Sam68 on BRCA1 expression. In this no-cost extension year, using MCF7 Sam68-RNAi stable cells, we expect to be able to examine how the reduced expression of Sam68 affects BRCA1 mRNA export. We will also identify the RNA export pathway for BRCA1 mRNA, proposed in Aim 2.

DTIC

*Breast; Cancer; Mammary Glands; Ribonucleic Acids*

**20070018980** Northwestern Univ., Evanston, IL USA

**Constitutive Activation of NF-KB in Prostate Carcinoma Cells Through a Positive Feedback Loop: Implication of Inducible IKK-Related Kinase (IKKi)**

Budunova, Irina V; Aug 2005; 60 pp.; In English

Contract(s)/Grant(s): DAMD17-03-1-0522

Report No.(s): AD-A465245; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465245

The overall goal of this project is to understand the role of inducible IKK-related kinase IKKi in constitutive activation of anti-apoptotic transcription factor NF-KB prostate carcinoma (PC) cells. During FYO2 we developed the conditions for RNA isolation from OCT-embedded frozen PC and BPH samples, developed conditions for cell lysis and IKKi immunoprecipitation from transfected cells using FLAG antibody. We also generated PC cell lines stably infected with lentiviruses harboring w.t. IKKi, d.n. IKKi mutant K38A, and constitutively active IKKi mutant S172E. We continued the characterization of biological effects of IKKi overexpression/IKKi blockage in PC cells. Our data provide the experimental evidence that IKKi could be involved in the regulation of NF-kB activity in PC cells through a positive feedback loop. Inactivation of IKKi in PC cells via infection with lentivirus expressing IKKi d.n. mutant indicated that IKKi plays an important role in the regulation not only NF-kB but also other transcriptional factors. IKKi appeared to be very important for PC cell growth regulation. The in vitro growth of PC3 cells infected with IKKi d.n. mutant was reduced by 60%. The results of our studies have been presented at the local and national meetings, two manuscripts are published, one is in press, and the fourth manuscript is under preparation.

DTIC

*Cancer; Positive Feedback; Prostate Gland*

**20070018989** Harvard Medical School, Boston, MA USA

**Parallel Genomic and Chemical Screens to Identify Both Therapeutic Targets and Inhibitors of These Targets in the Treatment of Neurofibromatosis**

Perrimon, Norbert; Dec 2006; 23 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W81XWH-06-1-0113

Report No.(s): AD-A465264; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465264

In model systems, such as Drosophila, high-throughput genetic and chemical screens are powerful tools to elucidate the components and inhibitors of signaling pathways. The success of these screens is dependent on the development of experimental assays which serve as readouts of pathway activity. However, to date no such assay has been developed to monitor the activity of Nf1 or Nf2. Here we describe the development of a novel technology that can be used to rigorously quantify and analyze single-cell morphology in an automated fashion. As a proof-of concept we have analyzed morphological data derived from 249 different conditions, and defined phenoclusters of functionally related genes. We observe that Nf1 and Nf2 are members of distinct phenoclusters, and that other genes in these clusters may be highly relevant to understanding role of Nf1 and Nf2 in promoting disease. With the successful development of methods to determine quantitative phenotypic profiles of cells, performing screens for genetic or chemical modifiers of Nf1 or Nf2 is now feasible.

DTIC

*Diseases; Genetics; Genome; Inhibitors; Targets; Therapy*

**20070019029** Uniformed Services Univ. of the Health Sciences, Bethesda, MD USA

**The Role of Dopamine in Normal Rodent Motor Cortex: Physiological Effects and Structural Correlates**

Awenowicz, Patrick W; Apr 5, 1999; 114 pp.; In English

Report No.(s): AD-A465325; No Copyright; Avail.: CASI: A06, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465325

Dopamine (DA) has been implicated in the cortical pathophysiology of several neurological disorders. Until recently, motor areas of the neocortex were thought to receive only sparse DA innervation. It is now known that the motor cortex of rodents and primates are densely innervated by DA, but its detailed circuitry and role in motor cortex function remain unclear. Immunohistochemistry and in situ hybridization were used to determine the laminar distribution and morphology of neurons that contain the protein and mRNA for the D1a, D2, and D5 receptors. Numerous pyramidal-shaped neuronal somata in layers II-VI of rodent motor cortex were immunoreactive for the D1a, D2, and D5 receptors, and sparse nonpyramidal-shaped neurons in layers V-VI were immunoreactive for the D1a receptor. Quantitative analysis revealed that all three receptor subtypes were expressed by neurons with distinct laminar distributions. Double label immunohistochemistry was used to

determine if DARPP-32, a phosphoprotein that acts as part of the D1 receptor signal transduction cascade, co-localized D1a, D2, or D5 receptors in motor cortex neurons. DARPP-32 was co-localized with D1a and D2 receptors in pyramidal-shaped neurons in layers V-VI, and with D5 receptors in neurons of deep layer VI. Tract tracing and immunohistochemical techniques were used to determine if pyramidal tract neurons (PTNs), output neurons from the motor cortex to the spinal cord, possess D1a, D2, or D5 receptors. All three receptor subtypes were found in identified PTNs. Locally applied DA induces both inhibitory and excitatory responses in the neocortex. Electrophysiological techniques were employed to determine the effects of iontophoretically applied DA on the spontaneous activity (SA) of PTNs, the receptors that mediate these effects, and DA's effects on glutamate-induced excitation of PTNs. The findings indicate that DA may have profound effects on motor cortex activity, through its influence on PTNs.
DTIC
*Cerebral Cortex; Dopamine; Efferent Nervous Systems; Neurons; Physiological Effects; Rodents; Sites*

**20070019046** Library of Congress, Washington, DC USA
**Military Medical Care: Questions and Answers**
Best, Jr, Richard A; Mar 7, 2007; 19 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465363; CRSL-RL33537; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465363

The primary mission of the military health system, which encompasses the Defense Department s hospitals, clinics, and medical personnel, is to maintain the health of military personnel so they can carry out their military missions, and to be prepared to deliver health care during wartime. The military health system also provides, where space is available, health care services in Department of Defense (DOD) medical facilities to dependents of active duty service members and to retirees and their dependents. The Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) was established in 1966 legislation as the military equivalent of a health insurance plan, run by DOD, for active duty dependents, military retirees and the dependents of retirees, survivors of deceased members, and certain former spouses. CHAMPUS reimburses beneficiaries for portions of the costs of health care received from civilian providers.
DTIC
*Management Systems; Medical Services*

**20070019052** Library of Congress, Washington, DC USA
**Federal Protection for Human Research Subjects: An Analysis of the Common Rule and Its Interactions with FDA Regulations and the HIPAA Privacy Rule**
Williams, Erin D; Jun 2, 2005; 81 pp.; In English
Report No.(s): AD-A465383; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465383

The Common Rule (45 CFR 46, Subpart A) governs research that is conducted on human beings if it is funded by one of 18 federal agencies. It requires a review of proposed research by an Institutional Review Board (IRB), the informed consent of research subjects, and institutional assurances of compliance with the regulations. In 1974, 45 CFR 46 was published following some cases of harm to human subjects, such as those caused by thalidomide drug trials and the USA Public Health Service syphilis study in Tuskeegee, Alabama. The regulations had their roots in numerous international agreements, such as the Nuremberg Code and the Declaration of Helsinki, and domestic policies, such as those put forth by the Department of Health, Education and Welfare (DHFW; now the Department of Health and Human Services, HHS). In 1991, 16 federal agencies adopted 45 CFR 46, Subpart A, which then became known as the Common Rule. Since the Common Rule took effect, events like the death offense Gelsinger in 1999 due to his participation a clinical trial have prompted scrutiny of the Rule and its ability to protect research subjects. In order to help enhance research subject protections, in 2000 HHS removed the Office for Protection from Research Risks (OPRR) from the National Institutes of Health (NIH), and created a new office the Office for Human Research Protections (OHRP) in an elevated position in HHS. In addition, groups like the National Bioethics Advisory Commission and the National Academies raised the following policy questions: (1) Should the Common Rule be applied to non-federally funded research, social and behavioral research, international clinical trials, and research with human biological materials? (2) Do existing provisions ensure the participation and protection of children, prisoners, minorities, those with diminished capacity, pregnant women, fetuses, neonates, and people in emergency sittiations?
DTIC
*Law (Jurisprudence); Medical Science; Privacy; Protection; Regulations; Research Management*

**20070019061** Library of Congress, Washington, DC USA

**Vaccine Policy Issues**

Thaul, Susan; May 19, 2005; 24 pp.; In English

Report No.(s): AD-A465410; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465410

This report's focus is on vaccination, one of the most cost-effective methods available to prevent infectious diseases. Whether a vaccine's target is naturally occurring or present because of hostile intent, the issues policy makers must deal with include vaccine development, production, availability, safety, effectiveness, and access. Vaccines are biologics: their basic components begin as living material. They introduce bacteria or dead or weakened viruses into a person or animal to stimulate an immune reaction that the body will remember if assaulted by the same pathogen in the future. There is no central federal authority for vaccine policy. In the Department of Health and Human Services (HHS), the National Vaccine Program Office (NVPO) coordinates vaccine-related activities, and the Food and Drug Administration (FDA) is responsible for the regulation of vaccines and other biologics. Also involved in vaccine activities are other components of HHS (e.g., the National Institutes of Health, the Centers for Disease Control and Prevention, and the Health Resources and Services Administration), the Departments of Defense, Veterans Affairs, and Homeland Security, and the U.S. Agency for International Development. Concerned about bioterrorist attacks in the USA, the 107th Congress passed several vaccine-related measures and the 108th Congress continued with legislative and oversight activities regarding the development and purchase of vaccines against possible bioterrorist attacks and dealing with the sudden shortage of influenza vaccine at the outset of the 2004-2005 flu season. Obstacles to vaccine availability such as production costs, concern for liability expenses, weak markets, and difficulties in predicting need often have economic roots. As mechanisms to enhance availability, Congress may consider financial incentives, public-private partnerships, improved coordination, and alternatives to safety and effectiveness documentation.
DTIC

*Drugs; Immunology; Law (Jurisprudence); Policies; Public Health; Vaccines*

**20070019067** Library of Congress, Washington, DC USA

**Military Medical Care Services: Questions and Answers**

Best ,Jr, Richard A; May 5, 2005; 18 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465432; CRS-IB93103; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465432

The primary mission of the Military Health Services System (MHSS), which encompasses the Defense Department's hospitals, clinics, and medical personnel, is to maintain the health of military personnel so they can carry out their military missions, and to be prepared to deliver health care during wartime. The military medical system also provides, where space is available, health care services in Department of Defense (DOD) medical facilities to dependents of active duty service members and to retirees and their dependents. The Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) was established in 1966 legislation as the military equivalent of a health insurance plan, run by DOD, for active duty dependents, military retirees, and the dependents of retirees, survivors of deceased members, and certain former spouses. CHAMPUS reimburses beneficiaries for portions of the costs of health care received from civilian providers. As a follow-on to CHAMPUS, DOD established Tricare to coordinate the efforts of the services medical facilities. Tricare also provides beneficiaries with the opportunity to receive their care through a DOD-managed health maintenance organization, a preferred provider organization, or to continue to use regular CHAMPUS (now known as Tricare Standard).
DTIC

*Health; Hospitals; Medical Personnel; Medical Services; Military Operations*

**20070019090** Dartmouth Coll., Hanover, NH USA

**Improving Symptom Control, QOL, and Quality of Care for Women with Breast Cancer: Developing a Research Program on Neurological Effects via Doctoral Education**

Bakitas, Marie; Ahles, Tim A; Jun 2006; 129 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-03-1-0298

Report No.(s): AD-A465488; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465488

The purpose of this traineeship was to develop the academic, clinical, and research skills of an expert advanced practice nurse within the context of a mentor's funded program of research on the Cognitive Effects of Chemotherapy. The scope of the program was to support the trainee's doctoral education with an ultimate career goal of becoming a Clinical Breast Cancer Research Scientist through a mentored research experience. Ms. Bakitas expanded an established research program on CNS

effects by developing a parallel focus on the peripheral nervous system effects of chemotherapy on quality of life. The major achievements of this final report, are the successful accomplishment of the planned training activities/tasks through the completion of the doctoral degree through successful defense of the dissertation, abstract presentations, acquiring an ACS doctoral scholarship, and receiving the Anthony DiGuida Research Prize for the dissertation. The significance of these achievements is that this funding has supported the training of a clinical nurse expert in a foundation for conduct of clinical breast cancer research.
DTIC
*Breast; Cancer; Education; Females; Mammary Glands; Neurology; Signs and Symptoms*

**20070019091** Loma Linda Univ., CA USA
**Pim-1: A Molecular Target to Modulate Cellular Resistance to Therapy in Prostate Cancer**
Lilly, Michael B; Oct 2006; 29 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-04-1-0887
Report No.(s): AD-A465489; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465489

The contract supports studies to define the role of the Pim-1 kinase in acquired resistance to chemotherapy by prostate cancer cells. Data to date for specific aim #1 define a signaling pathway induced by docetaxel, involving sequential steps of JAK1/2 activation, STAT3 phosphorylation, expression of Pim-1, and activation of NFkB signaling. Blockade of this pathway by expression of dominant negative Pim-1 proteins blocks drug-induced upregulation of NFkB activity, and sensitizes cells to docetaxel. Other studies (specific aim #2) focus on identifying a mechanism through which Pim-1 activates NFkB. We have unambiguously identified S937 as the major Pim-1 phosphorylation site on the NFKB1/p105 precursor protein, through use of LCM/MS/MS analysis. Other kinases that can phosphorylate this site include AKT and PKA. Additional data (specific aim #3) have been published to describe a small molecule inhibitor of Pim-1. This molecule can sensitize prostate cancer cells to the cytotoxic effects of docetaxel in an additive or synergistic manner.
DTIC
*Cancer; Enzymes; Phosphorus; Prostate Gland; Targets; Therapy*

**20070019093** Army Southeastern Regional Medical Command, Fort Gordon, GA USA
**Updating the Medical Military Unique Curriculum Using the SOFMH Online Editorial Review System**
Gore, Ney; Sep 2005; 217 pp.; In English
Contract(s)/Grant(s): 4EGAGMM4071
Report No.(s): AD-A465494; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465494

The Military Unique Curriculum (MUG) consists of 24 individual learning modules The Center for Total Access (CTA) applied for a FY04 grant of $298,200 to $120.000 to update these modules but only $120,000 was awarded Since the funding that we applied for was cut by 60% It was decided to concentrate our efforts on updating the eight modules of the Military Unique Curriculum that dealt with Chemical, Biological, Radiological Nuclear, and Explosive (CBRNE) topics. These modules are entitled: (1) Chemical Casualties: Introduction (2) Chemical Casualties: Vesicants (3) Chemical Casualties; Nerve Agents (4)Chemical Casualties: Pulmonary Agents (5)Chemical Casualties: Cyanide (6)Biological Warfare and Terrorism (7) Triage and Treatment of Radiation Casualties (8) Wounds of War There were three reasons for selecting these eight modules out of the twenty- four MUC modules (1) The USA is at war and these modules were felt to be the most valuable to the deployed military medical personnel (2) These eight were selected because of the pressing and urgent need to provide CBRNE education to military medical personnel in response to the 9 January 2004 Memorandum from the Assistant Secretary of Defense of Defense for Health Affairs Dr William Winkenwerder (see Appendix E) (3)We had access to up-to-date educational material from the Basic Disaster Life Support (BDLS) course.
DTIC
*Education; Medical Services; Military Operations; Military Personnel; On-Line Systems*

**20070019129** Israel Inst. for Biological Research, Ness-Ziona, Israel
**Generation of Recombinant Human AChE OP-Scavengers with Extended Circulatory Longevity**
Shafferman, Avigdor; Nov 2006; 144 pp.; In English
Contract(s)/Grant(s): DAMD17-03-C-0012
Report No.(s): AD-A465580; No Copyright; Avail.: CASI: A07, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465580

We demonstrate that chemical conjugation of polyethylene glycol (PEG) moieties to recombinant human acetylcholinesterase (rHuAChE) gives rise to OP bioscavenger species which reside for very long periods of time in the circulation of mice, regardless of their post-translation-modification state, and that circulatory elimination of AChE via specific amino acid-related epitopes can also be efficiently overcome by enzyme PEGylation. Taken together, these findings indicate that the circulatory residence is dictated primarily by the PEG appendage. In line with these findings, we examined the possibility to express human AChE in microorganism-based production systems which do not support animal-cell-related enzyme processing, utilizing a specialized designed synthetic human AChE gene. Although the gene product was rapidly degraded in Bacillus brevis cells, the Pichia pastoris yeast cell system was shown to support production and secretion of bioactive rHuAChE. In a series of studies we demonstrate that selective removal of human AChE lysine residues, which serve as target sites for PEG-conjugation, can generate an enzyme, which upon PEGylation, displays a high degree of homogeneity, extended circulatory longevity and reduced immunogenicity. In structure-function studies of AChE, we compared the reactivities of enantiomers of VX and their noncharged isosters, as well as ecothiophate, in conjunction with a battery of AChE mutants. These studies allowed us to define two subsites, located in the active site and peripheral anionic subsites, which confer enzyme stereoselectivity to CW agents such as VX.
DTIC
*Acetyl Compounds; Cholinesterase; Circulation; Pharmacology; Scavenging*

**20070019139** General Accounting Office, Washington, DC USA
**Defense Health Care. Force Health Protection and Surveillance Policy Compliance Was Mixed, but Appears Better for Recent Deployments**
Spruill, Clifton E; Fox, Steve; Beale, Rebecca; Holihan, Margaret; Johnson, Lynn; Mason, Susan; Mathers, William; Mejstrik, Clara; Rice, Christopher; Richardson, Terry; Nov 2004; 50 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465605; GAO-05-120; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465605

Overall compliance with DOD s force health protection and surveillance policies for servicemembers who deployed in support of OIF varied by service, by installation, and by policy requirement. Army and Air Force compliance during OIF for the installations in our review appears much better compared to the installations included in our previous review7 of OEF and OJG. Installations we examined from the Marine Corps, on the other hand, generally had lower levels of compliance across the policy requirements we examined when compared to other services; however, we did not review medical records from the Marines or Navy in our previous review. Our review disclosed that the extent of policy compliance varied in the following areas: ' Deployment health assessments. The Army and the Air Force installations were generally missing small percentages (less than 10 percent) of pre-deployment health assessments. In contrast, pre-deployment health assessments were missing for an estimated 63 percent8 of the servicemembers at one Marine Corps installation and for about 27 percent at the other Marine Corps installation reviewed. The Navy installation in our review was missing pre-deployment health assessments for 24 percent of the servicemembers. Post-deployment health assessments were completed for most servicemembers (95 percent or more) in our samples, except at one of the Marine Corps installations we visited. While almost all post-deployment health assessments for the services were completed within DOD required time frames except for one Army installation, many of the pre-deployment health assessments in our samples were not. Except for servicemembers at one of the two Marine Corps installations visited, a health care provider reviewed all but small percentages of the completed health assessments as required by DOD policy.
DTIC
*Deployment; Health; Medical Services; Military Personnel; Policies; Protection; Surveillance*

**20070019141** Minnesota Univ., Minneapolis, MN USA
**Role of Rad23 and Dsk2 in Nucleotide Excision Repair and Spindle Pole Body Duplication**
Diaz-Martinez, Laura; Mar 2007; 27 pp.; In English
Contract(s)/Grant(s): W81XWH-05-1-0310
Report No.(s): AD-A465609; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465609

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 or spindle dynamics. 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
*Maintenance; Nucleotides; Proteins; Reproduction (Copying); Spindles*

**20070019169** Georgia Inst. of Tech., Atlanta, GA USA
**A Statistically Based Surface Evolution Method for Medical Image Segmentation: Presentation and Validation**
Pichon, Eric; Tannenbaum, Allen; Kikinis, Ron; Jan 2003; 9 pp.; In English
Report No.(s): AD-A465665; No Copyright; Avail.: CASI: A02, Hardcopy

In this paper we present a new algorithm for 3D medical image segmentation. The algorithm is fast, relatively simple to implement, and semi-automatic. It is based on minimizing a global energy defined from a learned non-parametric estimation of the statistics of the region to be segmented. Implementation details are discussed and source code is freely available as part of the 3D Slicer project. In addition, a new unified set of validation metrics is proposed. Results on artificial and real MRI images show that the algorithm performs well on large brain structures both in terms of accuracy and robustness to noise.
DTIC
*Image Processing; Segments*

**20070019226** Georgia Inst. of Tech., Atlanta, GA USA
**Knowledge-Based 3D Segmentation and Reconstruction of Coronary Arteries Using CT Images**
Yang, Yan; Tannenbaum, Allen; Giddens, Don; Sep 2004; 4 pp.; In English
Report No.(s): AD-A465805; No Copyright; Avail.: CASI: A01, Hardcopy

An approach for the 3D segmentation and reconstruction of human left coronary arteries using angio-CT images is presented in this paper. Each voxel in the 3D dataset is assumed to belong to one of the three homogeneous regions: blood, myocardium, and lung. A priori knowledge of the regions is introduced via Bayes rule. Posterior probabilities obtained using Bayes rule are anisotropically smoothed, and the 3D segmentation is obtained via MAP classifications of the smoothed posteriors. An active contour model is then applied to extract the coronary arteries from the rest of the volumetric data with subvoxel accuracy. The geometric model of the left coronary arteries obtained in this work may be used to provide accurate boundary conditions for hemodynamic simulations, or to provide objective measurements of clinically relevant parameters such as lumen sizes in a 3D sense.
DTIC
*Arteries; Computer Aided Tomography; Coronary Circulation; Knowledge Based Systems; Segments*

**20070019350** Executive Office of the President, Washington, DC USA
**National Nanotechnology Initiative. Research and Development Supporting the Next Industrial Revolution. Supplement to the President's 2004 Budget**
Jan 2004; 55 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465646; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465646

Imagine a single area of scientific discovery with the potential to enable a wealth of innovative new technologies across a vast array of fields including healthcare, information technology, energy production and utilization, homeland security and national defense, biotechnology, food and agriculture, aerospace, manufacturing, and environmental improvement. Nanoscience, the study of the unique properties of matter that occur at extremely small scales, has this potential. Advances in nanoscience and nanoengineering are already ushering in new applications or nanotechnologies that are leading to improved products across a broad realm of sectors, from textiles to electronics. Some of these improved products are already available, including improved catalysts, stain resistant fabrics, better sunscreens, superior dental bonding materials, high resolution printer inks, digital camera displays, and high capacity computer hard disks, to name a few.
DTIC
*Biotechnology; Defense Program; Federal Budgets; Management Systems; Medical Services; Nanotechnology*

**20070019363** NASA Johnson Space Center, Houston, TX, USA
**Chromosome Model reveals Dynamic Redistribution of DNA Damage into Nuclear Sub-domains**
Costes, Sylvain V.; Ponomarev, Artem; Chen, James L.; Cucinotta, Francis A.; Barcellos-Hoff, Helen; [2007]; 29 pp.; In English; Journal PLOS, projected Aug. 1, 2007; Copyright; Avail.: CASI: A03, Hardcopy

Several proteins involved in the response to DNA double strand breaks (DSB) form microscopically visible nuclear domains, or foci, after exposure to ionizing radiation. Radiation-induced foci (RIF) are believed to be located where DNA damage is induced. To test this assumption, we analyzed the spatial distribution of 53BP1, phosphorylated ATM and gammaH2AX RIF in cells irradiated with high linear energy transfer (LET) radiation. Since energy is randomly deposited along high-LET particle paths, RIF along these paths should also be randomly distributed. The probability to induce DSB can be derived from DNA fragment data measured experimentally by pulsed-field gel electrophoresis. We used this probability in Monte Carlo simulations to predict DSB locations in synthetic nuclei geometrically described by a complete set of human chromosomes, taking into account microscope optics from real experiments. As expected, simulations produced DNA-weighted random (Poisson) distributions. In contrast, the distributions of RIF obtained as early as 5 min after exposure to high LET (1 GeV/amu Fe) were non-random. This deviation from the expected DNA-weighted random pattern can be further characterized by relative DNA image measurements. This novel imaging approach shows that RIF were located preferentially at the interface between high and low DNA density regions, and were more frequent in regions with lower density DNA than predicted. This deviation from random behavior was more pronounced within the first 5 min following irradiation for phosphorylated ATM RIF, while gammaH2AX and 53BP1 RIF showed very pronounced deviation up to 30 min after exposure. These data suggest the existence of repair centers in mammalian epithelial cells. These centers would be nuclear sub-domains where DNA lesions would be collected for more efficient repair.
Author
*Chromosomes; Deoxyribonucleic Acid; Ionizing Radiation; Nuclei; Mathematical Models*

**20070019364** NASA Johnson Space Center, Houston, TX, USA
**DNA Recombinase Proteins, their Function and Structure in the Active Form, a Computational Study**
Carra, Claudio; Cucinotta, Francis A.; July 8, 2007; 1 pp.; In English; Enzymes, coenzymes and Metabolic Pathways, 8-13 Jul. 2007, Biddeford, ME, USA; Copyright; Avail.: Other Sources; Abstract Only

Homologous recombination is a crucial sequence of reactions in all cells for the repair of double strand DNA (dsDNA) breaks. While it was traditionally considered as a means for generating genetic diversity, it is now known to be essential for restart of collapsed replication forks that have met a lesion on the DNA template (Cox et al., 2000). The central stage of this process requires the presence of the DNA recombinase protein, RecA in bacteria, RadA in archaea, or Rad51 in eukaryotes, which leads to an ATP-mediated DNA strand-exchange process. Despite many years of intense study, some aspects of the biochemical mechanism, and structure of the active form of recombinase proteins are not well understood. Our theoretical study is an attempt to shed light on the main structural and mechanistic issues encountered on the RecA of the e-coli, the RecA of the extremely radio resistant Deinococcus Radiodurans (promoting an inverse DNA strand-exchange repair), and the homolog human Rad51. The conformational changes are analyzed for the naked enzymes, and when they are linked to ATP and ADP. The average structures are determined over 2ns time scale of Langevian dynamics using a collision frequency of 1.0 ps(sup -1). The systems are inserted in an octahedron periodic box with a 10 Angstrom buffer of water molecules explicitly described by the TIP3P model. The corresponding binding free energies are calculated in an implicit solvent using the Poisson-Boltzmann solvent accessible surface area, MM-PBSA model. The role of the ATP is not only in stabilizing the interaction RecA-DNA, but its hydrolysis is required to allow the DNA strand-exchange to proceed. Furthermore, we extended our study, using the hybrid QM/MM method, on the mechanism of this chemical process. All the calculations were performed using the commercial code Amber 9.
Author
*Biochemistry; Deoxyribonucleic Acid; Proteins; Biological Diversity*

## 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*.

**20070018856** NASA Johnson Space Center, Houston, TX, USA
**Interactions of the C-terminal Domain of Human Ku70 with DNA Substrate: A Molecular Dynamics Study**
Hu, Shaowen; Huff, Janice; Pluth, Janice M.; Cucinotta, Francis A.; [2007]; 1 pp.; In English; International Congress of Radiation Research, 8-12 Jul. 2007, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

NASA is developing a systems biology approach to improve the assessment of health risks associated with space

radiation. The primary toxic and mutagenic lesion following radiation exposure is the DNA double strand break (DSB), thus a model incorporating proteins and pathways important in response and repair of this lesion is critical. One key protein heterodimer for systems models of radiation effects is the Ku(sub 70/80) complex. The Ku70/80 complex is important in the initial binding of DSB ends following DNA damage, and is a component of nonhomologous end joining repair, the primary pathway for DSB repair in mammalian cells. The C-terminal domain of Ku70 (Ku70c, residues 559-609), contains an helix-extended strand-helix motif and similar motifs have been found in other nucleic acid-binding proteins critical for DNA repair. However, the exact mechanism of damage recognition and substrate specificity for the Ku heterodimer remains unclear in part due to the absence of a high-resolution structure of the Ku70c/DNA complex. We performed a series of molecular dynamics (MD) simulations on a system with the subunit Ku70c and a 14 base pairs DNA duplex, whose starting structures are designed to be variable so as to mimic their different binding modes. By analyzing conformational changes and energetic properties of the complex during MD simulations, we found that interactions are preferred at DNA ends, and within the major groove, which is consistent with previous experimental investigations. In addition, the results indicate that cooperation of Ku70c with other subunits of Ku(sub 70/80) is necessary to explain the high affinity of binding as observed in experiments. Author

*Radiation Effects; Deoxyribonucleic Acid; Lesions; Risk; Health; Molecular Dynamics; Extraterrestrial Radiation*

**20070018868** NASA Johnson Space Center, Houston, TX, USA

**Mechanisms of Injury and Countermeasures for EVA Associated Upper Extremity Medical Issues: Extended Vent Tube Study**

Jones, Jeff; Hoffman, Ron; Harvey, Craig; Bowen, C. K.; Hudy, C. E.; Tuxhorn, Jennifer; Gernhardt, Mike; Scheuring, Richard A.; May 2007; 33 pp.; In English; 16th Humans in Space 2007, 20-24 May 2007, Beijing, China; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018868

The goal of this study is to determine the role that moisture plays in the injury to the fingers and fingernails during EVA training operations in the Neutral Buoyancy Laboratory. Current Extravehicular Mobility Unit (EMU, with a PLSS) as configured in the NBL was used for all testing and a vent tube was extended down a single arm of the crewmember during the test; vent tube was moved between left and right arm to serve as experimental condition being investigated and the other arm served as control condition.

Derived from text

*Countermeasures; Extravehicular Activity; Injuries; Portable Life Support Systems; Vents; Fingers; Aerospace Medicine; Pipes (Tubes)*

**20070019121** West Virginia Univ., Morgantown, WV USA

**Exercise and Bone Density: Meta-Analysis**

Kelley, George A; Sharpe-Kelley, Kristi; Jan 2007; 98 pp.; In English

Contract(s)/Grant(s): DAMD17-98-1-8513

Report No.(s): AD-A465550; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465550

Our first two-year period of funding focused on using the meta-analytic approach to examine the effects of exercise on BMD in adult humans using summary means from completed studies. Since no meta-analysis had existed using individual patient data (IPD) to examine the effects of exercise on BMD, our second two-year period of funding was devoted to examining the feasibility of such. The major conclusions from this work are as follows: (1) site-specific, weight bearing exercise appears to increase and/or maintain BMD anywhere from 1% to 3% in both men and women, (2) when conducting meta-analytic research, either the original metric or standardized effect size can be used when analyzing data dealing with the effects of exercise on BMD in adults, (3) Given the poor response rate in the retrieval of IPD, the use of summary means meta-analyses may be more appropriate for studies dealing with the effects of exercise on BMD in adults, (4) Adherence to the recent recommendations from the American College of Sports Medicine regarding physical activity and bone health should bring about the 1% to 3% benefit observed in our meta-analytic work.

DTIC

*Bone Mineral Content; Bones; Minerals; Physical Exercise*

**20070019358** NASA Johnson Space Center, Houston, TX, USA

**Biomedical Results of ISS Expeditions 1-12**

Fogarty, Jennifer; Sams, Clarence F.; March 2007; 16 pp.; In English; 3rd Bi-annual Countermeasure Summit, 5-9 Mar. 2007, Houston, TX, USA; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

A viewgraph presentation on biomedical data from International Space Station (ISS) Expeditions 1-12 is shown. The topics include: 1) ISS Expeditions 1-12; 2) Biomedical Data; 3) Physiological Assessments; 4) Bone Mineral Density; 5) Bone Mineral Density Recovery; 6) Orthostatic Tolerance; 7) Postural Stability Set of Sensory Organ Test 6; 8) Performance Assessment; 9) Aerobic Capacity of the Astronaut Corps; 10) Pre-flight Aerobic Fitness of ISS Astronauts; 11) In-flight and Post-flight Aerobic Capacity of the Astronaut Corps; and 12) ISS Functional Fitness Expeditions 1-12.
CASI
*Biomedical Data; Expeditions; International Space Station; Manned Space Flight*

**20070019359** NASA Johnson Space Center, Houston, TX, USA
**WISE-2005: Supine Treadmill Exercise within Lower Body Negative Pressure and Flywheel Resistive Exercise as a Countermeasure to Bed Rest-Induced Bone Loss during 60-Day Simulated Microgravity in Women**
Smith, Scott M.; Zwart, Sara R.; Heer, Martina; Lee, Stuart M. C.; Meuche, Sabine; Macias, Brandon R.; Schneider, Suzanne; Hargens, Alan R.; [2007]; 27 pp.; In English
Contract(s)/Grant(s): NNJ04HF71G; Copyright; Avail.: CASI: A03, Hardcopy

Aerobic or resistive exercise can decrease bone loss. We examined the effect of combining these exercise modalities on bone metabolism during a 60-day bed rest. Sixteen women were randomly assigned to control or exercise groups. Combined exercise did not prevent bone resorption, but may help promote bone formation.
Author
*Bed Rest; Bone Demineralization; Flywheels; Lower Body Negative Pressure; Microgravity; Physical Exercise; Treadmills; Simulation; Biochemistry; Supine Position*

**20070019365** NASA Johnson Space Center, Houston, TX, USA
**The Effect of Manipulating Subject Mass on Lower Extremity Torque Patterns During Locomotion**
DeWitt, John K.; Cromwell, Ronita L.; Hagan, R. Donald; [2007]; 2 pp.; In English; American Society of Biomechanics Annual Meeting, 22-25 Aug. 2007, Palo Alto, CA, USA; Copyright; Avail.: CASI: A01, Hardcopy

During locomotion, humans adapt their motor patterns to maintain coordination despite changing conditions (Reisman et al., 2005). Bernstein (1967) proposed that in addition to the present state of a given joint, other factors, including limb inertia and velocity, must be taken into account to allow proper motion to occur. During locomotion with added mass counterbalanced using vertical suspension to maintain body weight, vertical ground reaction forces (GRF's) increase during walking but decrease during running, suggesting that adaptation may be velocity-specific (De Witt et al., 2006). It is not known, however, how lower extremity joint torques adapt to changes in inertial forces. The purpose of this investigation was to examine the effects of increasing body mass while maintaining body weight upon lower-limb joint torque during walking and running. We hypothesized that adaptations in joint torque patterns would occur with the addition of body mass.
Derived from text
*Limbs (Anatomy); Body Weight; Torque; Joints (Anatomy); Locomotion*

## 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*.

**20070018809** NASA Johnson Space Center, Houston, TX, USA
**International Space Station Atmosphere Control and Supply, Atmosphere Revitalization, and Water Recovery and Management Subsystem - Verification for Node 1**
Williams, David E.; [2007]; 14 pp.; In English; 37th International Conference on Environmental Control and Life Support, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): 401769.06.01.01.01; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018809

The International Space Station (ISS) Node 1 Environmental Control and Life Support (ECLS) System is comprised of five subsystems: Atmosphere Control and Supply (ACS), Atmosphere Revitalization (AR), Fire Detection and Suppression (FDS), Temperature and Humidity Control (THC), and Water Recovery and Management (WRM). This paper provides a

summary of the nominal operation of the Node 1 ACS, AR, and WRM design and detailed Element Verification methodologies utilized during the Qualification phase for Node 1.
Author
*International Space Station; Water Reclamation; Environmental Control; Atmospheric Temperature; Control Systems Design; Smoke Detectors; Life Support Systems*

**20070018810** NASA Johnson Space Center, Houston, TX, USA
**International Space Station USOS Waste and Hygiene Compartment Development**
Link, Dwight E., Jr.; Broyan, James Lee, Jr.; Gelmis, Karen; Philistine, Cynthia; Balistreri, Steven; [2007]; 6 pp.; In English; 37th International Space Station USOS Waste and Hygiene Compartment Development, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): 401769.06.03.03.02.02
Report No.(s): Paper Number 07ICES-314; Copyright; Avail.: Other Sources

The International Space Station (ISS) currently provides human waste collection and hygiene facilities in the Russian Segment Service Module (SM) which supports a three person crew. Additional hardware is planned for the USA Operational Segment (USOS) to support expansion of the crew to six person capability. The additional hardware will be integrated in an ISS standard equipment rack structure that was planned to be installed in the Node 3 element; however, the ISS Program Office recently directed implementation of the rack, or Waste and Hygiene Compartment (WHC), into the U.S. Laboratory element to provide early operational capability. In this configuration, preserved urine from the WHC waste collection system can be processed by the Urine Processor Assembly (UPA) in either the U.S. Lab or Node 3 to recover water for crew consumption or oxygen production. The human waste collection hardware is derived from the Service Module system and is provided by RSC-Energia. This paper describes the concepts, design, and integration of the WHC waste collection hardware into the USOS including integration with U.S. Lab and Node 3 systems.
Author
*Human Wastes; International Space Station; Service Modules; Collection; Water Consumption; Oxygen Production; Hygiene; Urine*

**20070018811** NASA Johnson Space Center, Houston, TX, USA
**Crew Exploration Vehicle Environmental Control and Life Support Design Reference Missions**
Lewis, John F.; Anderson, Molly K.; Ewert, Mike S.; Stephan, Ryan A.; Carrasquillo, Robyn L.; [2007]; 9 pp.; In English; International Conference of Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): 644423.02.36.12.10
Report No.(s): Rept-07ICES-173; Copyright; Avail.: Other Sources

In preparation for the contract award of the Crew Exploration Vehicle (CEV), the National Aeronautics and Space Administration (NASA) produced two design reference missions for the vehicle. The design references used teams of engineers across the agency to come up with two configurations. This process helped NASA understand the conflicts and limitations in the CEV design, and investigate options to solve them.
Author
*Crew Exploration Vehicle; Environmental Control; Life Support Systems*

**20070019086** Army Tank-Automotive Research and Development Command, Warren, MI USA
**DoD Force Protection Presentation**
Freeman, Marilyn D; Apr 13, 2006; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465481; TARDEC-15702; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465481

The Army's scientific and technical vision is to pursue transformational capabilities for a joint and expeditionary army. The Army seeks to accelerate technology directly into Current Modular Force. Key focus areas are soldier protection technologies.
DTIC
*Protection*

**20070019294** NASA Johnson Space Center, Houston, TX, USA

**Nanoscale Materials for Human Space Exploration: Regenerable CO2 Removal**

Arepalli, Sivaram; Nikolaev, Pasha; Gorelik, Olga; Huffman, Chad; Moloney, Padraig; Allada, Ram; Yowell, Leonard; June 2005; 16 pp.; In English; Environmental Sentinels 2005, 1-2 June 2005, Houston, TX, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

This viewgraph presentation reviews the use of Nanoscale materials in CO2 removal. It presented the background and review work on regenerable CO2 removal for spaceflight application. It demonstrated a new strategy for developing solid-supported amine absorbents based on carbon nanotube materials.

Derived from text

*Carbon Dioxide Removal; Carbon Nanotubes; Amines; Regeneration (Engineering); Reclamation; Air Purification; Decontamination; Life Support Systems*

**20070019346** NASA Johnson Space Center, Houston, TX, USA

**Crew Exploration Vehicle Environmental Control and Life Support Development Status**

Lewis, John F.; Barido, Richard; Carrasquillo, Robyn; Cross, CIndy; Peterson, Laurie; Tuan, George; [2007]; 6 pp.; In English; International Conference on Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations

Contract(s)/Grant(s): 644423.02.36.12.10

Report No.(s): SAE-2007-01-3044; Copyright; Avail.: Other Sources

The Crew Exploration Vehicle (CEV) is the first crew transport vehicle to be developed by the National Aeronautics and Space Administration (NASA) in the last thirty years. The CEV is being developed to transport the crew safely from the Earth to the Moon and back again. This year, the prime contractor has been selected, requirements have been refined, and development areas are being pursued. The Environmental Control and Life Support (ECLS) system, which includes the life support and active thermal control systems, is moving one year closer to performing on orbit.

Author

*Crew Exploration Vehicle; Life Support Systems; Transport Vehicles; Temperature Control; Active Control; Environmental Control*

**20070019348** Executive Office of the President, Washington, DC USA

**National Plant Genome Initiative: 2003-2008**

Jan 2003; 24 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465635; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465635

The National Plant Genome Initiative (NPGI) was established in 1998 as a coordinated national plant genome research program by the Interagency Working Group (IWG) on Plant Genomes with representatives from the Department of Agriculture (USDA), Department of Energy (DOE), National Institutes of Health (NIH), National Science Foundation (NSF), Office of Science and Technology Policy (OSTP), and the Office of Management and Budget (OMB). Since 1998, the field of plant genomics has made tremendous strides. It has changed the way research is conducted in plant biology; it has attracted a new generation of scientists into the field; and it has contributed new information and knowledge to science. Through development of plant genomic resources, the NPGI has built a foundation on which the scientific community can advance research, not only in plant genomics but also in diverse disciplines ranging from fundamental biological sciences to biotechnology. In this report, the IWG describes the NPGI plan for next five years (2003-2008). The IWG solicited and received input from many sources, which were used as the basis for this plan.

DTIC

*Agriculture; Biotechnology; Federal Budgets; Genome; Organizations*

## 55
## EXOBIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

**20070018800** NASA Marshall Space Flight Center, Huntsville, AL, USA

**A Minimized Technological Approach towards Human Self Sufficiency off Earth**

Curreri, Peter A.; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 11-15 Feb. 2007, Albuquerque, NM, USA; No Copyright; Avail.: Other Sources; Abstract Only

Gerard K. O'Neill devised and popularized an approach to extend human life beyond Earth. O'Neill's approach (believed to be viable with 1970's technology) would use space resources (lunar and asteroids) to construct cities in space capable of supporting 1 to 3 million people. By construction of Space Solar Power Satellites (of the type advocated by Peter Glaser in the early 1970s) his analysis predicted in testimony to the Senate Subcommittee on Aerospace Technology, 1976, that the venture would break even financially in about 17 years with an Apollo level of investment. The result of this investment could have been abundant cheep energy on Earth and millions of people living in space by the 1990s. Of course, as history proved, society was not ready to sustain a leap of this magnitude regardless of the obvious benefits. This paper results for asking the question 'What is the minimum technical investment that could enable a self sufficient expansion of humanity beyond Earth?' A minimum technical system is described (dubbed SpaCel) that could support one human reproductive unit (family) in free space or on a planetary or lunar surface. The system consists of life support, materials extraction, mobility, and power production. It is capable of reproducing it self, with the help of the humans aboard, in one generation. It is the subsistence farm relative to O'Neill's city. Once the technology is developed for the single unit, many could be deployed. They could reproduce themselves using space resources and energy at an exponential rate. One would imagine cooperation of these units to build any combination of towns, cities and nations in space to extend human life beyond Earth.

Author

*Extraterrestrial Life; Earth (Planet); Technology Utilization; Extraterrestrial Resources*

**20070019376** NASA Johnson Space Center, Houston, TX, USA

**Advanced Extravehicular Activity Breakout Group Summary**

Kosmo, Joseph J.; Perka, Alan; Walz, Carl; Cobb, Sharon; Hanford, Anthony; Eppler, Dean; May 19, 2005; 16 pp.; In English; ESA-NASA Planetary Protection & Mars Workshop, 19-20 May 2005, Noordwijk, Netherlands; Copyright; Avail.: CASI: A03, Hardcopy

This viewgraph document summarizes the workings of the Advanced Extravehicular Activity (AEVA) Breakout group in a Martian environment. The group was tasked with: identifying potential contaminants and pathways for AEVA systems with respect to forward and backward contamination; identifying plausible mitigation alternatives and obstacles for pertinent missions; identifying topics that require further research and technology development and discuss development strategies with uncertain Planetary Protection (PP) requirements; Identifying PP requirements that impose the greatest mission/development costs; Identifying PP requirements/topics that require further definition;

CASI

*Contamination; Extravehicular Activity; Mission Planning; Planetary Protection; Extraterrestrial Life*

## 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*.

**20070019092** Naval Research Lab., Washington, DC USA

**Practical Defenses Against Storage Jamming**

McDermott, J; Froscher, J; Jan 1997; 13 pp.; In English

Report No.(s): AD-A465493; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465493

Storage jamming [15] is malicious but surreptitious modification of stored data, to reduce its quality. The person initiating the storage jamming does not receive any direct benefit. Instead, the goal is more indirect, such as deteriorating the position

of a competitor. We assume that a Trojan horse does the storage jamming, since the Trojan horse may access data that the attacker cannot. Manual storage jamming is possible, but in general much less effective. We call values that should be stored authentic values. We call values stored by a jammer bogus values. A storage jamming attack diverges the state of the stored data from the authentic state. The attacker expects the bogus state will adversely affect the victim's performance of some real-world task. On the other hand, the attacker does not want the user to experience a catastrophic failure. The attacker expects that the victim will not detect the source of the problem but will continue to use the damaged data for a relatively long time. We make this more precise with the notion of lifetime. We define the lifetime of a storage jammer as the number of jams it can perform against a specific system before being discovered. The discovery does not necessarily have to be made on the system being jammed. The lifetime of a storage jammer is a function of the rate and extent of its jamming, the specific user population, and the seriousness of its impact on the real world.
DTIC
*Computer Information Security; Computer Storage Devices; Data Storage; Jamming*

**20070019105** Naval Research Lab., Washington, DC USA
**On Unifying Some Cryptographic Protocol Logics**
Syverson, Paul F; van Oorschot, Paul C; Jan 1994; 16 pp.; In English
Report No.(s): AD-A465512; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465512

We present a logic for analyzing cryptographic protocols. This logic encompasses a unification of four of its predecessors in the BAN family of logics, namely those given in [GNY90], [AT91], [vO93], and BAN itself [BAN89]. We also present a model-theoretic semantics with respect to which the logic is sound. The logic herein captures all of the desirable features of its predecessors and more; nonetheless, it accomplishes this with no more axioms or rules than the simplest of its predecessors.
DTIC
*Computers; Cryptography; Logic Design; Protocol (Computers)*

**20070019125** Naval Research Lab., Washington, DC USA
**Controlled Link Sharing and Quality of Service Data for Military Internetworking (Preprint)**
Macker, Joseph P; Jan 1996; 9 pp.; In English
Report No.(s): AD-A465572; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465572

This paper discusses system design issues related to enhancing present internetworking architectures to achieve controlled link sharing and high assurance data interchange guarantees. The military services are implementing both wired and wireless Internet Protocol (IP) based data networks to provide interoperable, heterogeneous network connectivity. At present, internetwork routing products forward network data traffic with limited concern for the link sharing policies or the specific quality requirements of the traffic flow. An enhanced Integrated Services IP architecture is emerging which provides solutions for a rich set of resource sharing requirements. We present an overview of this architecture and discuss performance issues for candidate system components in a military context. The strong conclusion is that, based upon recent research and emerging technologies, a dynamic mixture of guaranteed services and controlled link sharing is achievable over operational packet networks. We recommend future work to validate candidate servicing models and to understand military application, security, and policy management requirements within this enhanced architecture.
DTIC
*Internets; Military Technology; Protocol (Computers)*

**20070019128** Naval Research Lab., Washington, DC USA
**Storage Jamming**
McDermott, John; Goldschlag, David; Jan 1995; 20 pp.; In English
Report No.(s): AD-A465577; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465577

In the past, the most likely motive for attacks that modify data would have been financial gain. The problem of fraud has been addressed by Clark and Wilson [2], by Sandhu and Jajodia [13], and by others [8, 9]. However, changes in technology have made many organizations so dependent on information systems that it is now possible to disrupt or degrade their operations by interfering with their supporting information systems [3]. When this disruption is accomplished by unauthorized modification of data we call it storage jamming. Storage jamming is the malicious modification of stored data, done for the

purpose of degrading or disrupting real-world operations that depend on the correctness of the data. We assume the person initiating the malicious modification (frequently via a Trojan horse) does not receive any direct benefit, financial or otherwise, but rather is motivated by more indirect goals such as improving the competitive position of his or her own organization. The target data need not be data stored by a general purpose database system, it can be any values stored for future reference: application data, system data (e.g. initialization files), linking data (index structures, hot lists, routing tables), or metadata. In this sense, a file of electronic mail messages that have been saved for future reference is a fair target. We call the values introduced into storage by the jammer bogus values. We call the values we meant to store authentic values. If a data item contains a bogus value, we say that the data item has been jammed. In order to simplify our analysis of a very complex problem, we will exclude the possibility of mistakes made by users or inadvertent flaws in software. (This does not mean that we exclude from consideration conventional data integrity techniques that also have anti-jamming properties.)
DTIC
*Computer Storage Devices; Data Storage; Jamming*

**20070019207** RAM Labs., Inc., San Diego, CA USA
**Evolution of the Standard Simulation Architecture**
Steinman, Jeffrey S; Hardy, Douglas R; Jun 2004; 53 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465748; No Copyright; Avail.: CASI: A04, Hardcopy

This paper proposes the standardization of a layered simulation architecture that addresses the critical modeling needs of the DoD simulation community. The Standard Simulation Architecture works with HLA to provide the additional infrastructure necessary for developing highly inter-acting, decoupled software models, while simultaneously supporting technology infusion from R&D organizations. A layered architecture is proposed to modularize critical capabilities including high-speed communications between nodes in a multiprocessing federate, general-purpose software utilities, modeling semantics, time management, interest management, and automated interoperability with HLA. The interface layers must be standardized to promote (1) model development, (2) portability and interoperability with other models, (3) scalable high performance, and (4) technology infusion from the research community. Through the standardization process, COTS, GOTS, and Open Source business models are supported. The Standard Simulation Architecture extends interoperability and reuse principles to (1) the entities residing within a multiprocessing federate and to (2) the components hierarchically residing within an entity or within components. This standardized hierarchical modeling paradigm promotes development of reusable entity and component repositories that can be reused to support different modeling applications. Instead of providing only course-grained interoperability through HLA, the Standard Simulation Architecture also supports medium and fine-grained interoperability between entities and their components.
DTIC
*Architecture (Computers); Simulation*

**20070019209** Virginia Univ., Charlottesville, VA USA
**Analytical Model for Sensor Placement on Microprocessors**
Lee, Kyeong-Jae; Skadron, Kevin; Huang, Wei; Jan 2005; 5 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W911NF-04-1-0288; CCR-0133634
Report No.(s): AD-A465760; No Copyright; Avail.: CASI: A01, Hardcopy

Thermal management in microprocessors has become a major design challenge in recent years. Thermal monitoring through hardware sensors is important, and these sensors must be carefully placed on the chip to account for thermal gradients. In this paper, we present an analytical model that describes the maximum temperature differential between a hot spot and a region of interest based on their distance and processor packaging information. We also use a runtime thermal model, as an illustration of virtual sensors, and examine two benchmarks that exhibit highly concentrated thermal stress. We then use our analytical model to demonstrate the safety margins of the chip. Ultimately, the mathematical expression allows designers to obtain worst case behavior of thermal heat up and select the optimal location of additional sensors.
DTIC
*Mathematical Models; Microprocessors; Temperature Gradients*

**20070019291** NASA Johnson Space Center, Houston, TX, USA
**Use of Field Programmable Gate Array Technology in Future Space Avionics**
Ferguson, Roscoe C.; Tate, Robert; October 30, 2005; 11 pp.; In English; 24th Digital Avionics Systems Conference (DASC)/IEEE/AIAA, 30 October - 3 November 2005, Washington, DC, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NAS9-20000; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019291

Fulfilling NASA's new vision for space exploration requires the development of sustainable, flexible and fault tolerant spacecraft control systems. The traditional development paradigm consists of the purchase or fabrication of hardware boards with fixed processor and/or Digital Signal Processing (DSP) components interconnected via a standardized bus system. This is followed by the purchase and/or development of software. This paradigm has several disadvantages for the development of systems to support NASA's new vision. Building a system to be fault tolerant increases the complexity and decreases the performance of included software. Standard bus design and conventional implementation produces natural bottlenecks. Configuring hardware components in systems containing common processors and DSPs is difficult initially and expensive or impossible to change later. The existence of Hardware Description Languages (HDLs), the recent increase in performance, density and radiation tolerance of Field Programmable Gate Arrays (FPGAs), and Intellectual Property (IP) Cores provides the technology for reprogrammable Systems on a Chip (SOC). This technology supports a paradigm better suited for NASA's vision. Hardware and software production are melded for more effective development; they can both evolve together over time. Designers incorporating this technology into future avionics can benefit from its flexibility. Systems can be designed with improved fault isolation and tolerance using hardware instead of software. Also, these designs can be protected from obsolescence problems where maintenance is compromised via component and vendor availability.To investigate the flexibility of this technology, the core of the Central Processing Unit and Input/Output Processor of the Space Shuttle AP101S Computer were prototyped in Verilog HDL and synthesized into an Altera Stratix FPGA.
Author
*Field-Programmable Gate Arrays; Astrionics; Spacecraft Electronic Equipment; Spacecraft Instruments; Avionics; Evolvable Hardware; Systems-on-a-Chip*

## 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.

**20070018952** Virginia Univ., Charlottesville, VA USA
**Deployment Strategies for Differentiated Detection in Wireless Sensor Networks**
Zhang, Jingbin; Yan, Ting; Son, Sang H; Jan 2006; 11 pp.; In English
Contract(s)/Grant(s): CCR-0329609; CCR-0325197
Report No.(s): AD-A465201; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465201

In this paper, we address the deployment problem for differentiated detection requirements, in which the required detection probability thresholds at different locations are different. We focus on differentiated deployment algorithms that are applied to the probabilistic detection model, since it is more realistic than the binary detection model. We show that the relationship between the node deployment strategy and the logarithmic collective miss probability distribution is Linear Shift Invariant (LSI). Using this property, we formulate the differentiated deployment problem as an integer linear programming problem, which is a well known NP-hard problem. We propose a differentiated node deployment algorithm called DIFF DEPLOY, which achieves much better performance than the state-of-the-art node deployment algorithm for both uniform and differentiated detection requirements.
DTIC
*Communication Networks; Deployment; Detection; Integers; Linear Programming; Radiotelephones*

**20070018964** Naval Research Lab., Washington, DC USA
**Reducing Uncertainty About Common-Mode Failures**
Voas, Jeffrey; Ghosh, Anup; Charron, Frank; Kassab, Lora; Jan 1997; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-95-C-0282
Report No.(s): AD-A465215; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465215

Multi-version programming is employed in fault tolerant computer systems in order to provide protection against common-mode failure in software. Multi-version programming involves building diverse software implementations of critical functions. The premise of building diverse versions is that the likelihood of a programming error in one version causing a failure in an identical manner as an error in another version is reduced. Skeptics of multi-version programming have correctly pointed out that common-mode failures between redundant diverse versions can reduce the return on investment in creating

diverse versions. To date, other than using historical data from other projects, there has been no way to estimate the potential for a given multi-version programming system to suffer a common-mode failure. This paper presents an algorithm and software analysis prototype to reduce the uncertainty of whether software flaws in diverse versions can result in common-mode failure. The analysis uses software fault injection techniques to subject one or more versions to anomalous behavior. From this, we can predict how the software will behave if real faults exist in the multiple versions.
DTIC
*Computer Programming; Computer Programs; Computer Systems Design; Failure; Fault Tolerance*

**20070018978** Florida Univ., Gainesville, FL USA
**Parallel Matched-Field Tracking (MFT) for Distributed Deployable Systems**
Han, J; Koh, B; George, Alan D; Kim, K; Jan 2001; 4 pp.; In English
Contract(s)/Grant(s): N00014-99-1-0278
Report No.(s): AD-A465242; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465242

Quiet submarine threats and high clutter in the littoral undersea environment demand the development and use of enhanced and new acoustic processing algorithms with increased sophistication. These algorithms exhibit high levels of computational complexity and memory utilization, making implementation in real-time sonar array systems a significant challenge. Concomitant with the increase in demand for computing resources implied by new acoustic processing algorithms, mission requirements continue to transition toward the goal of autonomous, in-situ processing with minimal off-array communication and battery power consumption. Taken together, these trends make imperative the development and use of advanced distributed and parallel processing techniques in terms of algorithm, architecture, network, and system design. In that regard, this presentation focuses on the design and analysis of several novel parallel algorithms for a prominent algorithm in sonar array processing, Matched-Field Tracking (MFT), and includes promising experimental results from a distributed array testbed comprised of a network of SHARC processors.
DTIC
*Algorithms; Parallel Processing (Computers); Regions; Signal Processing; Sonar; Sound Detecting and Ranging; Targets*

**20070018988** Naval Research Lab., Bay Saint Louis, MS USA
**Generalized Vertical Coordinates for Eddy-Resolving Global and Coastal Ocean Forecasts**
Chassignet, Eric P; Hurlburt, Harley E; Smedstad, Ole M; Halliwell, George R; Wallcraft, Alan J; Metzger, E J; Blanton, Brian O; Lozano, Carlos; Rao, Desiraju B; Hogan, Patrick J; Mar 2006; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465260; NRL/JA/7304-05-6046; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465260

Numerical modeling studies over the past several decades have demonstrated progress both in model architecture and in the use of rapidly advancing computational resources. Perhaps the most notable aspect of this progression has been the evolution from simulations on coarse-resolution horizontal and vertical grids that outline basins of simplified geometry and bathymetry and that are forced by idealized surface fluxes, to fine-resolution simulations that incorporate realistic coastline definition and bottom data on relatively short time scales.
DTIC
*Coasts; Coordinates; Forecasting; Mathematical Models; Oceans; Prediction Analysis Techniques; Resolution; Vertical Orientation; Vortices*

**20070018995** Naval Research Lab., Washington, DC USA
**Verifiable Middleware for Secure Agent Interoperability**
Bharadwaj, Ramesh; Oct 2002; 8 pp.; In English
Report No.(s): AD-A465276; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465276

There is an increasing need, within organizations such as the Department of Defense and NASA, for building distributed applications that are rapidly re-configurable and survivable in the face of attacks and changing mission needs. Existing methods and tools are inadequate to deal with the multitude of challenges posed by application development for systems that may be distributed over multiple physical nodes separated by vast geographical distances. The problem is exacerbated in a hostile and unforgiving environment such as space where, in addition, systems are vulnerable to failures. It is widely believed that intelligent software agents are central to the development of agile, efficient, and robust distributed applications. This paper

presents details of agent-based middleware that could be the basis for developing such applications. We pay particular attention to the correctness, survivability, and efficiency of the underlying middleware architecture, and develop a middleware definition language that permits applications to use this infrastructure in a scalable and seamless manner.
DTIC
*Applications Programs (Computers); Computer Programs; Interoperability; Security*

**20070018997** Certico, Inc., Madison, WI USA
**Unlinkable Serial Transactions: Protocols and Applications**
Stubblebine, Stuart G; Syverson, Paul F; Goldschlag, David M; Nov 1999; 37 pp.; In English
Report No.(s): AD-A465280; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465280

We present a protocol for unlinkable serial transactions suitable for a variety of network-based subscription services. It is the first protocol to use cryptographic blinding to enable subscription services. The protocol prevents the service from tracking the behavior of its customers, while protecting the service vendor from abuse due to simultaneous or cloned use by a single subscriber. Our basic protocol structure and recovery protocol are robust against failure in protocol termination. We evaluate the security of the basic protocol and extend the basic protocol to include auditing, which further deters subscription sharing. We describe other applications of unlinkable serial transactions for pay-per-use transactions within a subscription, third-party subscription management, multivendor coupons, proof of group membership, and voting.
DTIC
*Computer Techniques; Cryptography; Information Retrieval; Protocol (Computers)*

**20070019012** Naval Research Lab., Washington, DC USA
**Formal Analysis of Domain Models**
Bharadwaj, Ramesh; Sep 2002; 9 pp.; In English
Report No.(s): AD-A465300; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465300

Recently, there has been a great deal of interest in the application of formal methods, in particular, precise formal notations and automatic analysis tools for the creation and analysis of requirements specifications (i.e., mathematically precise descriptions of the required black-box behavior of a system). In this paper, the author discusses the role of formal methods in requirements engineering (RE), emphasizing that in contrast to their more conventional application in RE for the creation and analysis of requirements specifications, formal methods may be applied in a cost-effective way to answer specific questions about the domain through the construction and automated analysis of 'domain models.'
DTIC
*Computer Programming; Program Verification (Computers); Requirements; Software Engineering; Systems Analysis*

**20070019017** Naval Research Lab., Washington, DC USA
**Analysis of Agent-Based Systems Using Decision Procedures**
Bharadwaj, Ramesh; Jul 2001; 3 pp.; In English
Report No.(s): AD-A465305; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465305

In recent years, model checking has emerged as a remarkably effective technique for the automated analysis of descriptions of hardware systems and communication protocols. To analyze software system descriptions, however, a direct application of model checking rarely succeeds, since these descriptions often have huge (often infinite) state spaces that are not amenable to the finite-state methods of model checking. More important, the computation of a fixpoint (the hallmark of the model-checking approach) is not always needed in practice for the verification of an interesting class of properties, viz, properties that are invariantly true in all reachable states or transitions of the system. To establish a property as an invariant, an induction proof, suitably augmented with automatically generated lemmas, often suffices.
DTIC
*Computer Programming; Decision Making; Program Verification (Computers); Software Engineering; Systems Analysis*

**20070019020** Naval Research Lab., Washington, DC USA
**A Framework for the Formal Analysis of Multi-Agent Systems**
Bharadwaj, Ramesh; Apr 2003; 14 pp.; In English
Report No.(s): AD-A465311; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465311

In this paper we present an integrated formal framework for the specification and analysis of Multi-Agent Systems (MAS). Agents are specified in a synchronous programming language called Secure Operations Language (SOL) which supports the modular development of secure agents. Multi-agent systems are constructed from individual agent modules by using the composition operator of SOL, the semantics of which are guaranteed to preserve certain individual agent properties. The formal semantics and the underlying framework of SOL also serve as the basis for analysis and transformation techniques such as abstraction, consistency checking, verification by model checking or theorem proving, and automatic synthesis of agent code. Based on this framework, we are currently developing a suite of analysis and transformation tools for the formal specification, analysis, and synthesis of multi-agent systems.
DTIC
*Computer Information Security; Program Verification (Computers)*

**20070019025** Naval Research Lab., Washington, DC USA
**Consistency Checking of SCR-Style Requirements Specifications**
Heitmeyer, Constance; Labaw, Bruce; Kiskis, Daniel; Mar 27, 1995; 9 pp.; In English
Report No.(s): AD-A465317; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465317

This paper describes a class of formal analysis called consistency checking that mechanically checks requirements specifications, expressed in the SCR tabular notation, for application-independent properties. Properties include domain coverage, type correctness, and determinism. As background, the SCR notation for specifying requirements is reviewed. A formal requirements model describing the meaning of the SCR notation is summarized, and consistency checks derived from the formal model are described. The results of experiments to evaluate the utility of automated consistency checking are presented. Where consistency checking of requirements fits in the software development process is discussed.
DTIC
*Computer Programming; Computer Programs; Consistency; Cost Reduction; Requirements; Software Engineering; Specifications*

**20070019026** Naval Research Lab., Washington, DC USA
**SCR*: A Toolset for Specifying and Analyzing Requirements**
Heitmeyer, Constance; Bull, Alan; Gasarch, Carolyn; Labaw, Bruce; Jan 1995; 15 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465318; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465318

A set of CASE tools is described for developing formal requirements specifications expressed in the SCR (Software Cost Reduction) tabular notation. The tools include an editor for building the specifications, a consistency checker for testing the specifications for consistency with a formal requirements model, a simulator for symbolically executing the specifications, and a verifier for checking that the specifications satisfy selected application properties. As background, the SCR method for specifying requirements is reviewed, and a formal requirements model is introduced. Examples are presented to illustrate the tools.
DTIC
*Computer Programs; Cost Reduction; Requirements; Software Development Tools*

**20070019027** Naval Research Lab., Washington, DC USA
**Tools for Formal Specification, Verification, and Validation of Requirements**
Heitmeyer, Constance; Kirby, James; Labaw, Bruce; Jan 1997; 14 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465319; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465319

Although formal methods for developing computer systems have been available for more than a decade, few have had significant impact in practice. A major barrier to their use is that software developers find formal methods difficult to understand and apply. One exception is a formal method called SCR for specifying computer system requirements which, due to its easy to use tabular notation and its demonstrated scalability, has already achieved some success in industry. Recently, a set of software tools, including a specification editor, a consistency checker, a simulator, and a verifier, has been developed to support the SCR method [9, 11, 5]. This paper describes recent enhancements to the SCR tools: a new dependency graph browser which displays the dependencies among the variables in the specification, an improved consistency checker which

produces detailed feedback about detected errors, and an assertion checker which checks application properties during simulation. To illustrate the tool enhancements, a simple automobile cruise control system is presented and analyzed.
DTIC
*Computer Programming; Program Verification (Computers); Software Development Tools; Specifications*

**20070019030** Naval Research Lab., Washington, DC USA
**SOL: A Verifiable Synchronous Language for Reactive Systems**
Bharadwaj, Ramesh; Jan 2002; 15 pp.; In English
Report No.(s): AD-A465328; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465328

SOL (Secure Operations Language) is a synchronous programming language for implementing reactive systems. The utility of SOL hinges upon the fact that it is a secure language, i.e., most programs in SOL are amenable to fully automated static analysis techniques, such as automatic theorem proving using decision procedures or model checking. Among the unique features of SOL is the ability to express a wide class of enforceable safety and security policies (including the temporal aspects of software component interfaces) in the language itself, thereby opening up the possibility of eliminating runaway computations and malicious code, such as worms and viruses.
DTIC
*Programming Languages; Reactivity*

**20070019034** Naval Research Lab., Washington, DC USA
**SCR*: A Toolset for Specifying and Analyzing Software Requirements**
Heitmeyer, Constance; Kirby, James; Labaw, Bruce; Bharadwaj, Ramesh; Jan 1998; 8 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465334; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465334

A controversial issue in the formal methods community is the degree to which mathematical sophistication and theorem proving skills should be needed to apply a formal method and its support tools. This paper describes the SCR (Software Cost Reduction) tools, part of a 'practical' formal methodla method with a solid mathematical foundation that software developers can apply without theorem proving skills, knowledge of temporal and higher order logics, or consultation with formal methods experts. The SCR method provides a tabular notation for specifying requirements and a set of 'light-weight' tools that detect several classes of errors automatically. The method also provides support for more 'heavy-duty' tools, such as a model checker. To make model checking feasible, users can automatically apply one or more abstraction methods.
DTIC
*Computer Programming; Software Development Tools; Software Engineering*

**20070019057** Cambridge Environmental, Inc., MA USA
**Computer-Mediated Training Tools to Enhance Joint Task Force Cognitive Leadership Skills**
Linkov, Igor; Fenton, George; Satterstrom, F K; Gaskins, Ryland; Lewis, Barclay; Apr 2007; 77 pp.; In English
Contract(s)/Grant(s): W74V8H-06-P-0191; Proj-M770
Report No.(s): AD-A465397; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465397

This project describes a computer-mediated cognitive leadership training program for helping leaders of a Joint Task Force overcome cultural barriers between services. The program focuses on the brigade level (and higher) echelons of service warfighting units, and it is intended as a supplement to intermediate-level formal service schools. The training environment features a user-friendly interface based on the Decisive Action platform, which provides a controlled environment for leadership skill training. The proposed scenario places the participant in a crisis situation as the commanding officer of a Joint Force operation. A crisis situation requires information from a wide range of information sources and categories, and the trainee, as the commander, must assess the situation with the information provided. The trainees are assessed on how well they adapt to unforeseen circumstances that are introduced during the course of the experiment.
DTIC
*Computer Techniques; Education; Leadership; Software Development Tools*

**20070019068** Library of Congress, Washington, DC USA

**The Federal Networking and Information Technology Research and Development Program: Funding Issues and Activities**

Figliola, Patricia M; May 2, 2005; 17 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465434; CRS-IB10130; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465434

In the early 1990s, Congress recognized that several federal agencies had ongoing high-performance computing programs, but no central coordinating body existed to ensure long-term coordination and planning. To provide such a framework, Congress passed the High-Performance Computing and Communications Program Act of 1991 (P.L. 102-194) to enhance the effectiveness of the various programs. In conjunction with the passage of the act, the White House Office of Science and Technology Policy (OSTP) released 'Grand Challenges: High-Performance Computing and Communications.' That document outlined a research and development (R&D) strategy for high-performance computing and a framework for a multiagency program, the High-Performance Computing and Communications (HPCC) Program. The HPCC Program has evolved over time and is now called the Networking and Information Technology Research and Development (NITRD) Program, to better reflect its expanded mission. The NITRD Program is composed of 12 agencies; its members work in collaboration to increase the overall effectiveness and productivity of federal information technology (IT) R&D. A National Coordinating Office coordinates the activities of the NITRD Program and reports to OSTP and the National Science and Technology Council. Proponents assert that federal support of IT R&D has produced positive outcomes for the country and played a crucial role in supporting long-term research into fundamental aspects of computing. Such fundamentals provide broad practical benefits, but generally take years to realize. The FY2006 budget calls for $2.155 billion for the NITRD Program, a 4.5% decrease from the FY2005 budget of $2.256 billion. During the 109th Congress, one NITRD-related bill has been introduced, H.R. 28; it was agreed to by voice vote in the House on April 26, 2005, and received in the Senate and where it was read twice and referred to the Committee on Commerce, Science, and Transportation, on April 27, 2005.

DTIC

*Computer Programming; Computers; Federal Budgets; Information Systems; Management Planning; Research and Development; Software Engineering; United States*

**20070019072** Naval Research Lab., Washington, DC USA

**SCR: A Practical Method for Requirements Specification**

Heitmeyer, Constance; Jan 1998; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465445; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465445

A controversial issue in the formal methods research community is the degree to which mathematical sophistication and theorem proving skills should be needed to apply a formal method. A premise of this paper is that formal methods research has produced several techniques with potential utility in practical software development, but that mathematical sophistication and theorem proving skills should not be prerequisites for using these techniques. In the paper, several attributes needed to make a formal method useful in practice are described. These attributes include user-friendly notation, automated (i.e., push button) analysis, and easy to understand feedback. To illustrate the attributes of a practical formal method, a formal method for requirements specification called SCR (Software Cost Reduction) is introduced.

DTIC

*Computer Programming; Computer Programs; Cost Reduction; Software Engineering; Specifications*

**20070019074** Naval Research Lab., Washington, DC USA

**Verifying SCR Requirements Specifications Using State Exploration**

Bharadwaj, Ramesh; Heitmeyer, Constance; Jan 1997; 15 pp.; In English

Report No.(s): AD-A465447; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465447

Researchers at the Naval Research Laboratory (NRL) have been developing a formal method, known as the SCR (Software Cost Reduction) method, to specify the requirements of software systems using tables. NRL has developed a formal state machine model defining the SCR semantics and support tools for analysis and validation. Recently, a verification capability was added to the SCR toolset. Users can now invoke the Spin model checker within the toolset to establish properties of a specification. This paper describes the results of our initial experiments to verify properties of SCR requirements specifications using Spin. After reviewing the SCR requirements method and introducing our formal requirements model, we describe how SCR specifications can be translated into an imperative programming notation. We also

describe how we limit state explosion by verifying abstractions of the original requirements specification. These abstractions are derived using the formula to be verified and special attributes of SCR specifications. The paper concludes with the results of our experiments with Spin and a discussion of ongoing and future work.
DTIC
*Computer Programs; Cost Reduction; Explosions; Requirements; Software Development Tools; Specifications*

**20070019081** Naval Research Lab., Washington, DC USA
**Protecting Unattended Computers Without Software**
Landwehr, Carl E; Dec 1997; 11 pp.; In English
Report No.(s): AD-A465472; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465472

In many environments, users login to workstations and then leave them unattended. Rather than trying to stop users from doing what comes naturally, this paper suggests a simple, hardware-based system that can protect computers in such an environment from unauthorized use by those with physical access to the monitor and keyboard. Requirements for the system are described, some design issues are discussed, and a sketch of a design for an initial prototype is provided, together with an assurance argument for it. A prototype implementing many of the concepts described has been built; two dozen copies of a second prototype are soon to be installed in an office environment.
DTIC
*Computers; Security*

**20070019082** Naval Research Lab., Washington, DC USA
**Modeling Security-Enhanced Linux Policy Specifications for Analysis (Preprint)**
Archer, Myla; Leonard, Elizabeth; Pradella, Matteo; Jan 2003; 7 pp.; In English
Report No.(s): AD-A465473; XB-NRL/MR/5540; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465473

Security-Enhanced (SE) Linux is a modification of Linux initially released by NSA in January 2001 that provides a language for specifying Linux security policies and, as in the Flask architecture, a security server for enforcing policies defined in the language. To determine whether user requests to the operating system should be granted, the security server refers to an internal form of the policy compiled from the policy specification. Since the most convenient description of the policy for user understanding is its 'source' specification in the policy language, it is natural for users to expect to be able to analyze the properties of the policy from this source specification. However, though specifications in the SE Linux policy language avoid implementation details, the policy language is very low-level, making the high level properties of a policy difficult to deduce by inspection. For this reason, tools to help users with the analysis are necessary. The goal of the NRL project on analyzing SE Linux security policies is to first use mechanized support to analyze the specification of an example policy, and then to customize this support for use by practitioners in the open source software community. This paper summarizes how we have modeled an example security policy in the analysis tool TAME, the kinds of analysis we can support, and prototype mechanical support to enable others to model example security policies in TAME.
DTIC
*Policies; Security; Unix (Operating System)*

**20070019097** Naval Research Lab., Washington, DC USA
**Using Abstraction and Model Checking to Detect Safety Violations in Requirements Specifications**
Heitmeyer, Constance; Kirby, Jr , James; Labaw, Bruce; Archer, Myla; Bharadwaj, Ramesh; Nov 1998; 23 pp.; In English
Report No.(s): AD-A465502; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465502

Exposing inconsistencies can uncover many defects in software specifications. One approach to exposing inconsistencies analyzes two redundant specifications, one operational and the other property-based, and reports discrepancies. This paper describes a practical formal method, based on this approach and the SCR (Software Cost Reduction) tabular notation, that can expose inconsistencies in software requirements specifications. Because users of the method do not need advanced mathematical training or theorem proving skills, most software developers should be able to apply the method without extraordinary effort. This paper also describes an application of the method which exposed a safety violation in the contractor-produced software requirements specification of a sizable, safety-critical control system. Because the enormous state space of specifications of practical software usually renders direct analysis impractical, a common approach is to apply

abstraction to the specification. To reduce the state space of the control system specification, two push button abstraction methods were applied, one which automatically removes irrelevant variables and a second which replaces the large, possibly infinite, type sets of certain variables with smaller type sets. Analyzing the reduced specification with the model checker Spin uncovered a possible safety violation. Simulation demonstrated that the safety violation was not spurious but an actual defect in the original specification.
DTIC
*Computer Programs; Cost Reduction; Models; Requirements; Safety; Specifications*

**20070019099** Naval Research Lab., Washington, DC USA
**Program Synthesis from Formal Requirements Specifications Using APTS**
Leonard, Elizabeth I; Heitmeyer, Constance L; Jan 2003; 31 pp.; In English
Report No.(s): AD-A465504; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465504

Formal specifications of software systems are extremely useful because they can be rigorously analyzed, verified, and validated, giving high confidence that the specification captures the desired behavior. To transfer this confidence to the actual source code implementation, a formal link is needed between the specification and the implementation. Generating the implementation directly from the specification provides one such link. A program transformation system such as Paige's APTS can be useful in developing a source code generator. This paper describes a case study in which APTS was used to produce code generators that construct C source code from a requirements specification in the SCR (Software Cost Reduction) tabular notation. In the study, two different code generation strategies were explored. The first strategy uses rewrite rules to transform the parse tree of an SCR specification into a parse tree for the corresponding C code. The second strategy associates a relation with each node of the specification parse tree. Each member of this relation acts as an attribute, holding the C code corresponding to the tree at the associated node; the root of the tree has the entire C program as its member of the relation. This paper describes the two code generators supported by APTS, how each was used to synthesize code for two example SCR requirements specifications, and what was learned about APTS from these implementations.
DTIC
*Computer Programming; Computer Programs; Cost Reduction; Software Engineering; Specifications*

**20070019100** Naval Research Lab., Washington, DC USA
**Proving Invariants of I/O Automata with TAME**
Archer, Myla; Heitmeyer, Constance; Riccobene, Elvinia; Jan 2002; 33 pp.; In English
Report No.(s): AD-A465506; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465506

This paper describes a specialized interface to PVS called TAME (Timed Automata Modeling Environment) which provides automated support for proving properties of I/O automata. A major goal of TAME is to allow a software developer to use PVS to specify and prove properties of an I/O automaton efficiently and without first becoming a PVS expert. To accomplish this goal, TAME provides a template that the user completes to specify an I/O automaton and a set of proof steps natural for humans to use for proving properties of automata. Each proof step is implemented by a PVS strategy and possibly some auxiliary theories that support that strategy. We have used the results of two recent formal methods studies as a basis for two case studies to evaluate TAME. In the first formal methods study, Romijn used I/O automata to specify and verify memory and remote procedure call components of a concurrent system. In the second formal methods study, Devillers et al. specified a tree identify protocol (TIP), part of the IEEE 1394 bus protocol, and provided hand proofs of TIP properties. Devillers also used PVS to specify TIP and to check proofs of TIP properties. In our first case study, the third author, a new TAME user with no previous PVS experience, used TAME to create PVS specifications of the I/O automata formulated by Romijn and Devillers et al. and to check their hand proofs. In our second case study, the TAME approach to verification was compared with an alternate approach by Devillers which uses PVS directly.
DTIC
*Automata Theory; Computer Programming; Software Engineering*

**20070019101** Carnegie-Mellon Univ., Pittsburgh, PA USA
**Modular Typestate Verification of Aliased Objects**
Bierhoff, Kevin; Aldrich, Jonathan; Mar 2007; 51 pp.; In English
Contract(s)/Grant(s): DAAD19-02-1-0389
Report No.(s): AD-A465507; CMU-ISRI-07-105; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465507

A number of type systems have used typestates to specify and statically verify protocol compliance. Aliasing is a major challenge for these systems. This paper proposes a modular type system for a core object-oriented language that leverages linear logic for verifying compliance to more expressive protocol specifications than previously supported. The system improves reasoning about aliased objects by associating references with access permissions that systematically capture what aliases know about and can do to objects. Permissions grant full, shared, or read-only access to a certain part of object state and allow aliasing both on the stack and in the heap. The system supports dynamic state tests, arbitrary callbacks, and open recursion. The system's expressiveness is illustrated with examples from the Java I/O library.
DTIC
*Computer Programming; Java (Programming Language); Object-Oriented Programming*

**20070019103** Naval Research Lab., Washington, DC USA
**A Formal Specification of Requirements for Payment Transactions in the SET Protocol**
Meadows, Catherine; Syverson, Paul; Feb 24, 1998; 16 pp.; In English
Report No.(s): AD-A465510; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465510
Payment transactions in the SET (Secure Electronic Transaction) protocol are described. Requirements for SET are discussed and formally represented in a version of NPATRL (the NRL Protocol Analyzer Temporal Requirements Language). NPATRL is language for expressing generic requirements, heretofore applied to key distribution or key agreement protocols. Transaction vectors and other new constructs added to NPATRL for reasoning about SET payment transactions are described along with properties of their representation.
DTIC
*Cryptography; Internets; Protocol (Computers); Requirements; Specifications*

**20070019110** Northwestern Univ., Evanston, IL USA
**Sketching for Military Courses of Action Diagrams**
Forbus, Kenneth D; Usher, Jeffrey; Chapman, Vemell; Jan 2003; 9 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465525; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465525
A serious barrier to the digitalization of the US military is that commanders find traditional mouse/menu, CAD-style interfaces unnatural. Military commanders develop and communicate battle plans by sketching courses of action (COAs). This paper describes nuSketch Battlespace, the latest version in an evolving line of sketching interfaces that commanders find natural, yet supports significant increased automation. We describe techniques that should be applicable to any specialized sketching domain: glyph bars and compositional symbols to tractably handle the large number of entities that military domains use, specialized glyph types and gestures to keep drawing tractable and natural, qualitative spatial reasoning to provide sketch-based visual reasoning, and comic graphs to describe multiple states and plans. Experiments, both completed and in progress, are described to provide evidence as to the utility of the system.
DTIC
*Software Development Tools; User Requirements*

**20070019114** Naval Research Lab., Washington, DC USA
**Unlinkable Serial Transactions**
Syverson, Paul F; Stubblebine, Stuart G; Goldschlag, David M; Jan 1997; 18 pp.; In English
Report No.(s): AD-A465531; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465531
We present a protocol for unlinkable serial transactions suitable for a variety of network-based subscription services. The protocol prevents the service from tracking the behavior of its customers while protecting the service vendor from abuse due to simultaneous or 'cloned' usage from a single subscription. We present variants of the protocol supporting pay-per-use transactions within a subscription. We describe other applications including third-party subscription management, multivendor package sales, proof of group membership, and voter registration.
DTIC
*Electronic Commerce; Protocol (Computers)*

**20070019119** Naval Research Lab., Washington, DC USA
**The NRL Protocol Analyzer: An Overview**
Meadows, Catherine; Jan 1995; 20 pp.; In English
Report No.(s): AD-A465542; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465542

The NRL Protocol Analyzer is a prototype special-purpose verification tool, written in Prolog, that has been developed for the analysis of cryptographic protocols that are used to authenticate principals and services and distribute keys in a network. In this paper we give an overview of how the Analyzer works and describe its achievements so far. We also show how our use of the Prolog language benefited us in the design and implementation of the Analyzer.
DTIC
*Cryptography; Program Verification (Computers); Protocol (Computers)*

**20070019124** Naval Research Lab., Washington, DC USA
**Formal Specification and Analysis of the Group Domain of Intrepretation Protocol Using NPATRL and the NRL Protocol Analyzer (Preprint)**
Meadows, Catherine; Syverson, Paul; Cervesato, Iliano; Jan 2004; 40 pp.; In English
Contract(s)/Grant(s): N00173-00-C-2086
Report No.(s): AD-A465570; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465570

Although research has been going on in the formal analysis of cryptographic protocols for a number of years, they are only slowly being integrated into the protocol design process. In this paper we describe how we furthered the integration of analysis and design by working closely with the Multicast Security Working Group in the Internet Engineering Task Force on the analysis of a proposed Internet Standard, the Group Domain Of Interpretation (GDOI) Protocol. We describe the challenges that had to be met before the analysis could be successfully completed, and some of the challenges that still remain. Perhaps not surprisingly, some of the most challenging work was in understanding the security requirements for group protocols in general. We give a detailed specification of the requirements for GDOI, describe our formal analysis of the protocol with respect to these requirements, and show how our analysis impacted the development of GDOI.
DTIC
*Protocol (Computers); Security*

**20070019126** Naval Research Lab., Washington, DC USA
**Automated Consistency Checking of Requirements Specifications**
Heitmeyer, Constance L; Jeffords, Ralph D; Labaw, Bruce G; Jul 1996; 32 pp.; In English
Report No.(s): AD-A465574; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465574

This article describes a formal analysis technique, called consistency checking, for automatic detection of errors, such as type errors, nondeterminism, missing cases, and circular definitions, in requirements specifications. The technique is designed to analyze requirements specifications expressed in the SCR (Software Cost Reduction) tabular notation. As background, the SCR approach to specifying requirements is reviewed. To provide a formal semantics for the SCR notation and a foundation for consistency checking, a formal requirements model is introduced; the model represents a software system as a finite-state automaton, which produces externally visible outputs in response to changes in monitored environmental quantities. Results of two experiments are presented which evaluated the utility and scalability of our technique for consistency checking in a real-world avionics application. The role of consistency checking during the requirements phase of software development is discussed.
DTIC
*Consistency; Error Detection Codes; Specifications*

**20070019127** Naval Research Lab., Washington, DC USA
**The Epistemic Representation of Information Flow Security in Probabilistic Systems**
Syverson, Paul F; Gray, James W; Jun 1995; 16 pp.; In English
Report No.(s): AD-A465575; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465575

We set out a logic for reasoning about multilevel security of probabilistic systems. This logic includes modalities for time,

knowledge, and probability. In earlier work we gave syntactic definitions of multilevel security and showed that their semantic interpretations are equivalent to independently motivated information-theoretic definitions. This paper builds on that earlier work in two ways. First, it substantially recasts the language and model of computation into the more standard Halpern-Tuttle framework for reasoning about knowledge and probability. Second, it brings together two distinct characterizations of security from that work. One was equivalent to the information-theoretic security criterion for a system to be free of covert channels but was difficult to prove. The other was a verification condition that implied the first; it was more easily provable but was too strong. This paper presents a characterization that is syntactically very similar to our previous verification condition but is proven to be semantically equivalent to the security criterion. The new characterization also means that our security criterion is expressible in a simpler logic and model.
DTIC
*Information Flow; Interprocessor Communication; Security; Warning Systems*

**20070019142** Kansas State Univ., Manhattan, KS USA
**O-MaSE: A Customizable Approach to Developing Multiagent Development Processes**
Garcia-Ojeda, Juan C; DeLoach, Scott A; Robby,; Oyenan, Walamitien H; Valenzuela, Jorge; Jan 2007; 16 pp.; In English
Contract(s)/Grant(s): FA9550-06-1-0058
Report No.(s): AD-A465610; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465610

This paper describes the Organization-based Multiagent System Engineering (O-MaSE) Process Framework, which helps process engineers define custom multiagent systems development processes. O-MaSE builds off the MaSE methodology and is adapted from the OPEN Process Framework (OPF). OPF implements a Method Engineering approach to process construction. The goal of O-MaSE is to allow designers to create customized agent-oriented software development processes. O-MaSE consists of three basic structures: (1) a metamodel, (2) a set of methods fragments, and (3) a set of guidelines. The O-MaSE metamodel defines the key concepts needed to design and implement multiagent systems. The method fragments are operations or tasks that are executed to produce a set of work products, which may include models, documents, or code. The guidelines define how the method fragments are related to one another. The paper also demonstrates two examples of creating custom O-MaSE processes.
DTIC
*Computer Programming; Software Engineering; Systems Engineering*

**20070019161** Naval Research Lab., Washington, DC USA
**Managing Complexity in Software Development with Formally Based Tools**
Heitmeyer, Constance; Jan 2004; 10 pp.; In English
Report No.(s): AD-A465463; No Copyright; Avail.: CASI: A02, Hardcopy

Over the past two decades, formal methods researchers have produced a number of powerful software tools designed to detect errors in, and to verify properties of, hardware designs, software systems, and software system artifacts. Mostly used in the past to debug hardware designs, in future years, these tools should help developers improve the quality of software systems. They should be especially useful in developing high assurance software systems, where compelling evidence is required that the system satisfies critical properties, such as safety and security. This paper describes the different roles that formally based software tools can play in improving the correctness of software and software artifacts. Such tools can help developers manage complexity by automatically exposing certain classes of software errors and by producing evidence (e.g., mechanically checked proofs, results of executing automatically generated test cases, etc.) that a software system satisfies its requirements. In addition, the tools allow practitioners to focus on development tasks best performed by people e.g., obtaining and validating requirements and constructing a high-quality requirements specification.
DTIC
*Computer Programming; Software Development Tools; Software Engineering*

**20070019163** Naval Research Lab., Washington, DC USA
**On the Need for Practical Formal Methods**
Heitmeyer, Constance; Jan 1998; 10 pp.; In English
Report No.(s): AD-A465485; No Copyright; Avail.: CASI: A02, Hardcopy

A controversial issue in the formal methods community is the degree to which mathematical sophistication and theorem proving skills should be needed to apply a formal method. A fundamental assumption of this paper is that formal methods

research has produced several classes of analysis that can prove useful in software development. However, to be useful to software practitioners, most of whom lack advanced mathematical training and theorem proving skills, current formal methods need a number of additional attributes, including more user- friendly notations, completely automatic (i.e., push button) analysis, and useful, easy to understand feedback. Moreover, formal methods need to be integrated into a standard development process. I discuss additional research and engineering that is needed to make the current set of formal methods more practical. To illustrate the ideas, I present several examples, many taken from the SCR (Software Cost Reduction) requirements method, a formal method that software developers can apply without theorem proving skills, knowledge of temporal and higher order logics, or consultation with formal methods experts.
DTIC
*Computer Programming; Software Engineering*

**20070019186** Echelon 4, LLC, Mequon, WI USA
**Engineering Model for Enterprise Command and Control**
Bayne, Jay; Paul, Raymond; Mar 15, 2004; 42 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465710; No Copyright; Avail.: CASI: A03, Hardcopy

Enterprises are increasingly complex; especially those found in National Defense. They are dynamic systems, geographically and operationally distributed, and faced with operating with increased agility in always on conditions under greater regulatory scrutiny within highly volatile market conditions where continuous quality improvements are expected. This situation requires continuous improvements in the conduct of enterprise operations, with a corresponding increase in the efficacy of decision (command) and control applied to all facets of enterprise management. To address this challenge we introduce and engineering model supporting advances in both the concept and implementation of enterprise command and control (EC2) systems. We characterize the objectives of EC2 in terms of units of value production (VPU) that function at the intersection of enterprise supply and asset chains. Enterprise governance is consequently focused on the continuous optimization of performance of value production processes linked by these two value chains. VPUs range in size and function from low level tactical, to mid-level operational, to high level strategic activities, all of which must interact effectively in order to sustain enterprise viability. This paper provides a summary of our work in the application of our VPU model to the EC2 requirements of complex federated enterprise systems.
DTIC
*Command and Control; Decision Support Systems*

**20070019189** New Haven Project, USA
**Synchronous Batching: From Cascades to Free Routes**
Dingledine, Roger; Shmatikov, Vitaly; Syverson, Paul; May 2004; 21 pp.; In English
Report No.(s): AD-A465713; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A03, Hardcopy

The variety of possible anonymity network topologies has spurred much debate in recent years. In a synchronous batching design, each batch of messages enters the mix network together, and the messages proceed in lockstep through the network. We show that a synchronous batching strategy can be used in various topologies, including a free-route network, in which senders choose paths freely, and a cascade network, in which senders choose from a set of fixed paths. We show that free-route topologies can provide better anonymity as well as better message reliability in the event of partial network failure.
DTIC
*Routes; Security*

**20070019190** New Haven Project, USA
**Reliable MIX Cascade Networks through Reputation**
Dingledine, Roger; Syverson, Paul; Mar 2002; 17 pp.; In English
Report No.(s): AD-A465714; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy

We describe a MIX cascade protocol and a reputation system that together increase the reliability of a network of MIX cascades. In our protocol, MIX nodes periodically generate a communally random seed that, along with their reputations, determines cascade configuration. Nodes send test messages to monitor their cascades. Senders can also demonstrate message decryptions to convince honest cascade members that a cascade is misbehaving. By allowing any node to declare the failure of its own cascade, we eliminate the need for global trusted witnesses.
DTIC
*Protocol (Computers); Security*

**20070019191** Naval Research Lab., Washington, DC USA
**Hidden Safety Requirements in Large-Scale Systems (Preprint)**
Landwehr, Carl E; Sep 1, 1994; 9 pp.; In English
Report No.(s): AD-A465715; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy

To avoid hidden safety problems in future large scale systems, we must be able to identify the crucial assumptions underlying the development of their components and to enunciate straightforward rules for safe component interconnection.
DTIC
*Safety; Safety Factors; Security; Systems Engineering*

**20070019192** Naval Research Lab., Washington, DC USA
**A Formal Model of Several Fundamental VHDL Concepts**
Goldschlag, David M; Jun 1994; 6 pp.; In English
Report No.(s): AD-A465716; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy

This paper presents a formal model of several fundamental concepts in VHDL including the semantics of individual concurrent statements, and groups of those statements, resolution functions, delta delays, and hierarchical component structuring. Based on this model, several extensions to VHDL are proposed, including nondeterministic assignments and unbounded asynchrony. Nondeterminism allows the specification of environments and of classes of devices. This model naturally captures the meaning of composition of VHDL programs.
DTIC
*Hardware Description Languages; Programming Languages; VHSIC (Circuits)*

**20070019193** George Mason Univ., Fairfax, VA USA
**ACT-PRO Action Protocol Analyzer: A Tool for Analyzing Discrete Action Protocols**
Fu, Wai-Tat; Jan 2001; 11 pp.; In English
Contract(s)/Grant(s): F49620-97-1-0353
Report No.(s): AD-A465717; No Copyright; Avail.: CASI: A03, Hardcopy

This article presents a top-down approach for analyzing sequential events in behavioral data. Analysis of behavioral sequential data often entails identifying patterns specified by the researchers. Algorithms were developed and applied to analyze a kind of behavioral data, called discrete action protocol data. Discrete action protocols consist of discrete user actions, such as mouse clicks and keypresses. Unfortunately, the process of analyzing the huge volume of actions (typically, \g10(exp 5)) is very labor intensive. To facilitate this process, we developed an action protocol analyzer (ACT-PRO) that provides two levels of pattern matching. Level one uses formal grammars to identify sequential patterns. Level two matches these patterns to a hierarchical structure. ACT-PRO can be used to determine how well data fit the patterns specified by an experimenter. Complimentarily, it can be used to focus an experimenter's attention on data that do not fit the prespecified patterns.
DTIC
*Protocol (Computers)*

**20070019208** Virginia Univ., Charlottesville, VA USA
**Model-Checking of Component-Based Event-Driven Real-Time Embedded Software**
Gu, Zonghua; Shin, Kang G; Jan 2005; 9 pp.; In English
Contract(s)/Grant(s): DAAD19-1-1-0473
Report No.(s): AD-A465755; No Copyright; Avail.: Defense Technical Information Center (DTIC)

As complexity of real-time embedded software grows, it is desirable to use formal verification techniques to achieve a high level of assurance. We discuss application of model-checking to verify system-level concurrency properties of component-based real-time embedded software based on CORBA Event Service, using Avionics Mission Computing software as an application example. We use the process algebra FSP to formalize specification of software components and system architecture, previously only available in the form of natural language and prone to misinterpretation and misunderstanding, and use model-checking to verify system-level concurrency properties. We also discuss effective techniques for coping with the state-space explosion problem by exploiting application domain semantics. We have applied our analysis techniques to realistic application scenarios provided by our industry partner to demonstrate their utility and power.
DTIC
*Computer Programs; Real Time Operation*

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## 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.

**20070018763** United Space Alliance, Houston, TX, USA
**Sustainable, Reliable Mission-Systems Architecture**
O'Neil, Graham; Orr, James K.; Watson, Steve; [2005]; 3 pp.; In English; Space 2005, 30 Aug. - 1 Sep. 2005, Long Beach, CA, USA
Contract(s)/Grant(s): NAS9-20000; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018763

A mission-systems architecture, based on a highly modular infrastructure utilizing open-standards hardware and software interfaces as the enabling technology is essential for affordable md sustainable space exploration programs. This mission-systems architecture requires (8) robust communication between heterogeneous systems, (b) high reliability, (c) minimal mission-to-mission reconfiguration, (d) affordable development, system integration, end verification of systems, and (e) minimal sustaining engineering. This paper proposes such an architecture. Lessons learned from the Space Shuttle program and Earthbound complex engineered systems are applied to define the model. Technology projections reaching out 5 years are made to refine model details.
Author
*Architecture (Computers); Complex Systems; Systems Integration; Reliability Engineering; Systems Analysis; Systems Engineering; System Effectiveness*

**20070018939** Naval Research Lab., Washington, DC USA
**Proving Correctness of the Basic TESLA Multicast Stream Authentication Protocol with TAME**
Archer, Myla; Jan 2002; 13 pp.; In English
Report No.(s): AD-A464932; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464932

The TESLA multicast stream authentication protocol is distinguished from other types of cryptographic protocols in both its key management scheme and its use of timing. It takes advantage of the stream being broadcast to periodically commit to and later reveal keys used by a receiver to verify that packets are authentic, and it uses both inductive reasoning and time arithmetic to allow the receiver to determine that an adversary cannot have prior knowledge of a key that has just been revealed. While an informal argument for the correctness of TESLA has been published, no mechanized proof appears to have previously been done for TESLA or any other protocol of the same variety. This paper reports on a mechanized correctness proof of the basic TESLA protocol based on establishing a sequence of invariants for the protocol using the tool TAME, an interface to PVS specialized for proving properties of automata. It discusses the organization and process used in the proof, and the possibilities for reusing these techniques in correctness proofs of similar protocols, starting with more sophisticated versions of TESLA.
DTIC
*Computer Information Security; Protocol (Computers)*

**20070018946** Naval Research Lab., Washington, DC USA
**A General Theory of Composition for Trace Sets Closed Under Selective Interleaving Functions**
McLean, John; Jan 1994; 16 pp.; In English
Report No.(s): AD-A465146; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465146

This paper presents a general theory of system composition for 'possibilistic' security properties. We see that these properties fall outside of the Alpern-Schneider safety/liveness domain and hence, are not subject to the Abadi-Lamport Composition Principle. We then introduce a set of trace constructors called selective interleaving functions and show that possibilistic security properties are closure properties with respect to different classes of selective interleaving functions. This provides a uniform framework for analyzing these properties and allows us to construct a partial ordering for them. We present a number of composition constructs, show the extent to which each preserves closure with respect to different classes of selective interleaving functions, and show that they are sufficient for forming the general hook-up construction. We see that,

although closure under a class of selective interleaving functions is generally preserved by product and cascading, it is not generally preserved by feedback, internal system composition constructs, or refinement. We examine the reason for this.
DTIC
*Computer Networks; Security*

**20070018962** Virginia Univ., Charlottesville, VA USA
**Secure and Practical Defense Against Code-Injection Attacks using Software Dynamic Translation**
Hu, Wei; Hiser, Jason; Williams, Dan; Filipi, Adrian; Davidson, Jack W; Evans, David; Knight, John C; Nguyen-Tuong, Anh; Rowanhill, Jonathan; Jun 16, 2006; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8750-04-2-0246
Report No.(s): AD-A465213; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465213

One of the most common forms of security attacks involves exploiting a vulnerability to inject malicious code into an executing application and then cause the injected code to be executed. A theoretically strong approach to defending against any type of code-injection attack is to create and use a process-specific instruction set that is created by a randomization algorithm. Code injected by an attacker who does not know the randomization key will be invalid for the randomized processor effectively thwarting the attack. This paper describes a secure and efficient implementation of instruction-set randomization (ISR) using software dynamic translation. The paper makes three contributions beyond previous work on ISR. First, we describe an implementation that uses a strong cipher algorithm the Advanced Encryption Standard (AES), to perform randomization. AES is generally believed to be impervious to known attack methodologies. Second, we demonstrate that ISR using AES can be implemented practically and efficiently (considering both execution time and code size overheads) without requiring special hardware support. The third contribution is that our approach detects malicious code before it is executed. Previous approaches relied on probabilistic arguments that execution of non-randomized foreign code would eventually cause a fault or runtime exception.
DTIC
*Computer Information Security; Education; Injection; Translating*

**20070018965** Virginia Univ., Charlottesville, VA USA
**Evaluating Fragment Construction Policies for SDT Systems**
Hiser, Jason D; Williams, Daniel; Filipi, Adrian; Davidson, Jack W; Childers, Bruce R; Jan 2006; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8750-04-2-0246
Report No.(s): AD-A465218; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465218

Software Dynamic Translation (SDT) systems have been used for program instrumentation, dynamic optimization, security policy enforcement, intrusion detection, and many other uses. To be widely applicable, the overhead (runtime, memory usage, and power consumption) should be as low as possible. For instance, if an SDT system is protecting a web server against possible attacks, but causes 30% slowdown, a company may need 30% more machines to handle the web traffic they expect. Consequently, the causes of SDT overhead should be studied rigorously. This work evaluates many alternative policies for the creation of fragments within the Strata SDT framework. In particular, we examine the effects of ending translation at conditional branches; ending translation at unconditional branches; whether to use partial inlining for call instructions; whether to build the target of calls immediately or lazily; whether to align branch targets; and how to place code to transition back to the dynamic translator. We find that effective translation strategies are vital to program performance, improving performance from as much as 28% overhead, to as little as 3% overhead on average for the SPEC CPU2000 benchmark suite. We further demonstrate that these translation strategies are effective across several platforms, including Sun SPARC UltraSparc IIi, AMD Athlon Opteron, and Intel Pentium IV processors.
DTIC
*Construction; Costs; Fragments; Policies; Translating*

**20070018966** Virginia Univ., Charlottesville, VA USA

**N-Variant Systems: A Secretless Framework for Security through Diversity**

Cox, Benjamin; Evans, David; Filipi, Adrian; Rowanhill, Jonathan; Hu, Wei; Davidson, Jack; Knight, John; Nguyen-Tuong, Anh; Hiser, Jason; Jan 2006; 17 pp.; In English

Contract(s)/Grant(s): FA8750-04-2-0246

Report No.(s): AD-A465219; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465219

We present an architectural framework for systematically using automated diversity to provide high assurance detection and disruption for large classes of attacks. The framework executes a set of automatically diversified variants on the same inputs, and monitors their behavior to detect divergences. The benefit of this approach is that it requires an attacker to simultaneously compromise all system variants with the same input. By constructing variants with disjoint exploitation sets, we can make it impossible to carry out large classes of important attacks. In contrast to previous approaches that use automated diversity for security, our approach does not rely on keeping any secrets. In this paper, we introduce the N-variant systems framework, present a model for analyzing security properties of N-variant systems, define variations that can be used to detect attacks that involve referencing absolute memory addresses and executing injected code, and describe and present performance results from a prototype implementation.

DTIC

*Architecture (Computers); Security*

**20070018973** Naval Research Lab., Washington, DC USA

**Onion Routing Access Configurations**

Syverson, Paul F; Reed, Michael G; Goldschlag, David M; Jan 2000; 8 pp.; In English

Report No.(s): AD-A465234; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465234

Onion Routing is an infrastructure for private communication over a public network. It provides anonymous connections that are strongly resistant to both eavesdropping and traffic analysis. Thus it hides not only the data being sent, but who is talking to whom. Onion Routing's anonymous connections are bidirectional and near real-time, and can be used anywhere a socket connection can be used. Proxy aware applications, such as web browsing and e-mail, require no modification to use Onion Routing, and do so through a series of proxies. Other applications, such as remote login, can also use the system without modification. Access to an onion routing network can be configured in a variety of ways depending on the needs, policies, and facilities of those connecting. This paper describes some of these access configurations and also provides a basic overview of Onion Routing and comparisons with related work.

DTIC

*Data Transmission; Security*

**20070018985** Naval Research Lab., Washington, DC USA

**Towards an Analysis of Onion Routing Security**

Syverson, Paul; Tsudik, Gene; Reed, Michael; Landwehr, Carl; Jan 2000; 20 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465255; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465255

This paper presents a security analysis of Onion Routing, an application independent infrastructure for traffic-analysis-resistant and anonymous Internet connections. It also includes an overview of the current system design, definitions of security goals and new adversary models.

DTIC

*Security*

**20070018998** Naval Research Lab., Washington, DC USA

**Formal Methods for Cryptographic Protocol Analysis: Emerging Issues and Trends**

Meadows, Catherine; Jan 2003; 12 pp.; In English

Report No.(s): AD-A465281; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465281

The history of the application of formal methods to cryptographic protocol analysis spans over twenty years, and recently

has been showing signs of new maturity and consolidation. Not only have a number of specialized tools been developed, and general-purpose ones been adapted, but people have begun applying these tools to realistic protocols, in many cases supplying feedback to designers that can be used to improve the protocol's security. In this paper we will describe some of the ongoing work in this area, as well as describe some of the new challenges and the ways in which they are being met.
DTIC
*Computer Information Security; Cryptography; Protocol (Computers); Trends*

**20070019010** Naval Research Lab., Washington, DC USA
**Chapter 17. Agent Safety and Security**
Goldschlag, David; Landwehr, Carl; Reed, Michael; Jan 1996; 18 pp.; In English
Report No.(s): AD-A465298; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465298

Automobiles have proven to be a wonderful invention, and people all over the world depend on them. But people also recognize that cars used improperly can cause injuries. Cars can also serve as hiding places for car bombs. It's hard to imagine a software agent that could cause physical harm to anyone -- it's only software, after all. But what if that software is controlling an electrical appliance, say a coffee maker? Could a control failure cause the coffee maker to overheat and start a fire? We hope not; the coffee maker should in any case have passed an Underwriters' Laboratory test to assure that it won't start a fire even if it fails catastrophically. It's easy to imagine a software agent that damages data stored in computers, however: usually, it's called a virus. Of course, agents are supposed to be friendly and useful, not malicious and destructive. And they presumably operate in a constrained environment of some sort. But to be useful, an agent must be able to operate flexibly and dynamically: it may, for example, need to determine where to go next in search of some particular piece of data. It may need to store results or to send messages back to its initiator. It certainly will require some computing cycles on every site it visits. (We use the term applet for agents that are imported from a remote site for strictly local execution; agent encompasses both applets and mobile agents.)
DTIC
*Computer Information Security; Safety; Security*

**20070019015** Naval Research Lab., Washington, DC USA
**Doc, Wyatt, and Virgil: Prototyping Storage Jamming Defenses**
McDermott, J; Gelinas, R; Ornstein, S; Jan 1997; 10 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465303; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465303

This paper describes progress to date on three prototype tools for detecting storage jamming attacks. One prototype uses a replay defense; another uses logical replication, and the third can be used to determine the source and pattern of a detected attack. Three prototype jammers are used to test the effectiveness of the defenses. Initial experiments have shown that access control, encryption, audit, and virus detection do not prevent or detect storage jamming. The prototype tools have been effective in detecting the same attacks. Object-oriented data storage may require the use of application-specific techniques for applying checksums.
DTIC
*Cryptography; Jamming; Prototypes; Warfare*

**20070019016** Naval Research Lab., Washington, DC USA
**A Client-Server Architecture Supporting MLS Interoperability with COTS Components**
Froscher, J N; Kang, M H; Jan 1997; 5 pp.; In English
Report No.(s): AD-A465304; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465304

A major challenge facing the MLS community is to find ways to provide the information and connectivity that DoD users demand without either imposing unacceptable security risks or requiring expensive hardware and software that fails to mesh with commercial off-the-shelf (COTS) applications. This paper proposes, very briefly, an architecture that meets these goals using only a small number of relatively simple, low cost, high assurance components in combination with a preponderance of unmodified COTS hardware, operating systems and applications.
DTIC
*Interoperability; Microwave Landing Systems; Security*

**20070019024** Naval Research Lab., Washington, DC USA
**A Different Look at Secure Distributed Computation**
Syverson, Paul F; Jun 1997; 8 pp.; In English
Report No.(s): AD-A465315; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465315

We discuss various aspects of secure distributed computation and look at weakening both the goals of such computation and the assumed capabilities of adversaries. We present a new protocol for a conditional form of probabilistic coordination and present a model of secure distributed computation in which friendly and hostile nodes are represented in competing interwoven networks of nodes. It is suggested that reasoning about goals, risks, tradeoffs, etc. for this model be done in a game-theoretic framework.
DTIC
*Computation; Computer Information Security; Computer Networks; Distributed Processing; Failure*

**20070019032** Naval Research Lab., Washington, DC USA
**Towards Fault-Tolerant Mobile Agents**
Kassab, Lora L; Voas, Jeffrey; Jan 1998; 13 pp.; In English
Contract(s)/Grant(s): F30602-95-C-0282; F30602-97-C-0322
Report No.(s): AD-A465330; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465330

The absence of a trusted computing base for mobile agents poses serious security issues for both the host system and the survivability of the agent. Once a mobile agent is dispatched, asserting anything about the host system, the agent's behavior, or even the agent's existence is difficult to ascertain. In order to employ agents with any degree of confidence, constraints need to be placed on the agent computation since no restraints can be imposed (or assumed) about the host system's hardware or software. This paper presents a fault- tolerant approach for increasing an agent owner's confidence in the integrity of its agent.
DTIC
*Computer Networks; Computer Systems Design; Fault Tolerance*

**20070019035** Foreign Military Studies Office (Army), Fort Leavenworth, KS USA
**Hezballah, Israel, and Cyber PSYOP**
Thomas, Timothy L; Jan 2007; 7 pp.; In English
Report No.(s): AD-A465336; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465336

Parties on both sides of the recent fighting in Iraq, Afghanistan, and Lebanon have used cyber technologies to their advantage. Of course, this is nothing new. Tanks, planes, and soldiers have been uploaded with a host of cyber/information technologies for the past two decades at least. These technologies have increased the precision and lethality of weaponry, the situational awareness of the soldier, and the overall efficiency of operations. However, an evolving cyber phenomenon is underway: the concept of cyber psychological operations (CYOP, pronounced 'PSYOP')-which are cyber operations (those that use the computer chip) that aim to directly attack and influence the attitudes and behaviors of soldiers and the general population. While armies continue to compete in digital battlespace, local populations are now caught up in digital influence space battles. As a result armies can no longer stand between an enemy and the public as they once did. CYOP is also awash with unintended consequences, since we are only now starting to understand what degree of influence, persuasion, deception, and mobilization the cyber environment offers. For example, mobile (cell) phones became tools for citizen journalism in Lebanon since they provided people the capability to transmit audio, video and photographs by short message service. Such contributions from 'the street' carry their own form of psychological persuasion.
DTIC
*Electronic Warfare; Israel; Lethality*

**20070019043** Foreign Military Studies Office (Army), Fort Leavenworth, KS USA
**Cyber Mobilization: A Growing Counterinsurgency Campaign**
Thomas, Timothy L; Jan 2006; 7 pp.; In English
Report No.(s): AD-A465348; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465348

According to US Army publications, two types of offensive actions are key components of insurgency doctrine: armed

conflict and mass mobilization. It is clear after more than three years of fighting in Afghanistan and Iraq that the insurgents use improvised explosive devices (IEDs) as their main instrument to conduct armed conflict, and that they have learned to mobilize and conduct conflict-related cognitive activities using cyber means. For example, they capitalize on Internet capabilities to plan, target, educate, recruit, and influence sympathizers. If an insurgency's strength is predicated on the support of the local population, then Coalition counterinsurgency efforts must take cybermoblization enabled by computerized devices such as cell phones and the Internet into account. The warning signs of the advent of mobile phone and Internet mobilization were evident long before the wars in Afghanistan and Iraq. In December 1999, agitators used the Internet to organize resistance to the World Trade Organization (WTO) meeting in Seattle. Net-recruited protestors converged on Seattle from all directions. They frustrated well designed police control plans by using cell phones to move crowds to unattended areas, or to focus on other advantageous spots. Both television and Internet sites picked up coverage of these successful efforts, all of which encouraged similar demonstrations and championed other causes.
DTIC
*Bomber Aircraft; Internets*

**20070019055** Carnegie-Mellon Univ., Pittsburgh, PA USA
**Enabling Dynamic Security Management of Networked Systems via Device-Embedded Security (Self-Securing Devices)**
Ganger, Gregory R; Jan 15, 2007; 187 pp.; In English
Contract(s)/Grant(s): F49620-01-1-0433
Report No.(s): AD-A465393; No Copyright; Avail.: CASI: A09, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465393

This report summarizes the results of the work on the AFOSR's Critical Infrastructure Protection Program project, entitled Enabling Dynamic Security Management of Networked Systems via Device-Embedded Security (Self-Securing Devices), funded by the Air Force Research Laboratory contract number F49620-01-1-0433. The scientific goal of this CIP/URI effort was to fundamentally advance the state-of-the-art in network security and digital intrusion tolerance by exploring a new paradigm in which individual devices erect their own security perimeters and defend their own critical resources (e.g., network links or storage media). Together with conventional border defenses (e.g., firewalls), such self-securing devices provide a flexible infrastructure for dynamic prevention, detection, diagnosis, isolation, and repair of successful breaches in borders and device security perimeters. More specifically, the research sought to understand the costs, benefits and appropriate realization of (1) multiple, increasingly-specialized security perimeters placed between attackers and specific resources; (2) independent security perimeters placed around distinct resources, isolating each from compromises of the others; (3) rapid and effective intrusion detection, tracking, diagnosis, and recovery, using the still-standing security perimeters as a solid foundation from which to proceed; (4) the ability to dynamically shut away compromised systems, throttling their network traffic at its sources and using secure channels to reactively advise their various internal components to increase their protective measures; and (5) the ability to effectively manage and dynamically update security policies within and among the devices and systems in a networked environment. The underlying motivation throughout this research was to go beyond the 'single perimeter' mindset that typifies today's security solutions and results in highly brittle protections.
DTIC
*Embedding; Intrusion; Management Systems; Networks; Safety Devices; Security; Warning Systems*

**20070019078** Naval Research Lab., Washington, DC USA
**A Formal Framework and Evaluation Method for Network Denial of Service**
Meadows, Catherine; Jan 1999; 12 pp.; In English
Report No.(s): AD-A465455; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465455

Denial of service is becoming a growing concern. As our systems communicate more and more with others that we 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 our resources and disable our servers. Since these attacks occur before parties are authenticated to each other, we cannot rely upon enforcement of the appropriate access control policy to protect us (as is recommended in the classic work of Gligor and Millen in [5, 18, 19]). Instead we must build our defenses, as much as possible, into the protocols themselves. This paper shows how some principles that have already been used to make

protocols more resistant to denial of service can be formalized, and indicates the ways in which existing cryptographic protocol analysis tools could be modified to operate within this formal framework.
DTIC
*Computer Information Security; Protocol (Computers)*

**20070019079** Naval Research Lab., Washington, DC USA
**Security Issues in Networks with Internet Access**
Landwehr, Carl E; Goldschlag, David M; Jan 1997; 24 pp.; In English
Report No.(s): AD-A465468; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465468

This paper describes the basic principles of designing and administering a relatively secure network. The principles are illustrated by describing the security issues a hypothetical company faces as the networks that support its operations evolve from strictly private, through a mix of Internet and private nets, to a final state in which the Internet is fully integrated into its operations, and the company participates in international electronic commerce. At each stage, the vulnerabilities and threats that the company faces, the countermeasures that it considers, and the residual risk the company accepts are noted. Network security policy and services are discussed, and a description of Internet architecture and vulnerabilities provides additional technical detail underlying the scenario. Finally, a number of building blocks for secure networks are presented that can mitigate some of the vulnerabilities.
DTIC
*Computer Information Security; Internets; Security*

**20070019087** Naval Research Lab., Washington, DC USA
**A Strategy for an MLS Workflow Management System**
Kang, Myong H; Froscher, Judith N; Eppinger, Brian J; Moskowitz, Ira S; Jan 1999; 16 pp.; In English
Report No.(s): AD-A465482; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465482

Current DoD information systems need to support many different missions through cooperation with different organizations and allies. In today's fast paced and dynamic environment, it is almost impossible to design and implement a different information system for each mission. Therefore, DoD needs MLS workflow management systems (WFMS) to enable globally distributed users and existing applications to cooperate across classification domains to achieve mission critical goals. An MLS WFMS that allows users to program multilevel mission logic, securely coordinate widely distributed tasks, and monitor the progress of the workflow across classification domains is required. In this paper, we present requirements for MLS workflow and a strategy for implementing it, especially the method for decomposing an MLS workflow into multiple single-level workflows.
DTIC
*Management Systems; Microwave Landing Systems*

**20070019088** Naval Research Lab., Washington, DC USA
**Towards an Infrastructure for MLS Distributed Computing**
Kang, Myong H; Froscher, Judith N; Eppinger, Brian J; Jan 1998; 22 pp.; In English
Report No.(s): AD-A465483; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465483

Distributed computing owes its success to the development of infrastructure, middleware, and standards (e.g., CORBA) by the computing industry. This community has also recognized the need to protect information and has started to develop commercial security infrastructures and standards. The US Government must protect national security information against unauthorized information flow. To support MLS distributed computing, a MLS infrastructure must be built that enables information sharing among users at different classification levels. This infrastructure should provide MLS services for protection of classified information and use both the emerging distributed computing and commercial security infrastructures. The resulting infrastructure will enable users to integrate commercial information technology products into their systems. In this paper, we examine the philosophy that has led to successful distributed computing among heterogeneous, autonomous components and propose an analogous approach for MLS distributed computing. We identify some services that are required

to support MLS distributed computing, argue that these services are needed regardless of the MLS architecture used, present an approach for designing these services, and provide design guidance for a critical building block of the MLS infrastructure.
DTIC
*Distributed Processing; Microwave Landing Systems*

**20070019095** Carnegie-Mellon Univ., Pittsburgh, PA USA
**Is Host-Based Anomaly Detection + Temporal Correlation = Worm Causality**
Sekar, Vyas; Xie, Yinglian; Reiter, Michael K; Zhang, Hui; Mar 6, 2007; 30 pp.; In English
Contract(s)/Grant(s): CNS-0433540; ANI-0221653
Report No.(s): AD-A465497; CMU-CS-07-112; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465497

Epidemic-spreading attacks (e.g., worm and botnet propagation) have a natural notion of attack causality - a single network flow causes a victim host to get infected and subsequently spread the attack. This paper is motivated by a simple question regarding the diagnosis of such attacks - is it possible to establish attack-causality through network-level monitoring, without relying on signatures and attack-specific properties? Using the observation that communication patterns of normal hosts are sparse, we posit the hypothesis that it is feasible to uncover attack causality through a combination of host-based anomaly detection and temporal correlation of network events. The contribution of this paper is a systematic exploration of this hypothesis over the spectrum of attack properties and system design options. Our analysis, trace-driven experiments, and real prototype based study suggest that it is feasible to establish attack causality accurately using anomaly detection and temporal event correlation in enterprise network environments with tens of thousands of hosts.
DTIC
*Anomalies; Computer Viruses; Correlation Detection*

**20070019116** Naval Research Lab., Washington, DC USA
**Salsa: Combining Constraint Solvers with BDDs for Automatic Invariant Checking**
Bharadwaj, Ramesh; Sims, Steve; Jan 2000; 17 pp.; In English
Report No.(s): AD-A465536; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465536

Salsa is an invariant checker for specifications in SAL (the SCR Abstract Language). To establish a formula as an invariant without any user guidance Salsa carries out an induction proof that utilizes tightly integrated decision procedures, currently a combination of BDD algorithms and a constraint solver for integer linear arithmetic, for discharging the verification conditions. The user interface of Salsa is designed to mimic the interfaces of model checkers; i.e., given a formula and a system description, Salsa either establishes the formula as an invariant of the system (but returns no proof) or provides a counterexample. In either case, the algorithm will terminate. Unlike model checkers, Salsa returns a state pair as a counterexample and not an execution sequence. Also, due to the incompleteness of induction, users must validate the counterexamples. The use of induction enables Salsa to combat the state explosion problem that plagues model checkers it can handle specifications whose state spaces are too large for model checkers to analyze. Also, unlike general purpose theorem provers, Salsa concentrates on a single task and gains efficiency by employing a set of optimized heuristics.
DTIC
*Decision Support Systems; Program Verification (Computers)*

**20070019117** Naval Research Lab., Washington, DC USA
**On Key Distribution Protocols for Repeated Authentication**
Syverson, Paul; Jan 1993; 8 pp.; In English
Report No.(s): AD-A465538; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465538

In [KSL92], Kehne et al. present a protocol (KSL) for key distribution. Their protocol allows for repeated authentication by means of a ticket. They also give a proof in BAN logic [BAN89] that the protocol provides the principals with a reasonable degree of trust in the authentication and key distribution. They present an optimality result that their protocol contains a minimal number of messages. Nonetheless, in [NS93] Neuman and Stubblebine present a protocol (NS) as an explicit alternative to KSL that requires one less message in the initial authentication and key distribution. One goal of this paper is to examine some of the reasons for this discrepancy. Another goal is to demonstrate possible attacks on NS. Like any attacks on cryptographic protocols, these depend on assumptions about implementation details. But, when possible they are serious:

a penetrator can initiate the protocol, masquerade as another principal, obtain the session key, and even generate the session key herself. We will set out implementation assumptions required for the attacks to take place and implementation assumptions that preclude such an attack. We will also look at other protocols, including one that is not subject to this form of attack and has the same number of messages as NS. Finally, we will briefly discuss the logical analysis of these repeat authentication protocols.
DTIC
*Computer Information Security; Protocol (Computers)*

**20070019118** Naval Research Lab., Washington, DC USA
**Orange Locking: Channel-Free Database Concurrency Control via Locking**
McDermott, John; Jajodia, Sushil; Jan 1992; 19 pp.; In English
Report No.(s): AD-A465539; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465539

The concurrency control lock (e.g. file lock, table lock) has long been used as a canonical example of a covert channel in a database system. Locking is a fundamental concurrency control technique used in many kinds of computer systems besides database systems. Locking is generally considered to be interfering and hence unsuitable for multilevel systems. In this paper we show how such locks can be used for concurrency control, without introducing covert channels.
DTIC
*Data Bases; Locking; Protection; Security*

**20070019122** Florida Univ., Gainesville, FL USA
**Radio Frequency Circuits for Tunable Multi-Band CMOS Receivers for Wireless LAN Applications**
Li, Zhenbiao; Dec 2004; 187 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N66001-03-1-8901
Report No.(s): AD-A465551; No Copyright; Avail.: CASI: A09, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465551

Currently, three mainstream wireless LAN (WLAN) standards, IEEE 802.11a, b and g, co-exist in the market. The network should be able to work with all these standards. This has increased the demand of multi-band wireless LAN transceivers. Being a commercial application, the transceiver must be low cost, which points to a CMOS single chip solution. This dissertation addresses the design issues of multi-band CMOS WLAN receivers. A multi-band and multi-function receiver architecture is proposed for wireless LAN applications. The key blocks include RF switches, a multi-band RF down-converter, a multi-band voltage controlled oscillator (VCO) and a wide-tuning range VCO. This thesis work demonstrates the feasibility of realizing these circuits in CMOS technology. Two RF CMOS switches working at 2.4 GHz and 5.8 GHz were designed and tested. The 2.4-GHz switch exhibits sufficient performance for 802.11b/g applications.
DTIC
*Circuits; CMOS; Local Area Networks; Radio Frequencies; Receivers; Wireless Communication*

**20070019134** Naval Research Lab., Washington, DC USA
**A Taxonomy of Computer Program Security Flaws, with Examples**
Landwehr, Carl E; Bull, Alan R; McDermott, John P; Choi, William S; Sep 1994; 37 pp.; In English
Report No.(s): AD-A465587; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465587

An organized record of actual flaws can be useful to computer system designers, programmers, analysts, administrators, and users. This paper provides a taxonomy for computer program security flaws together with an appendix that carefully documents 50 actual security flaws. These flaws have all been described previously in the open literature, but in widely separated places. For those new to the field of computer security, they provide a good introduction to the characteristics of security flaws and how they can arise. Because these flaws were not randomly selected from a valid statistical sample of such flaws, we make no strong claims concerning the likely distribution of actual security flaws within the taxonomy. However, this method of organizing security flaw data can help those who have custody of more representative samples to organize them and to focus their efforts to remove and, eventually, to prevent the introduction of security flaws.
DTIC
*Computer Information Security; Computer Programs; Defects; Security; Taxonomy*

**20070019136** Naval Research Lab., Washington, DC USA
**Authentic Attributes with Fine-Grained Anonymity Protection**
Stubblebine, Stuart G; Syverson, Paul F; Jan 2000; 22 pp.; In English
Report No.(s): AD-A465589; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465589

Collecting accurate profile information and protecting an individual's privacy are ordinarily viewed as being at odds. This paper presents mechanisms that protect individual privacy while presenting accuratelindeed authenticated-profile information to servers and merchants. In particular, we give a pseudonym registration scheme and system that enforces unique user registration while separating trust required of registrars, issuers, and validators. This scheme enables the issuance of global unique pseudonyms (GUPs) and attributes enabling practical applications such as authentication of accurate attributes and enforcement of 'one-to-a- customer' properties. We also present a scheme resilient to even pseudonymous profiling yet preserving the ability of merchants to authenticate the accuracy of information. It is the first mechanism of which the authors are aware to guarantee recent validity for group signatures, and more generally multi- group signatures, thus effectively enabling revocation of all or some of the multi-group certificates held by a principal.
DTIC
*Computer Information Security; Protection*

**20070019140** Naval Research Lab., Washington, DC USA
**One Time Passwords in Everything (OPIE): Experiences with Building and Using Stringer Authentication**
McDonald, Daniel L; Atkinson, Randall J; Metz, Craig; Jan 1995; 12 pp.; In English
Report No.(s): AD-A465608; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465608

The U. S. Naval Research Laboratory's OPIE (One-time Passwords In Everything) Software Distribution is an enhancement of Bellcore's S/Key (TradeMark) 1.0 package. OPIE improves on S/Key in several areas, including FTP service with one-time passwords, and a stronger algorithm for generating one-time passwords. OPIE diverges from S/Key in select design decisions and in the behavior of certain programs. While not a total security solution, OPIE can be an important part of one. OPIE and its evolutionary predecessors have been used for over a year in parts of NRL. Its use has taught the authors lessons on implementation, usability, deployment, and future directions for improvement.
DTIC
*Computer Information Security; Computer Programs; Cryptography; Data Transmission; Security; Stringers*

**20070019162** Naval Research Lab., Washington, DC USA
**Analysis of the Internet Key Exchange Protocol Using the NRL Protocol Analyzer**
Meadows, Catherine; Jan 1999; 17 pp.; In English
Report No.(s): AD-A465466; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper we show how the NRL Protocol Analyzer, a special-purpose formal methods tool designed for the verification of cryptographic protocols, was used in the analysis of the Internet Key Exchange (IKE) protocol. We describe some of the challenges we faced in analyzing IKE, which specifies a set of closely related subprotocols, and we show how this led to a number of improvements to the Analyzer. We also describe the results of our analysis, which uncovered several ambiguities and omissions in the specification which would have made possible attacks on some implementations that conformed to the letter, if not necessarily the intentions, of the specifications.
DTIC
*Cryptography; Internets; Protocol (Computers)*

**20070019185** Naval Research Lab., Washington, DC USA
**Verifying Hybrid Systems Modeled as Timed Automata: A Case Study**
Archer, Myla; Heitmeyer, Constance; Mar 1997; 16 pp.; In English
Report No.(s): AD-A465709; No Copyright; Avail.: CASI: A03, Hardcopy

Verifying properties of hybrid systems can be highly complex. To reduce the effort required to produce a correct proof, the use of mechanical verification techniques is promising. Recently, we extended a mechanical verification system, originally developed to reason about deterministic real-time automata, to verify properties of hybrid systems. To evaluate our approach, we applied our extended proof system to a solution, based on the Lynch-Vaandrager timed automata model, of the Steam Boiler Controller problem, a hybrid systems benchmark. This paper reviews our mechanical verification system, which builds

on SRI's Prototype Verification System (PVS), and describes the features we added to handle hybrid systems. It also discusses some errors we detected in applying our system to the benchmark problem. We conclude with a summary of insights we acquired in using our system to specify and verify hybrid systems.
DTIC
*Automata Theory; Prototypes*

**20070019188** Miami Univ., Coral Gables, FL USA
**A Novel Anomaly Detection Scheme Based on Principal Component Classifier**
Shyu, Mei-Ling; Chen, Shu-Ching; Sarinnapakorn, Kanoksri; Chang, LiWu; Jan 2003; 9 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465712; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy

This paper proposes a novel scheme that uses robust principal component classifier in intrusion detection problems where the training data may be unsupervised. Assuming that anomalies can be treated as outliers, an intrusion predictive model is constructed from the major and minor principal components of the normal instances. A measure of the difference of an anomaly from the normal instance is the distance in the principal component space. The distance based on the major components that account for 50% of the total variation and the minor components whose eigenvalues less than 0.20 is shown to work well. The experiments with KDD Cup 1999 data demonstrate that the proposed method achieves 98.94% in recall and 97.89% in precision with the false alarm rate 0.92% and outperforms the nearest neighbor method, density-based local outliers (LOF) approach, and the outlier detection algorithm based on Canberra metric.
DTIC
*Anomalies; Classifiers; Computer Information Security; Detection; Warning Systems*

**20070019197** Space and Naval Warfare Systems Command, Charleston, SC USA
**Agile Assessment Techniques for Evaluating Mission Capability Portfolio Ensembles in Complex Adaptive Architectures (Briefing Charts)**
Lenahan, Jack; Jun 2005; 19 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465725; No Copyright; Avail.: CASI: A03, Hardcopy

Given the prototypical architectural template's demise, the purpose of this research is to begin a formulation of the Agile Assessment Methodology needed to evaluate the mission capability impact of using composeable web services in complex adaptive architectures. Network Centric Warfare (NCW) Assessment Processes must validate that a 'rush towards a transformation' by date 'X' does not sacrifice warfighter capability by introducing de-stabilizing architecture components. What assessment methodology and criteria will be used to evaluate or even define the NCW architectural boundaries for platform system reductions? What assessment methodology will be used to evaluate mission execution success probabilities given the migration away from traditional platform centric mission capabilities? The results of this research indicate that platforms should be wary of removing systems in favor of GIG services which may jeopardize crew or platform survivability; it also recommends that composeable assessment and simulation capabilities required to manage the assessment of mixed architecture capability ensembles be developed.
DTIC
*Charts; Command and Control*

**20070019205** Army Research Lab., Aberdeen Proving Ground, MD USA
**A Unifying Strategy for Data Integration for Global Force Management**
Chamberlain, Sam; Sprung, George; Jun 2004; 23 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465741; No Copyright; Avail.: CASI: A03, Hardcopy

Global operations in a network centric environment require high-resolution, richly populated force management data, constructs and management processes that extend across Service boundaries. This paper presents an approach that is based upon three pillars. First, realistically, the only way to maintain force structure data is to obtain it directly from the agencies responsible for building and maintaining that data. This requires that the people who develop and maintain force structure data in the Services and for the DOD must provide it in a form conducive to computer manipulation for use by a diverse population of users. Second, force structure data must be formally and rigorously specified and its semantics unambiguously defined and implemented so that sophisticated computer programs can economically exploit it. Finally, a common naming convention must be accepted across the Services with the capability of being extended through coalition boundaries. This paper presents a set

of fundamental constructs and a description of how they can be manipulated to accomplish the objectives of the Global Force Management (GFM) process.
DTIC
*Data Integration; Data Management; High Resolution*

**20070019216** Connecticut Univ., Storrs, CT USA
**Agent-based Decision Support System for the Third Generation Distributed Dynamic Decision-making (DDD-III) Simulator**
Meirina, Candra; Ruan, Sui; Yu, Feili; Zhu, Liang; Pattipati, Krishna R; Kleinman, David L; Jun 2004; 34 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-00-1-0101
Report No.(s): AD-A465785; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper, we discuss the design and application of a decision support system (DSS) based on the third-generation distributed dynamic decision-making (DDD-III) simulator and contingency theory to increase the organizational cognitive capacity and to facilitate the processes of adaptation. The role of the DSS is to provide mission-monitoring and re-planning information to human decision-makers (DMs) in order to manage the explicit and tacit knowledge, codify them into simple and meaningful formats, and facilitate rapid transfer of knowledge among the DMs. We present an overview of contingency notions that incorporate three relevant components affecting organizational performance: (1) environment, (2) organizational structure, and (3) strategy, and demonstrate that triggers for organizational adaptation require an integrated multi-dimensional concept of congruence ('fit between the organization and mission environment') incorporating structure-environment, strategy-environment, and strategy-structure matches. Due to the elusive nature of knowledge necessary for efficient and effective organizational adaptation, the knowledge management strategies for efficiently codifying and rapidly transferring the knowledge among DMs is central to achieving superior organizational performance. Our DSS is a suitable test-bed to investigate these processes, and thus provides a means for organizations to gain competitive advantage.
DTIC
*Congruences; Decision Making; Decision Support Systems; Simulators*

**20070019262** Communications Research Centre, Ottawa, Ontario Canada
**Study of Tools for Network Discovery and Network Mapping**
Bantseev, Sergei; Labbe, Isabelle; Nov 2003; 109 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465674; No Copyright; Avail.: CASI: A06, Hardcopy

The work presented in this report is related to the DRDC Joint Network Management and Defense System (JNMDS) Technology Demonstrator Project. This work is an investigation of the currently available tools that are capable of performing automatic network discovery in an IP-based network. For the proposed system, it is required to provide an assessment of the existing tool's capabilities in identifying: the network topologies (map of physical links and logical links), the network resources (network elements and the configuration information) and the network services (network applications and system support). In particular, the study addresses the following issues: how is automatic network discovery achieved by the existing tools, and what is discovered. A number of tools from the commercial sector (COTS), the open-source community and the research$academic community were identified. Based on the main auto-discovery techniques that are implemented by the tools, four tool categories were defined. These are: the Active SNMP-based, the Active Hybrid, the Passive only and the Inventory & Audit tool category. For each of the four categories, a number of tools from the three sources were selected for further study. For the selected tools, a documentation-based evaluation of their auto-discovery capabilities was performed. The report presents the detailed evaluation of seventeen tools. The results of the evaluation are summarized in two characteristic tables. One thing that is apparent when looking at the outcome of the study is that although some tools present good capabilities, they all have their strengths and weaknesses. Within the scope of interest, the 'one tool does it all' solution does not exist. It is reasonable to expect that for the Technology Demonstrator Project system, the solution is likely to consist of an integrated suite of tools where functionality of each tool will be combined to achieve the desired capability.
DTIC
*Networks; Management Systems; Information Systems; Proving*

**20070019274** Naval Research Lab., Washington, DC USA
**Anonymity and Covert Channels in Simple Timed Mix-firewalls**
Newman, Richard E; Nalla, Vipan R; Moskowitz, Ira S; Jan 2004; 17 pp.; In English
Report No.(s): AD-A465141; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465141

Traditional methods for evaluating the amount of anonymity afforded by various Mix configurations have depended on either measuring the size of the set of possible senders of a particular message (the anonymity set size), or by measuring the entropy associated with the probability distribution of the messages possible senders. This paper explores further an alternative way of assessing the anonymity of a Mix system by considering the capacity of a covert channel from a sender behind the Mix to an observer of the Mix's output. Initial work considered a simple model [5], with an observer (Eve) restricted to counting the number of messages leaving a Mix configured as a rewall guarding an enclave with one malicious sender (Alice) and some other naive senders (Cluelessi's). Here, we consider the case where Eve can distinguish between multiple destinations, and the senders can select to which destination their message (if any) is sent each clock tick.
DTIC
*Computer Information Security; Probability Theory; Transmitters; Clocks*

**20070019277** Naval Research Lab., Washington, DC USA
**Replication Does Survive Information Warfare Attacks**
McDermott, J; Jan 1997; 11 pp.; In English
Report No.(s): AD-A465292; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465292

Recent literature on information warfare has suggested that general replication is not useful in dealing with storage jamming attacks. We show that special cases of replication are useful not only in detecting but also in recovering from storage jamming attacks.
DTIC
*Warfare; Detection*

**20070019283** Naval Research Lab., Washington, DC USA
**SCR: A Practical Approach to Building a High Assurance COMSEC System**
Kirby, Jr , James; Archer, Myla; Heitmeyer, Constance; Dec 1999; 11 pp.; In English
Report No.(s): AD-A465332; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465332

To date, the tabular-based SCR (Software Cost Reduction) method has been applied mostly to the development of embedded control systems. This paper describes the successful application of the SCR method, including the SCR* toolset, to a different class of system, a COMSEC (Communications Security) device called CD that must correctly manage encrypted communications. The paper summarizes how the tools in SCR* were used to validate and to debug the SCR specification and to demonstrate that the specification satisfies a set of critical security properties. The development of the CD specification involved many tools in SCR*: a specification editor, a consistency checker, a simulator, the TAME interface to the theorem prover PVS, and various other analysis tools. Our experience provides evidence that use of the SCR* toolset to develop high-quality requirements specifications of moderately complex COMSEC systems is both practical and low-cost.
DTIC
*Security; Communication Equipment; Control Systems Design*

**20070019284** Cambridge Univ., Cambridge, UK
**From a Trickle to a Flood: Active Attacks on Several Mix Types**
Serjantov, Andrei; Dingledine, Roger; Syverson, Paul; Jan 2002; 17 pp.; In English
Report No.(s): AD-A465475; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465475

The literature contains a variety of different mixes, some of which have been used in deployed anonymity systems. We explore their anonymity and message delay properties, and show how to mount active attacks against them by altering the traffic between the mixes. We show that if certain mixes are used, such attacks cannot destroy the anonymity of a particular message completely. We work out the cost of these attacks in terms of the number of messages the attacker must insert into the network and the time he must spend. We discuss advantages and disadvantages of these mixes and the settings in which their use is appropriate. Finally, we look at dummy traffic and Stop-and-Go (SG) mixes as other promising ways of protecting against the attacks, point out potential weaknesses in existing designs, and suggest improvements.
DTIC
*Security; Algorithms; Deployment*

**20070019287** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Engineering Complex Embedded Systems with State Analysis and the Mission Data System**

Ingham, Michel D.; Rasmussen, Robert D.; Bennett, Matthew B.; Moncada, Alex C.; September 20, 2004; In English; AIAA Intelligent Systems Technical Conference, 20-22 Sep. 2006, Chicago, IL, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39870

It has become clear that spacecraft system complexity is reaching a threshold where customary methods of control are no longer affordable or sufficiently reliable. At the heart of this problem are the conventional approaches to systems and software engineering based on subsystem-level functional decomposition, which fail to scale in the tangled web of interactions typically encountered in complex spacecraft designs. Furthermore, there is a fundamental gap between the requirements on software specified by systems engineers and the implementation of these requirements by software engineers. Software engineers must perform the translation of requirements into software code, hoping to accurately capture the systems engineer's understanding of the system behavior, which is not always explicitly specified. This gap opens up the possibility for misinterpretation of the systems engineer s intent, potentially leading to software errors. This problem is addressed by a systems engineering methodology called State Analysis, which provides a process for capturing system and software requirements in the form of explicit models. This paper describes how requirements for complex aerospace systems can be developed using State Analysis and how these requirements inform the design of the system software, using representative spacecraft examples.

Author

*Complex Systems; Software Engineering; Software Reliability; Airborne/Spaceborne Computers; Systems Analysis*

**20070019296** Naval Research Lab., Washington, DC USA

**A Network Version of the Pump**

Kang, Myong H; Moskowitz, Ira S; Lee, Daniel C; Jan 1995; 13 pp.; In English

Report No.(s): AD-A465537; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465537

A designer of reliable MLS networks must consider covert channels and denial of service attacks in addition to traditional network performance measures such as throughput, fairness, and reliability. In this paper we show how to extend the NRL data Pump to a certain MLS network architecture in order to balance the requirements of congestion control, fairness, good performance, and reliability against those of minimal threats from covert channels and denial of service attacks. We back up our claims with simulation results.

DTIC

*Security; Controllability; Architecture (Computers)*

## 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*.

**20070018941** Naval Research Lab., Washington, DC USA

**Limitations on Design Principles for Public Key Protocols**

Syverson, Paul; Jan 1996; 12 pp.; In English

Report No.(s): AD-A465132; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465132

Recent papers have taken a new look at cryptographic protocols from the perspective of proposing design principles. For years the main approach to cryptographic protocols has been logical, and a number of papers have examined the limitations of those logics. This paper takes a similar cautionary look at the design principal approach. Limitations and exceptions are offered on some of the previously given basic design principals. The focus is primarily on public key protocols, especially on the order of signature and encryption. But, other principles are discussed as well. Apparently secure protocols that fail to meet principles are presented. Also presented are new attacks on protocols as well as previously claimed attacks which are not.

DTIC

*Cryptography; Data Processing; Design Analysis; Message Processing; Protocol (Computers); Texts*

**20070018983** Defence Science and Technology Organisation, Edinburgh, Australia
**The Generation of Situational Awareness within Autonomous Systems - A Near to Mid term Study - Analysis**
Hew, Patrick C; Jul 2006; 24 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465252; DSTO-GD-0467; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465252

This study aims to clarify and capture the nature of electronic situational awareness and its interface with electro/mechanical systems. It argues that autonomous situation awareness is about the sufficiency of awareness for autonomy in the situation at hand. The approach is calibrated through historical case studies, and the study then considers the potential from near to mid term technology.
DTIC
*Autonomous Navigation; Autonomy; Robotics; Situational Awareness*

**20070019071** Army Tank-Automotive Research and Development Command, Warren, MI USA
**Operational Effectiveness Modeling of Intelligent Systems**
Kerr, Michael; Jun 1, 2006; 16 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465440; TACOM/TARDEC-15850; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465440

CONCLUSIONS: * Significant work remains to properly model intelligent systems in a constructive simulation model like CASTFOREM. * Obtaining adequate data to properly model some issues (i.e., timelines) will be the largest hurdle. * Some issues, like anti-tamper, cannot be properly modeled without a major commitment of resources to obtain the model changes and the detailed data required. * TTPs for intelligent systems are still in the infant stages.
DTIC
*Artificial Intelligence; Models; System Effectiveness*

**20070019107** Northwestern Univ., Evanston, IL USA
**An Integrated Architecture for Engineering Problem Solving**
Pisan, Yusuf; Dec 1998; 169 pp.; In English
Report No.(s): AD-A465520; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465520

Problem solving is an essential function of human cognition. To build intelligent systems that are capable of assisting engineers and tutoring students, we need to develop an information processing model that captures the skills used in engineering problem solving. This thesis describes the Integrated Problem Solving Architecture (IPSA) that combines qualitative, quantitative and diagrammatic reasoning skills to produce annotated solutions to engineering problems. We focus on representing expert knowledge, and examine how control knowledge provides the structure for using domain knowledge. To demonstrate our architecture for engineering problem solving, we present a Thermodynamics Problem Solver (TPS) that uses the IPSA architecture. TPS solves over 150 thermodynamics problems taken from the first four chapters of a common thermodynamics textbook and produces expert-like solutions.
DTIC
*Artificial Intelligence; Problem Solving*

**20070019111** Carnegie-Mellon Univ., Pittsburgh, PA USA
**Real-Time Motion Planning and Safe Navigation in Dynamic Multi-Robot Environments**
Bruce, James R; Dec 15, 2006; 205 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DABT63-99-1-0013; F30602-98-2-0135
Report No.(s): AD-A465526; CMU-CS-06-181; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465526

All mobile robots share the need to navigate, creating the problem of motion planning. In multi-robot domains with agents acting in parallel, highly complex and unpredictable dynamics can arise. This leads to the need for navigation calculations to be carried out within tight time constraints, so that they can be applied before the dynamics of the environment make the calculated answer obsolete. At the same time, we want the robots to navigate robustly and operate safely without collisions. While motion planning has been used for high level robot navigation, or limited to semi-static or single-robot domains, it has often been dismissed for the real-time low-level control of agents due to the limited computational time and the unpredictable dynamics. Many robots now rely on local reactive methods for immediate control of the robot, but if the reason for avoiding

motion planning is execution speed, the answer is to find planners that can meet this requirement. Recent advances in traditional path planning algorithms may offer hope in resolving this type of scalability, if they can be adapted to deal with the specific problems and constraints mobile robots face. Also, in order to maintain safety, new scalable methods for maintaining collision avoidance among multiple robots are needed in order to free motion planners from the curse of dimensionality when considering the safety of multiple robots with realistic physical dynamics constraints. This thesis contributes the pairing of real-time motion planning which builds on existing modern path planners, and a novel cooperative dynamics safety algorithm for high speed navigation of multiple agents in dynamic domains. It also explores near real-time kinematically limited motion planning for more complex environments. The thesis algorithms have been fully implemented and tested with success on multiple real robot platforms.
DTIC
*Navigation; Planning; Real Time Operation; Robots; Trajectory Control*

**20070019130** Clemson Univ., SC USA
**Adaptive Visual Servo Regulation Control for Camera-in-Hand Configuration with a Fixed-Camera Extension**
Tatlicioglu, Enver; Dawson, Darren M; Xian, Bin; Mar 9, 2007; 12 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465581; CU-CRB-3-9-07-1; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465581

In this paper, image-based regulation control of a robot manipulator with an uncalibrated vision system is discussed. To compensate for the unknown camera calibration parameters, a novel prediction error formulation is presented. To achieve the control objectives, a Lyapunov-based adaptive control strategy is employed. The control development for the camera-in-hand problem is presented in detail and a fixed-camera problem is included as an extension.
DTIC
*Adaptive Control; Cameras; Computer Vision; Servomechanisms; Visual Control*

**20070019131** Clemson Univ., SC USA
**Euclidean Position Estimation of Static Features using a Moving Camera with Known Velocities**
Braganza, David; Dawson, Darren; Hughes, Tim; Mar 9, 2007; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465582; CU-CRB-3-9-07-2; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465582

The estimation of 3D Euclidean coordinates of features from 2D images is a problem of significant interest. In this paper we develop a 3D Euclidean position estimation strategy for a static object using a single moving camera whose motion is known. The Euclidean depth estimator which is developed has a very simple mathematical structure and is easy to implement. Numerical simulations and preliminary experimental results using a mobile robot in an indoor environment are presented to illustrate the performance of the algorithm. An extension of this estimation technique for a paracatadioptric system is also presented.
DTIC
*Cameras; Euclidean Geometry; Motion*

**20070019145** Texas Univ., Austin, TX USA
**Multi-Scale Behavioral Modeling and Analysis Promoting a Fundamental Understanding of Agent-Based System Design and Operation**
Barber, K S; Mar 2007; 25 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-00-2-0588; Proj-TASK
Report No.(s): AD-A465613; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465613

This research project used a combination of theory and experimentation to advance both the design methods and delivered functionality of Multi-Agent Systems in the context of military-relevant problem domains. The experiments conducted tested new theories about how systems of agents acting as distributed decision-makers should: (1) reorganize by allocating decision-making control to maximize system performance, (2) assess the trustworthiness of information by determining the level of information uncertainty and reliability of information source, and (3) coordinate by exchanging their preferences for actions under varying organizations and situations.
DTIC
*Decision Making; Experiment Design; Models; Software Development Tools; Systems Engineering*

**20070019147** Clemson Univ., SC USA

**Whole Arm Grasping Control for Redundant Robot Manipulators**

Braganza, D; McIntyre, M L; Dawson, D M; Walker, I; Jan 2005; 10 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465616; CU/CRB/10/12/05/ 1; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465616

An approach to whole arm grasping of objects using redundant robot manipulators is presented. A kinematic control development is presented which facilitates the encoding of both the end-effector position, as well as body self-motion positioning information as a desired trajectory signal for the manipulator joints. A joint space controller which provides asymptotic tracking of the encoded desired trajectory in the presence of system uncertainties is then presented. Experimental results for a planar, three link configuration of the Barrett whole arm manipulator are provided to illustrate the validity of the approach.

DTIC

*Manipulators; Robot Arms; Robotics*

**20070019148** Clemson Univ., SC USA

**A Novel Passive Path Following Controller for a Rehabilitation Robot**

Zhang, X; Behal, A; Dawson, D M; Chen, J; Jan 2004; 13 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465617; CU/CRB/3/3/04/ 1; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465617

In this paper, we present a path generation and control strategy for a robotic manipulator to mimic the dynamics of a continuously reconfigurable anisotropic impedance. Motivated by a nonholonomic kinematic constraint, a dynamic path generator is designed to trace a desired contour in the robot's workspace when an interaction force is applied at the robot's end-effector. The proposed continuous control strategy achieves semi-global asymptotically stable path following for the robot manipulator in the presence of uncertainty in the robot dynamics. Additionally, the path generator also ensures safety by maintaining the desired net flow of energy during the human robot interaction from the user toward the manipulator. In addition to providing asymptotic path following, the control algorithm also ensures sufficiently rapid error convergence at the end-effector such that the actual energy transfer profile follows the desired energy transfer profile - thus rigorously ensuring user safety. A variation of the generation and control algorithms is presented to deal with unknown interaction force at the end-effector.

DTIC

*Algorithms; Controllers; End Effectors; Robots; Trajectories*

**20070019150** Clemson Univ., SC USA

**Adaptive Nonlinear Tracking Control of Kinematically Redundant Robot Manipulators with Sub-Task Extensions**

Tatlicioglu, E; McIntyre, M; Dawson, D; Walker, I; Jan 2005; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465620; CU/CRB/8/30/05/ 1; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465620

Past research efforts have focused on the end-effector tracking control of redundant robots because of their increased dexterity over their non-redundant counterparts. This work utilizes an adaptive full-state feedback quaternion based controller developed in [5] and focuses on the design of a general sub-task controller. This sub-task controller does not affect the position and orientation tracking control objectives, but instead projects a preference on the configuration of the manipulator based on sub-task objective such as the following; singularity avoidance, joint limit avoidance, bounding the impact forces, and bounding the potential energy.

DTIC

*Adaptive Control; Controllers; End Effectors; Manipulators; Nonlinearity; Robot Arms; Robots*

**20070019224** Rensselaer Polytechnic Inst., Troy, NY USA

**Applications of Dynamic Systems Theory to Effects-Based Operations and Adversarial Modelling**

Bello, Paul; Mailman, Mitch; Mar 22, 2004; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465801; No Copyright; Avail.: CASI: A03, Hardcopy

Effects-based operations (EBO) has become an increasingly important doctrinal concept used in the prosecution of war, most especially against terrorist organizations and the rogue states which support them. As a philosophy, EBO reaches beyond the realm of the propagation of simple physical effects. EBO encompasses the full spectrum of military activities, including

psychological operations (PSYOPS). While a number of different accounts of EBO have been documented (Warden 1995, Barlow 1994), alarmingly little work has been conducted concerning the application of effects-based operations to organizations of human entities. Herein, we present a formal model of nth-order cascading belief revision in the style of Warden's model. The considered approach is motivated by the theory of dynamic systems, and is able to be generalized through the manipulation of beliefs via information-theoretic (Shannon & Weaver 1949) metrics. We shall conclude with a simple example, and some future directions for research in this area.
DTIC
*Artificial Intelligence; Cognition; Warfare*

**20070019271** Naval Research Lab., Washington, DC USA
**Analyzing the Needham-Schroeder Public Key Protocol: A Comparison of Two Approaches**
Meadows, Catherine A; Jan 1996; 15 pp.; In English
Report No.(s): AD-A465136; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465136

In this paper we contrast the use of the NRL Protocol Analyzer and Gavin Lowe's use of the model checker FDR [7] to analyze the Needham-Schroeder public key protocol. This is used as a basis to compare and contrast the two systems and to point out possible future directions for research.
DTIC
*Cryptography; Protocol (Computers)*

**20070019341** Army Tank-Automotive Research and Development Command, Warren, MI USA
**Robotic Technologies for the Future Force - The ART ATO**
Jaster, Jeffrey F; Apr 14, 2005; 19 pp.; In English
Report No.(s): AD-A465618; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465618

The purpose of this report is to advance the state of the art in unmanned platform technologies, achieve FCS ORD capabilities of ARV systems and ARV teams. Product: enhanced semi-autonomous mobility suite, integrated tactical/mission behavior system, survivability technology/devices/payload.
DTIC
*Robotics; Systems Integration; Autonomy*

**20070019383** NASA Johnson Space Center, Houston, TX, USA
**Grasp Control: Theory and Practice**
Platt, Robert; June 1, 2007; 8 pp.; In English; Third Annual New England Manipulation Symposium, 1 June 2007, Troy, NY, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019383

A theoretical convergence for grasp control along with experimental results are presented.
CASI
*Robotics; Automation; Holding; Convergence; Control Theory*

## 64
## NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

**20070018832** NASA Langley Research Center, Hampton, VA, USA
**Robust Design Optimization via Failure Domain Bounding**
Crespo, Luis G.; Kenny, Sean P.; Giesy, Daniel P.; [2007]; 25 pp.; In English; 9th AIAA Non-Deterministic Approaches Conference, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 457280.02.07; Copyright; Avail.: CASI: A03, Hardcopy

This paper extends and applies the strategies recently developed by the authors for handling constraints under uncertainty to robust design optimization. For the scope of this paper, robust optimization is a methodology aimed at problems for which some parameters are uncertain and are only known to belong to some uncertainty set. This set can be described by either a

deterministic or a probabilistic model. In the methodology developed herein, optimization-based strategies are used to bound the constraint violation region using hyper-spheres and hyper-rectangles. By comparing the resulting bounding sets with any given uncertainty model, it can be determined whether the constraints are satisfied for all members of the uncertainty model (i.e., constraints are feasible) or not (i.e., constraints are infeasible). If constraints are infeasible and a probabilistic uncertainty model is available, upper bounds to the probability of constraint violation can be efficiently calculated. The tools developed enable approximating not only the set of designs that make the constraints feasible but also, when required, the set of designs for which the probability of constraint violation is below a prescribed admissible value. When constraint feasibility is possible, several design criteria can be used to shape the uncertainty model of performance metrics of interest. Worst-case, least-second-moment, and reliability-based design criteria are considered herein. Since the problem formulation is generic and the tools derived only require standard optimization algorithms for their implementation, these strategies are easily applicable to a broad range of engineering problems.
Author
*Design Optimization; Robustness (Mathematics); Failure Analysis; Parameterization; Mathematical Models*

**20070018981** Naval Observatory, Washington, DC USA
**IGS Rapid Orbits: Systematic Error at Day Boundaries**
Slabinski, Victor J; May 2006; 13 pp.; In English
Report No.(s): AD-A465250; No Copyright; Avail.: CASI: A03, Hardcopy

When one fits a GPS spacecraft trajectory through several days of orbit positions from IGS Rapid orbit SP3 files, the orbit position residuals show discontinuities at the day boundaries between SP3 files. The discontinuities can be of order 10 cm, especially the component in the along-track direction. The discontinuity component values for a specific spacecraft usually have the same sign for several months, that is, the variation from day to day is not random. SVN 44 (PRN 28) during the year 2005 showed an along-track discontinuity that slowly varied over the runge +2 to +13 cm. IGS Final orbits show similar discontinuities at each 00 hr GPS. The biased residual discontinuities reflect a discontinuity in Rapid orbit systematic position error across day boundaries; this error is much larger than the 2 cm RMS difference between orbits from different Analysis Centers. We show that some reasonable orbit modelling errors could produce these discontinuities.
DTIC
*Errors; Geodynamics; Global Positioning System; Gravitational Fields; Navigation; Numerical Analysis; Systematic Errors*

**20070019007** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**Surrogate Structures for Computationally Expensive Optimization Problems With CPU-Time Correlated Functions**
Magallanez Jr, Raymond; Jun 2007; 74 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465291; AFIT/GOR/ENC/07-01; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465291

This research focuses on numerically solving a class of computationally expensive optimization problems that possesses a unique characteristic: as the optimal solution is approached, the computational time required to compute an objective function value decreases. This is motivated by an application in which each objective function evaluation requires both a numerical ?uid dynamics simulation and an image registration and comparison process. The goal is to ?nd the parameters of a predetermined image by comparing the ?ow dynamics from the numerical simulation and the predetermined image through the image comparison process. The generalized pattern search and mesh adaptive direct search methods were applied in a way that employs surrogate functions in the search step to reduce the number of costly function evaluations. The surrogate functions are formed, based on either previous function values or their computational times, or both. The solution to the surrogate optimization problem can be solved easily and provides an improved solution quickly. A time cut-o? parameter was also added to the objective function to allow its termination during the comparison process if the computational time exceeded a speci?ed threshold. The approach was tested on two problems using the NOMADm and DACE MATLABr software packages, and results are presented.
DTIC
*Central Processing Units; Problem Solving; Time Functions*

**20070019064** Catholic Univ. of America, Washington, DC USA
**The Binary Phase Only Filter as an Image Watermark**
Ahmed, Farid; Moskowitz, Ira S; Jan 12, 2004; 5 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465428; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465428

We describe our new method for watermarking digital images. Our work is motivated by the study of phase only filters in Fourier optics. In this paper we concentrate on grey scale images, even though our method works for color also. We take the discrete Fourier transform of an image and determine a signature based upon a binary phase-only filter (BPOF). We replace certain frequency magnitudes with this BPOF. This serves as the basis for our watermark. We may also insert additional side information and our method prevents spoofing of the watermark. Our method survives JPEG compression so that the watermark survives to pass various correlation tests. Our watermarking scheme is used for authentication purposes.
DTIC
*Discrete Functions; Fourier Transformation; Images*

**20070019069** George Washington Univ., Washington, DC USA
**Reduction of a Class of Fox-Wright PSI Functions for Certain Rational Parameters**
Miller, Allen R; Moskowitz, Ira S; Jan 1995; 20 pp.; In English
Report No.(s): AD-A465435; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465435

The Fox-Wright Psi function is a special case of Fox's H-function and a generalization of the generalized hypergeometric function. In the present paper we show that the Psi function reduces to a single generalized hypergeometric function when certain of its parameters are integers and to a finite sum of generalized hypergeometric functions when these parameters are rational numbers. Applications to the solution of algebraic trinomial equations and to a problem in information theory are provided. A connection with Meijer's G-function is also discussed.
DTIC
*Equations; Hypergeometric Functions; Information Theory*

**20070019070** Naval Research Lab., Washington, DC USA
**TAME: Using PVS Strategies for Special-Purpose Theorem Proving**
Archer, Myla; Jan 2001; 46 pp.; In English
Report No.(s): AD-A465436; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465436

TAME (Timed Automata Modeling Environment), an interface to the theorem proving system PVS, is designed for proving properties of three classes of automata: I/O automata, Lynch-Vaandrager timed automata, and SCR automata. TAME provides templates for specifying these automata, a set of auxiliary theories, and a set of specialized PVS strategies that rely on these theories and on the structure of automata specifications using the templates. Use of the TAME strategies simplifies the process of proving automaton properties, particularly state and transition invariants. TAME provides two types of strategies: strategies for \automatic' proof and strategies designed to implement \natural' proof steps, i.e., proof steps that mimic the high-level steps in typical natural language proofs. TAME's \natural' proof steps can be used both to mechanically check hand proofs in a straightforward way and to create proof scripts that can be understood without executing them in the PVS proof checker. Several new PVS features can be used to obtain better control and efficiency in user-defined strategies such as those used in TAME. This paper describes the TAME strategies, their use, and how their implementation exploits the structure of specifications and various PVS features. It also describes several features, currently unsupported in PVS, that would either allow additional \natural' proof steps in TAME or allow existing TAME proof steps to be improved. Lessons learned from TAME relevant to the development of similar specialized interfaces to PVS or other theorem provers are discussed.
DTIC
*Artificial Intelligence; Automata Theory; Models; Theorem Proving*

**20070019137** Xerox Corp., Palo Alto, CA USA
**Topological Inference of Teleology: Deriving Function from Structure via Evidential Reasoning**
Everett, John O; Jun 10, 1999; 55 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465599; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465599

Reasoning about the physical world is a central human cognitive activity. One aspect of such reasoning is the inference of function from the structure of the artifacts one encounters. In this article we present the Topological iNference of Teleology (TNT) theory, an efficient means of inferring function from structure. TNT comprises a representation language for structure and function that enables the construction, extension, and maintenance of the domain-specific knowledge base required for

such inferences, and an evidential reasoning algorithm. This reasoning algorithm trades deductive soundness for efficiency and flexibility. We discuss the representations and algorithm in depth and present an implementation of TNT, in a system called CARNOT. CARNOT demonstrates quadratic performance and broad coverage of the domain of single-substance thermodynamic cycles, including all such cycles presented in a standard text on the subject.We conclude with a discussion of CARNOTbased coaching tools that we have implemented as part of our publicly available CyclePad system, which is a design-based learning environment for thermodynamics. 1999 Elsevier Science B.V. All rights reserved.
DTIC
*Artificial Intelligence; Education; Inference; Quadratic Equations; Thermodynamics*

**20070019146** Columbia Univ., New York, NY USA
**Continuous Quantum Computation**
Traub, Joseph F; Mar 2007; 31 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8750-01-2-0523; Proj-L487
Report No.(s): AD-A465614; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465614

The focus of this research was on developing quantum algorithms for continuous problems, complexity analysis of these algorithms, and their simulation and implementation. Continuous problems are a focus because much of physics, chemistry, and engineering depends on continuous mathematical formulations such as partial differential equations, path integration, approximation, and high-dimensional integration. New algorithms and quantum speedups were obtained for a number of important problems such as path integration, eigenvalues of Hermitian operators, Feynman-Kac path integration, high-dimensional approximation, and the Sturm-Liouville eigenvalue problem. The simulation and implementation part of the project included simulation of the quantum summation algorithm, implementation of the quantum Baker's map, NMR implementation of a quantum lattice gas, application of a Loschmidt echo, single spin measurement, and experiments in solid-state simulation.
DTIC
*Algorithms; Quantum Computation; Quantum Theory*

**20070019167** Colorado State Univ., Fort Collins, CO USA
**Scheduling Under Uncertainty: An Analysis of an Air Force Application**
Howe, Adele; Whitley, L D; Jan 29, 2007; 10 pp.; In English
Contract(s)/Grant(s): FA9550-06-1-0421
Report No.(s): AD-A465658; No Copyright; Avail.: CASI: A02, Hardcopy

We investigated a new scheduling application under uncertainty: the Eglin AFB phased array radar tracks thousands of objects in space. Because of uncertainty associated with an object's location and radar cross-section, as well as the inherent power limits and weather, scheduling must trade-off maximizing the probability of detection against maximizing the total number of objects scheduled for observation; the system must also dynamically reschedule missed observations and incorporate new requests. The problem of scheduling under uncertainty, and what scheduling methods are robust under uncertainty, is not well understood. We developed and tested algorithms that can handle uncertainty during scheduling. We identified key factors that impact performance and algorithm characteristics that address it.
DTIC
*Algorithms; Scheduling*

**20070019176** Georgia Inst. of Tech., Atlanta, GA USA
**Area-Preserving Mappings for the Visualization of Medical Structures**
Zhu, Lei; Haker, Steven; Tannenbaum, Allen; Jan 2003; 9 pp.; In English
Contract(s)/Grant(s): NIH-R01-AG19513
Report No.(s): AD-A465685; No Copyright; Avail.: CASI: A02, Hardcopy

In this note, we present a method for flattening anatomical surfaces such as branched vessels and intestinal tracts in an area preserving way. This method is based on the theory of optimal mass transport and conformal mapping of surfaces. The flattened representations differ minimally from conformality in a certain precise sense. Potential applications include the detection and visualization of pathologies such as stenoses and polyps.
DTIC
*Blood Vessels; Conformal Mapping*

**20070019181** Georgia Inst. of Tech., Atlanta, GA USA

**A Stokes Flow Boundary Integral Measurement of Tubular Structure Cross Sections in Two Dimensions**

Niethammer, Marc; Pichon, Eric; Tannenbaum, Allen; Mucha, Peter J; Jan 2003; 5 pp.; In English

Report No.(s): AD-A465700; No Copyright; Avail.: CASI: A01, Hardcopy

In this paper we will develop a method to determine cross sections of arbitrary two-dimensional tubular structures, which are allowed to branch, by means of a Stokes flow based boundary integral formulation. The measure for the cross sections for a point on the boundary of a given structure will be the path obtained by integrating perpendicularly to the flow lines from one side of the boundary to the other. Special emphasis will be put on the behavior at branching points, the behavior at vortices, and the necessary boundary conditions. The method can be extended to three dimensional problems.

DTIC

*Boundaries; Flow Measurement; Integral Equations; Navier-Stokes Equation; Stokes Flow*

## 65
## STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

**20070018793** NASA Langley Research Center, Hampton, VA, USA

**A Statistical Approach for the Concurrent Coupling of Molecular Dynamics and Finite Element Methods**

Saether, E.; Yamakov, V.; Glaessgen, E.; April 23, 2007; 15 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference. Special Session on Nanostructured Materials, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 732759.07.09

Report No.(s): AIAA 2007-2169; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018793

Molecular dynamics (MD) methods are opening new opportunities for simulating the fundamental processes of material behavior at the atomistic level. However, increasing the size of the MD domain quickly presents intractable computational demands. A robust approach to surmount this computational limitation has been to unite continuum modeling procedures such as the finite element method (FEM) with MD analyses thereby reducing the region of atomic scale refinement. The challenging problem is to seamlessly connect the two inherently different simulation techniques at their interface. In the present work, a new approach to MD-FEM coupling is developed based on a restatement of the typical boundary value problem used to define a coupled domain. The method uses statistical averaging of the atomistic MD domain to provide displacement interface boundary conditions to the surrounding continuum FEM region, which, in return, generates interface reaction forces applied as piecewise constant traction boundary conditions to the MD domain. The two systems are computationally disconnected and communicate only through a continuous update of their boundary conditions. With the use of statistical averages of the atomistic quantities to couple the two computational schemes, the developed approach is referred to as an embedded statistical coupling method (ESCM) as opposed to a direct coupling method where interface atoms and FEM nodes are individually related. The methodology is inherently applicable to three-dimensional domains, avoids discretization of the continuum model down to atomic scales, and permits arbitrary temperatures to be applied.

Author

*Molecular Dynamics; Continuum Modeling; Statistical Analysis; Boundary Conditions; Finite Element Method*

**20070019062** Naval Research Lab., Washington, DC USA

**A Case Study of Two NRL Pump Prototypes**

Kang, Myong H; Moskowitz, Ira S; Montrose, Bruce E; Parsonese, James J; Jan 1996; 13 pp.; In English

Report No.(s): AD-A465418; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465418

As computer systems become more open and interconnected, the need for reliable and secure communication also increases. The NRL Pump was introduced to balance the requirements of reliability, congestion control, fairness, and good performance against those of threats from covert channels and denial of service attacks. In this paper, we describe two prototype efforts. One implements the Pump at the process (top) layer in terms of a 4-layer network reference model and the

other implements the Pump at the transport layer. We then discuss lessons learned and how these lessons will be used in deciding upon the final hardware implementation of the Pump.
DTIC
*Networks; Prototypes; Reliability*

**20070019204** Massachusetts Univ., Amherst, MA USA
**Chi-squared: A simpler evaluation function for multiple-instance learning**
McGovern, Amy; Jensen, David; Jan 2003; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-00-2-0597; F30602-01-2-0566
Report No.(s): AD-A465740; TR-03-14; No Copyright; Avail.: CASI: A02, Hardcopy

This paper introduces a new evaluation function for solving the multiple instance problem. Our approach makes use of the main idea of diverse density (Maron, 1998; Maron & Lozano- Perez, 1998) but finds the best concept using the chi-square statistic. This approach is simpler than diverse density and allows us to search more extensively by using properties of the contingency table to prune in a guaranteed manner. We demonstrate that this approach solves the multiple-instance problem as well as or better than diverse density and that the pruning mechanism allows chi-squared to identify the best concepts more quickly.
DTIC
*Learning; Significance; Statistical Tests*

## 66
## SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

**20070018872** NASA Stennis Space Center, Stennis Space Center, MS, USA
**A Support Database System for Integrated System Health Management (ISHM)**
FROM; Schmalzel, John; Figueroa, Jorge F.; Turowski, Mark; Morris, John; [2007]; 3 pp.; In English; Integrated System Health Management Conference/AFRL, 6-9 August 2007, Cincinnati, OH, USA; Original contains color illustrations
Contract(s)/Grant(s): NNS04AB67T
Report No.(s): SSTI-2200-0086; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018872

The development, deployment, operation and maintenance of Integrated Systems Health Management (ISHM) applications require the storage and processing of tremendous amounts of low-level data. This data must be shared in a secure and cost-effective manner between developers, and processed within several heterogeneous architectures. Modern database technology allows this data to be organized efficiently, while ensuring the integrity and security of the data. The extensibility and interoperability of the current database technologies also allows for the creation of an associated support database system. A support database system provides additional capabilities by building applications on top of the database structure. These applications can then be used to support the various technologies in an ISHM architecture. This presentation and paper propose a detailed structure and application description for a support database system, called the Health Assessment Database System (HADS). The HADS provides a shared context for organizing and distributing data as well as a definition of the applications that provide the required data-driven support to ISHM. This approach provides another powerful tool for ISHM developers, while also enabling novel functionality. This functionality includes: automated firmware updating and deployment, algorithm development assistance and electronic datasheet generation. The architecture for the HADS has been developed as part of the ISHM toolset at Stennis Space Center for rocket engine testing. A detailed implementation has begun for the Methane Thruster Testbed Project (MTTP) in order to assist in developing health assessment and anomaly detection algorithms for ISHM. The structure of this implementation is shown in Figure 1. The database structure consists of three primary components: the system hierarchy model, the historical data archive and the firmware codebase. The system hierarchy model replicates the physical relationships between system elements to provide the logical context for the database. The historical data archive provides a common repository for sensor data that can be shared between developers and applications. The firmware codebase is used by the developer to organize the intelligent element firmware into atomic units which can be assembled into complete firmware for specific elements.
Author
*Systems Integration; Health; Systems Management; Support Systems; Data Bases; Cost Effectiveness; Systems Engineering*

**20070019080** Florida Univ., Gainesville, FL USA
**Metrics for Traffic Analysis Prevention**
Newman, Richard E; Moskowitz, Ira S; Syverson, Paul; Serjantov, Andrei; Jan 2003; 19 pp.; In English
Report No.(s): AD-A465471; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465471

This paper considers systems for Traffic Analysis Prevention (TAP) in a theoretical model. It considers TAP based on padding and rerouting of messages and describes the effects each has on the difference between the actual and the observed traffic matrix (TM). The paper introduces an entropy-based approach to the amount of uncertainty a global passive adversary has in determining the actual TM, or alternatively, the probability that the actual TM has a property of interest. Unlike previous work, the focus is on determining the overall amount of anonymity a TAP system can provide, or the amount it can provide for a given cost in padding and rerouting, rather than on the amount of protection a afforded particular communications.
DTIC
*Information Theory; Prevention; Traffic*

**20070019096** Naval Research Lab., Washington, DC USA
**Towards a Model of Storage Jamming**
McDermott, John; Goldschlag, David; Jan 1996; 11 pp.; In English
Report No.(s): AD-A465500; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465500

Storage jamming can degrade real-world activities that share stored data. Storage jamming is not prevented by access controls or cryptographic techniques. Verification to rule out storage jamming logic is impractical for shrink-wrapped software or low-cost custom applications. Detection mechanisms do offer more promise. In this paper, we model storage jamming and a detection mechanism, using Unity logic. We find that Unity logic, in conjunction with some high-level operators, models storage jamming in a natural way and allows us to reason about susceptibility, rate of jamming, and impact on persistent values.
DTIC
*Computer Storage Devices; Data Storage; Detection; Jamming; Models*

**20070019098** Naval Research Lab., Washington, DC USA
**Reliable Multicast Data Delivery for Military Networking**
Macker, Joseph P; Klinker, J E; Corson, M S; Jan 1996; 9 pp.; In English
Report No.(s): AD-A465503; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465503

Multicast networking support is becoming an increasingly important technology area for both commercial and military distributed or group-based applications. The underlying delivery mechanism for IP multicast is presently the User Datagram Protocol (UDP) or raw IP packets. At present, these mechanisms provide a 'best effort' delivery service. Best effort implies that IP packets are treated with essentially equal weight, and while IP makes an effort to deliver all packets to their destination, packets may be occasionally be delayed, lost, duplicated, or delivered out of order. In the past such delivery mechanisms have worked fine for supporting traffic insensitive to occasional lost or missing data (e.g.. voice, video). An increasing variety of distributed multimedia applications are being developed in which a consistent and/or reliable data delivery of all or a subset of data packets is a critical performance factor. In future military tactical internetworks, situational awareness data will play a major role as a critical multicast application. Reliable group file transfer (e.g., image dissemination) and interactive mission planning applications are also likely applications for military mobile units. This paper presents a taxonomy of presently available reliable multicasting solutions. The protocols are classified in terms of performance issues and scalability. Using this taxonomy, reliable multicast solutions are considered for various military applications such as mission planning, Distributed Interactive Simulation (DIS), and situational awareness dissemination in a shared WAN environment.
DTIC
*Distributed Interactive Simulation; Protocol (Computers); Pulse Rate; Reliability; Scalers; Wide Area Networks*

**20070019104** Naval Research Lab., Washington, DC USA
**TAME: A Specialized Specification and Verification System for Timed Automata**
Archer, Myla; Heitmeyer, Constance; Dec 1996; 5 pp.; In English
Report No.(s): AD-A465511; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465511

Assuring the correctness of specifications of real-time systems can involve significant human effort. The use of a mechanical theorem prover to encode such specifications and to verify their properties could significantly reduce this effort. A barrier to routinely encoding and mechanically verifying specifications has been the need first to master the specification language and logic of a general theorem proving system. Our approach to overcoming this barrier is to provide mechanical support for producing specifications and verifying proofs, specialized for particular mathematical models and proof techniques. We are currently developing a mechanical verification system called TAME (Timed Automata Modeling Environment) that provides this specialized support using SRI's Prototype Verification System (PVS). Our system is intended to permit steps in reasoning similar to those in hand proofs that use model-specific techniques. TAME has recently been used to detect errors in a realistic example.
DTIC
*Automata Theory; Models; Prototypes; Real Time Operation*

**20070019159** Naval Research Lab., Washington, DC USA
**Tools for Constructing Requirements Specification: The SCR Toolset at the Age of Ten**
Heitmeyer, Constance; Archer, Myla; Bharadwaj, Ramesh; Jeffords, Ralph; Jan 2005; 18 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465422; No Copyright; Avail.: CASI: A03, Hardcopy

While human effort is critical to creating requirements specifications and human inspection can detect many specification errors, software tools find errors inspections miss and also find certain classes of errors more cheaply. This paper describes a set of tools for constructing and analyzing requirements specifications in the SCR (Software Cost Reduction) tabular notation. The tools include a specification editor, a consistency checker, a simulator, and tools for verifying application properties including a model checker, a verifier, a property checker based on decision procedures, and an invariant generator. The paper also describes the practical systems to which the tools are being applied as well as some new tools recently added to the toolset, e.g. a tool that constructs a sound and complete abstraction from a property and a specification. To illustrate the tools, the paper describes their use in developing a requirements specification for an automobile cruise control system.
DTIC
*Errors; Software Development Tools*

**20070019182** Clemson Univ., SC USA
**Visual Servo Tracking Control of a Wheeled Mobile Robot with a Monocular Fixed Camera**
Chen, J; Dixon, W E; Dawson, D M; Chitrakaran, V K; Jan 2004; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-99-1-0589
Report No.(s): AD-A465705; CU/CRB/5/12/04/ 1; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper, a visual servo tracking controller for a wheeled mobile robot (WMR) is developed that utilizes feedback from a monocular camera system that is mounted with a fixed position and orientation (i.e., the eye-to-hand problem). A pre-recorded image sequence (e.g., a video) of four target points is used to define a desired trajectory for the WMR. By comparing the target points from the pre-recorded sequence with the corresponding target points in the live image, projective geometric relationships are exploited to construct a Euclidean homography. The information obtained by decomposing the Euclidean homography is used to develop a kinematic controller. A Lyapunov-based analysis is used to develop an adaptive update law to actively compensate for the lack of depth information required for the translation error system. In contrast to previous WMR visual servo controllers using a fixed camera configuration, the controller in this paper does not require the camera to be mounted so that the optical axis is perpendicular to the WMR plane of motion. An extension is provided to illustrate the development of a visual servo regulation controller. Simulation results are provided to demonstrate the performance of the tracking control design.
DTIC
*Cameras; Control; Controllers; Optical Tracking; Robots; Servomechanisms*

**20070019184** Clemson Univ., SC USA
**Navigation and Control of a Wheeled Mobile Robot**
Chen, J; Dixon, W E; Dawson, D M; Galluzzo, T; Jan 2005; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-99-1-0589
Report No.(s): AD-A465707; CU/CRB/3/1/05/ 1; No Copyright; Avail.: CASI: A03, Hardcopy

Several approaches for incorporating navigation function approach into different controllers are developed in this paper

for task execution by a non-holonomic system (e.g., a wheeled mobile robot) in the presence of known obstacles. The first approach is a path planning-based control with planning a desired path based on a 3-dimensional position and orientation information. A navigation-like function yields a path from an initial configuration inside the free configuration space of the mobile robot to a goal configuration. A differentiable oscillator-based controller is then used to enable the mobile robot to follow the path and stop at the goal position. A second approach is developed for a navigation function that is constructed using 2-dimensional position information. A differentiable controller is proposed based on this navigation function that yields asymptotic convergence. Simulation results are provided to illustrate the performance of the second approach.
DTIC
*Autonomous Navigation; Control; Guidance (Motion); Navigation; Robots*

**20070019196** Clemson Univ., SC USA
**Passive Coordination of Nonlinear Bilateral Teleoperated Manipulators**
McIntyre, M; Dixon, W; Dawson, D; Tatlicioglu, E; Aug 16, 2005; 36 pp.; In English
Report No.(s): AD-A465723; CU-CRB-8-16-05-1; No Copyright; Avail.: CASI: A03, Hardcopy

Significant research has been aimed at the development and control of teleoperator systems due to both the practical importance and the challenging theoretical nature of the problem. Two controllers are developed in this paper for a nonlinear teleoperator system that target coordination of the master and slave manipulators and passivity of the overall system. The first controller is proven to yield a semi-global asymptotic result in the presence of parametric uncertainty in the master and slave manipulator dynamic models. The second controller yields a global asymptotic result despite unmeasurable user and environmental input forces. To develop each controller, a transformation encodes the coordination and passivity objectives in the closed loop system. The coordinated system is forced to track a dynamic system to assist in meeting all control objectives. Finally, continuous nonlinear integral feedback terms are used to accommodate for incomplete system knowledge for both controllers. Lyapunov-based techniques are used to prove that all control objectives are met and that all signals are bounded.
DTIC
*Coordination; Manipulators; Nonlinearity; Remote Control; Teleoperators*

**20070019228** Clemson Univ., SC USA
**Euclidean Position Estimation if Features on a Moving Object Using a Single Camera: A Lyapunov-Based Approach**
Chitrakaran, V K; Dawson, D M; Chen, J; Dixon, W E; Sep 9, 2004; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465810; CU-CRB-9-9-04-2; No Copyright; Avail.: Defense Technical Information Center (DTIC)

In this paper, an adaptive nonlinear estimator is developed to identify the Euclidean coordinates of feature points on a moving object using a single fixed camera. No explicit model is used to describe the movement of the object. Homography-based techniques are used in the development of the object kinematics, while Lyapunov design methods are utilized in the synthesis of the adaptive estimator. Simulation results are included to demonstrate the performance of the estimator.
DTIC
*Euclidean Geometry; Liapunov Functions; Targets*

## 67
## THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

**20070019047** Civil Aeromedical Inst., Oklahoma City, OK USA
**Predicting Subjective Workload Ratings: A Comparison and Synthesis of Operational and Theoretical Models**
Crutchfield, Jerry; Rosenberg, Craig; Mar 2007; 14 pp.; In English
Report No.(s): AD-A465365; DOT/FAA/AM-07/6; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465365

Output from a computer simulation of two air traffic control (ATC) scenarios was fit to workload ratings that ATC subject-matter experts provided while observing each scenario in real time. Simulation output enabled regression analyses that tested the assumptions of a variety of workload prediction models. These included both operational models that use observable situational and behavioral variables (e.g., number of aircraft and communications by type) and theoretical models that use queuing and cognitive architecture variables (e.g., activities performed, amount of busy time, and sensory and cognitive

resource usage). Results suggested the models that included number of activities performed weighted by priority accounted for the highest amount of variance in subjective workload ratings.
DTIC
*Air Traffic Controllers (Personnel); Mathematical Models; Prediction Analysis Techniques; Predictions; Workloads (Psychophysiology)*

**20070019173** Clemson Univ., SC USA
**Navigation Function Based Visual Servo Control**
Chen, J; Dason, D M; Dixon, W E; Chitrakaran, V K; Jan 2004; 18 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-99-1-0589; F49620-03-1-0381
Report No.(s): AD-A465679; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper, a unique camera mapping between the desired camera feature vector and the desired camera pose (i.e., the position and orientation) is investigated to develop a measurable image Jacobian-like matrix. An image-space path planner is then proposed to generate a desired image trajectory based on this measurable image Jacobian-like matrix and an image space navigation function (NF) (i.e., a special potential field function) while satisfying rigid body constraints. An adaptive, homography-based visual servo tracking controller is then developed to navigate the position and orientation of a camera held by the end-effector of a robot manipulator to a goal position and orientation along the desired image-space trajectory while ensuring the target points remain visible (i.e., the target points avoid self-occlusion and remain the in the field-of view (FOV) under certain technical restrictions. The self-occlusion problem is also discussed. Due to the inherent nonlinear nature of the problem and the lack of depth information form a manocular system, a Lyapunov-based analysis is used to analyze the path planner and the adaptive controller. Simulation results are provided to illustrate the performance of the proposed approach.
DTIC
*Adaptive Control; Liapunov Functions; Navigation; Servomechanisms; Visual Control*

## 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*.

**20070018991** Saint Louis Univ., MO USA
**Continent-Wide Maps of Lg Coda Q Variation and Rayleigh-wave Attenuation Variation for Eurasia**
Mitchell, Brian J; Cong, Lianli; Jan 30, 2007; 50 pp.; In English
Contract(s)/Grant(s): FA8718-04-C-0021; Proj-1010
Report No.(s): AD-A465269; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465269

We present new maps of Lg coda Q and its frequency dependence at 1 Hz (Qo and eta, respectively) as well as Rayleigh-wave attenuation coefficients at 5, 10, 20 and 50 s across virtually all of Eurasia. Qo is relatively high, 700 or more, in most cratonic regons but is surprisingly low in the Arabian craton (300-450), the Siberian trap portion of the Siberian Platform (~450) and the Deccan trap portion of the Indian Platform(450-650). It is generally low throughout the Tethysides orogenic belt but there too it displays substantial regional variations (150-400). All major Qo anomalies, and several minor ones, appear to be related to the tectonic history of the Eurasian crust. The four regions with lowest values approximately coincide with four of Eurasia's most active concentrations of earthquake activity. Comparison of the new Qo map with continent-wide maps of long-period Rayleigh-wave phase velocities, temperatures, subducted lithosphere and crustal strain lead us to infer that fluids, originating by hydrothermal release from subducting lithosphere or other upper mantle heat sources largely produce the observed variations of Qo across Eurasia. We estimated Rayleigh-wave attenuation coefficients across Eurasia, at periods of 5, 10, 20 and 50 s, using mapped values for Qo, eta and an empirically derived multiplicative factor for eta. 5 and 10 s attenuation values clearly show several attenuation maxima that are with thick accumulations of sediment, whereas the longer period attenuation, in most cases, mirror the Qo map. Differences, however, occur in some regions because because of high or low eta values.
DTIC
*Asia; Europe; Rayleigh Waves; Seismology; Wave Attenuation*

**20070019084** Naval Research Lab., Washington, DC USA

**Friction and Energy Dissipation at the Atomic Scale: A Review**

Singer, I L; Oct 1994; 13 pp.; In English

Report No.(s): AD-A465476; XB-NRL/MR/6170; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465476

Discussions of energy dissipation during friction processes have captured the attention of engineers and scientists for over 300 years. Why then do we know so little about either dissipation or friction processes? A simple answer is that we cannot see what is taking place at the interface during sliding. Recently, however, devices such as the atomic force microscope have been used to perform friction measurements, characterize contact conditions, and even describe the worn surface. Following these and other experimental developments, friction modeling at the atomic level particularly molecular dynamics (MD) simulations has brought scientists a step closer to seeing what takes place during sliding contact. With these investigations have come some answers and new questions about the modes and mechanisms of energy dissipation at the sliding interface. This article will review recent theoretical and experimental studies of friction processes at the atomic scale. Theoretical treatments range from simple, analytical models of two-dimensional, coupled ball-spring systems at 0 K, to more complex MD simulations of three-dimensional arrays of hydrogen- and hydrocarbon-terminated surfaces at finite temperatures. Results are presented for the simplest yet most practical cases of sliding contact: sliding without wear. Sliding without friction is seen in weakly interacting systems. Simple models can easily explain the energetics of such friction processes, but MD studies are needed to explore the dynamics excitation modes, energy pathways, of thermally excited atoms interacting in three-dimensional fields. These studies provide the first atomic-scale models for anisotropic friction and boundary lubrication. Friction forces at atomic interfaces must ultimately be measured at the macroscopic level; these measurements, which depend on the mechanical properties of the measuring system, are discussed. Two rather unique experimental studies of friction are also reviewed.

DTIC

*Atoms; Energy Dissipation; Friction*

**20070019133** Naval Air Warfare Center, Patuxent River, MD USA

**Initial Experimental Evaluation of a Circulation Controlled Sail on a Submersible Vehicle for Enhanced Maneuverability**

Imber, Robin; Rogers, Ernest; Abramson, Jane; Mar 14, 2007; 93 pp.; In English

Report No.(s): AD-A465585; NAWCADPAX/TR-2007/12; No Copyright; Avail.: CASI: A05, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465585

The potential for the sail (bridge fairwater) of a submerged vehicle to serve as an on-demand auxiliary maneuvering control surface was experimentally investigated in a wind tunnel. The sail used circulation (lift) control in the form of mass ejection from Coanda-effect trailing edge region slots. The sail was mounted on, and tested in conjunction with, an exploratory submarine hull design. Test results show that the side force developed by circulation control equaled the side force produced by yawing the fully appended hull by 10 deg, a substantial turning diameter reduction effect. This benefit was present over the tested yaw angle range of +30 deg. Associated yaw moments are in the favorable direction of turning the hull into the turn. Roll moment increments were lower than expected due to a counter-roll effect produced by the pressure field acting on the relatively flat hull topside. For side force and yaw moment, the data indicated that the body-sail interaction effects were negligible at zero angle of hull pitch and yaw (no crossflow). For a 10-deg noseup pitch at zero drift angle, the body reacted to sail circulation by developing an in-plane side force equal to that produced by the circulation of the sail; conversely, at 10 deg nosedown, the body contribution reversed direction so that the net side force was one-half of that at zero pitch. Out-of-plane forces at angles of drift (yaw) were generally not adversely impacted by sail lift augmentation, for a given level of net vehicle side force. Slot flow rate requirements for various operational conditions, and near-term development plans, are discussed. With the successful outcome of this demonstration of a lift augmented sail, it is recommended that systematic maneuvering simulations be conducted to quantify the specific benefits of a circulation controlled sail on naval vessels of interest.

DTIC

*Maneuverability; Sails*

## 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*.

**20070018990** Rhode Island Univ., Narragansett, RI USA

**Upper Circulation Patterns in the Ulleung Basin**

Mitchell, D A; Watts, D R; Wimbush, M; Teague, W J; Tracey, K L; Book, J W; Chang, K I; Suk, M S; Yoon, J H; Jul 27, 2005; 23 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-98-1-0246

Report No.(s): AD-A465267; NRL/JA/7330-02-62; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465267

Continuous acoustic travel-time measurements from a two-dimensional array of pressure-gauge-equipped inverted echo sounders spanning the entire Ulleung Basin of the southwestern Japan/East Sea between June 1999 and July 2001 are used to examine the upper temperature and current patterns. A new method, referred to as the Residual GEM Technique, interprets the travel-time data into a three-dimensional (x, y,p) time-series of daily, synoptically mapped current and temperature fields. During the two-year measurement period, at least five non-repeating persistent flow patterns are found. The patterns during the first year coincide with changes in the total volume transport through the Korea/Tsushima Strait, while the patterns of the second year do not. The mean temperature of the basin displays strong interannual variability and is correlated with the total Korea/Tsushima Strait transport, with a higher mean temperature in the first year when total volume transport was higher. In addition, a new framework for describing the flow patterns is presented. A newly described cold-core eddy, referred to as the Dok Cold Eddy, is about 60 km in diameter and typically forms southwest of Dok Island when the Subpolar Front loops southward between Ulleung and Dok (Takeshima) Islands and sheds an eddy. The Dok Cold Eddy is highly variable in space and time, and it tends to propagate westward towards the coast of Korea, where it merges with cold waters from the north. Three such propagation events preceed the disappearance of the East Korean Warm Current, which then remains absent between June and November 2000. The Offshore Branch forms by branching in the Korea/Tsushima Strait and is present during much of our two-year observation period.

DTIC

*Acoustic Measurement; Bathymeters; Bathythermographs; Echoes*

**20070019174** Washington Univ., Seattle, WA USA

**Mid-to-High Frequency Bottom Loss in the East China Sea**

Choi, Jee Woong; Dahl, Peter H; Oct 2004; 9 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-03-1-0271

Report No.(s): AD-A465683; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Bottom loss measurements made in the East China Sea in 2001 as part of the Asian Sea International Acoustics Experiment as a function of frequency (2-20 kHz) and seabed grazing angle (15 deg-24 deg) are presented. The measurements are interpreted as estimates of the modulus of the plane wave reflection coefficient, and data are compared to predictions using a reflection coefficient model, based on a two-layered sediment for which sound speed in the surficial sediment layer is allowed to vary as a linear kappa2 profile, where kappa is acoustic wave number. The region below this layer is modeled as a half-space with constant density and sound speed. The reflection coefficient model is driven by eight geoacoustic parameters. This parameter set produced model curves that agreed reasonably well with observations of bottom loss over the entire frequency range. Since this data set does not provide detailed information about sediment structure for depths beyond about 3 m, the geoacoustic parameter set is more properly viewed as description of the sediment layer and sediments in the underlying 2 m. Similarly, a self-consistent construction of a geoacoustic model for the East China Sea should necessarily amalgamate the mid to high frequency results given here with results obtained at lower frequencies.

DTIC

*China; High Frequencies; Losses; Models; Reflectance; Seas; Sediments*

## 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*.

**20070018971** Florida Environmental Research Inst., Tampa, FL USA
**High Resolution Multispectral and Hyperspectral Data Fusion for Advanced Geospatial Information Products**
Bissett, W P; Kohler, David D; Mar 2007; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-05-1-0416
Report No.(s): AD-A465229; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465229

This project seeks to develop the technology to fuse high spatial resolution Multi Spectral Imagery (MS I) with lower spatial resolution, but higher spectral resolution, HyperSpectral Imagery (HSI) to provided enhanced target detection and battlespace characterization. It seeks to push beyond traditional PAN sharpening techniques to develop applications that will increase the accuracy and fidelity of the sharpened spectral imagery.
DTIC
*High Resolution; Imagery; Multisensor Fusion*

**20070019227** Applied Research Labs., State College, PA USA
**On Modeling Structural Excitations by Low Speed Turbulent Boundary Layer Flows**
Hwang, Y F; Bonness, W K; Hambric, S A; Aug 2003; 60 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-00-G-0058
Report No.(s): AD-A465806; TR-03-008; No Copyright; Avail.: CASI: A04, Hardcopy

This report documents the results of an investigation on the modeling of structural excitations by low speed turbulent boundary layer flows. This work critically examines various spectral models, both wave vector-frequency spectra and cross-spectra. Many of these models became available after the publication of the monograph by Blake (1986). These models are used to predict the pressure spectra measured by flush-mounted hydrophones of various size and location on buoyantly propelled vehicles. Predicted hydrophone responses are compared with experimental data. Recent publications by Chase (1991, 1993) and Dowling (1998) demonstrate that near wall viscous shear stress contributions to the low-wave number pressures need to be included. By combining the Chase 1987 inviscid flow model with his 1993 semi%empirical shear stress model at low wave numbers, a so called 'Combined Chase Spectrum' is developed and presented as the most comprehensive model for underwater applications.
DTIC
*Boundary Layer Flow; Excitation; Low Speed; Turbulent Boundary Layer*

## 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*.

**20070018797** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Assembly and Thermal Hydraulic Test of a Stainless Steel Sodium-Potassium Circuit**
Garber, A.; Godfroy, T.; Webster, K.; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 'Space Renaissance Inspiring the Next Generation', 11-15 Feb. 2007, Albuquerque, NM, USA; No Copyright; Avail.: Other Sources; Abstract Only

Early Flight Fission Test Facilities (EFF-TF) team has been tasked by the NASA Marshall Space Flight Center Nuclear Systems Office to design, fabricate, and test an actively pumped alkali metal flow circuit. The system was originally built for use with lithium, but due to a shift in focus, it was redesigned for use with a eutectic mixture of sodium potassium (NaK). Basic circuit components include: reactor segment, NaK to gas heat exchanger, electromagnetic (EM) liquid metal pump, load/drain reservoir, expansion reservoir, instrumentation, and a spill reservoir. A 37-pin partial-array core (pin and flow path

dimensions are the same as those in a full design) was selected for fabrication and test. This paper summarizes the first fill and checkout testing of the Stainless Steel NaK-Cooled Circuit (SNaKC).
Author
*Circuits; Eutectics; Potassium; Sodium; Stainless Steels; Hydraulics; Fabrication; Alkali Metals; Test Facilities*

**20070018798** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Analysis and Down Select of Flow Passages for Thermal Hydraulic Testing of a SNAP Derived Reactor**
Godfroy, T. J.; Sadasivan, P.; Masterson, S.; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 'Space Renaissance Inspiring the Next Generation', 11-15 Feb. 2007, Albuquerque, NM, USA; Copyright; Avail.: Other Sources; Abstract Only

As past of the Vision for Space Exploration, man will return to the moon. To enable safe and productive time on the lunar surface will require adequate power resources. To provide the needed power and to give mission planners all landing site possibilities, including a permanently dark crater, a nuclear reactor provides the most options. Designed to be l00kWt providing approx. 25kWe this power plants would be very effective in delivering dependable, site non-specific power to crews or robotic missions on the lunar surface. An affordable reference reactor based upon the successful SNAP program of the 1960's and early 1970's has been designed by Los Alamos National Laboratory that will meet such a requirement. Considering current funding, environmental, and schedule limitations this lunar surface power reactor will be tested using non-nuclear simulators to simulate the heat from fission reactions. Currently a 25kWe surface power SNAP derivative reactor is in the early process of design and testing with collaboration between Los Alamos National Laboratory, Idaho National Laboratory, Glenn Research Center, Marshall Space Flight Center, and Sandia National Laboratory to ensure that this new design is affordable and can be tested using non-nuclear methods as have proven so effective in the past. This paper will discuss the study and down selection of a flow passage concept for a approx. 25kWe lunar surface power reactor. Several different flow passages designs were evaluated using computational fluid dynamics to determine pressure drop and a structural assessment to consider thermal and stress of the passage walls. The reactor design basis conditions are discussed followed by passage problem setup and results for each concept. A recommendation for passage design is made with rationale for selection.
Author
*SNAP; Computational Fluid Dynamics; Nuclear Power Reactors; Lunar Surface*

**20070018799** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Experimental Evaluation of a Water Shield for a Surface Power Reactor**
Pearson, J. B.; Reid, R.; Sadasivan, P.; Stewart, E.; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 'Space Renaissance Inspiring the Next Generation', 11-15 Feb. 2007, Albuquerque, NM, USA; Copyright; Avail.: Other Sources; Abstract Only

A water based shielding system is being investigated for use on initial lunar surface power systems. The use of water may lower overall cost (as compared to development cost for other materials) and simplify operations in the setup and handling. The thermal hydraulic performance of the shield is of significant interest. The mechanism for transferring heat through the shield is natural convection. A representative lunar surface reactor design is evaluated at various power levels in the Water Shield Testbed (WST) at the NASA Marshall Space Flight Center. The evaluation compares the experimental data from the WST to CFD models. Performance of a water shield on the lunar surface is predicted by CFD models anchored to test data, and by matching relevant dimensionless parameters.
Author
*Computational Fluid Dynamics; Lunar Surface; Power Reactors; Reactor Design; Surface Water; Shielding*

**20070018801** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Liquid Metal Pump Technologies for Nuclear Surface Power**
Polzin, Kurt A.; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 11-15 Feb. 2007, Albuquerque, NM, USA; No Copyright; Avail.: Other Sources; Abstract Only

Multiple liquid metal pump options are reviewed for the purpose of determining the technologies that are best suited for inclusion in a nuclear reactor thermal simulator intended to test prototypical space nuclear system components. Conduction, induction, and thermoelectric electromagnetic pumps are evaluated based on their performance characteristics and the technical issues associated incorporation into a reactor system. The thermoelectric electromagnetic pump is recommended for

inclusion in the present system based on favorable quantitative and qualitative measures relative to the other options under consideration.
Author
*Electromagnetic Pumps; Nuclear Reactors; Thermoelectricity; Liquid Metals*

**20070019009** Moscow State Univ., Russian Federation
**Excitation of Nuclei and Atoms Trapping in Optical Fields of High Intensity**
Andreev, Anatoli; Nov 2006; 148 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465294; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465294

This report results from a contract tasking Moscow State University as follows: Exploration of methods to control the radiative gamma- processes in nuclei is currently one of the most promising investigation directions of the modern Quantum Nucleonics - a new realm of contemporary Physics which spreads the basic conceptual ideas and methods of optical Quantum Electronics of atoms and molecules to the gamma-ray range and atomic nuclei and even anti-particles. One of the most important problems in this field is the generation of coherent gamma-radiation by a Gamma-ray Lasing (GRL) process which makes use of excited nuclei as an amplifying medium. The most likely medium for gamma-ray lasers is an ensemble of metastable nuclear isomers, Direct excitation of these isomeric states by electrons or X-ray photons will also create a deeper understanding of nuclear structure and properties.
DTIC
*Atoms; Excitation; Trapping*

**20070019260** Library of Congress, Washington, DC USA
**Nuclear Power: Outlook for New U.S. Reactors**
Parker, Larry; Holt, Mark; Mar 9, 2007; 28 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465398; CRS-RL33442; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465398

Nearly three decades after the most recent order was placed for a new nuclear power plant in the USA, several utilities are now expressing interest in building a total of up to 30 new reactors. The renewed interest in nuclear power has resulted primarily from higher prices for natural gas, improved operation of existing reactors, and uncertainty about future restrictions on coal emissions. A substantial tax credit and other incentives for nuclear generation provided by the Energy Policy Act of 2005 (P.L. 109-58) are also likely to improve the economic viability of qualifying new reactors. New nuclear plant applications can also take advantage of amendments to the Atomic Energy Act made in the early 1990s to reduce licensing delays. Currently, there are 103 licensed and operable power reactors at 65 plant sites in 31 states, generating about one-fifth of U.S. electricity. Although no new U.S. reactors have started up since 1996, U.S. nuclear electricity generation has since grown by more than 20%. Much of this additional output resulted from reduced downtime, notably through shorter refueling outages. Licensed commercial reactors generated electricity at an average of 89.8% of their total capacity in 2006, after averaging about 75% in the mid-1990s and about 65% in the mid-1980s. Falling operating costs have helped renew the economic viability of the nation's fleet of nuclear power plants. From 1989 to 1998, 12 commercial reactors were closed before reaching the end of their 40-year licenses. By the late 1990s, there was real doubt that any reactors would make it to 40 years. Since 2000, however, 44 commercial reactors have received 20-year license extensions from the Nuclear Regulatory Commission (NRC), giving them up to 60 years of operation, and more are pending.
DTIC
*Nuclear Power Plants; Nuclear Power Reactors; United States*

## 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*.

**20070018759** Naval Research Lab., Washington, DC, USA
**Efficiency of a Grazing-incidence Off-plane Grating in the Soft-x-ray Region**
Seely, J. F.; Laming, J. M.; Goray, L. I.; Kjornrattanawanich, B.; Holland, G. E.; Flanagan, K. A.; Heilmann, R. K.; Chang, C.-H.; Schattenburg, M. L.; Rasmussen, A. P.; Applied Optics; March 10, 2006; ISSN 0003-6935; Volume 45, Issue 8, pp. 1680-1687; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNG04GB16G; Copyright; Avail.: Other Sources

Efficiency measurements of a grazing-incidence diffraction grating in the off-plane mount were performed using polarized synchrotron radiation. The grating had 5000 grooves/mm, an effective blaze angle of 14 deg., and was gold coated. The efficiencies in the two polarization orientations (TM and TE) were measured in the 1.5-5.O nm wavelength range and were compared with the efficiencies calculated using the PCGrate-SX code. The TM and TE efficiencies differ, offering the possibility of performing unique science studies of astrophysical, solar, and laboratory sources by exploiting the polarization sensitivity of the off-plane grating.
Author
*Gratings (Spectra); Grazing Incidence; Supports; X Rays*

**20070018767** Colorado Univ., Boulder, CO, USA
**Frequency and Phase-lock Control of a 3 THz Quantum Cascade Laser**
Betz, A. L.; Boreiko, R. T.; Williams, B. S.; Kumar, S.; Hu, Q.; Reno, J. L.; Optics Letters; Jul. 15, 2005; Volume 30, No. 14; 6 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): DE-AC04-94AL85000; NNG04GC11G; NAG1-01074; Copyright; Avail.: Other Sources

We have locked the frequency of a 3 THz quantum cascade laser (QCL) to that of a far-infrared gas laser with a tunable microwave offset frequency. The locked QCL line shape is essentially Gaussian, with linewidths of 65 and 141 kHz at the -3 and -10 dB levels, respectively. The lock condition can be maintained indefinitely, without requiring temperature or bias current regulation of the QCL other than that provided by the lock error signal. The result demonstrates that a terahertz QCL can be frequency controlled with l-part-in-lO(exp 8) accuracy, which is a factor of 100 better than that needed for a local oscillator in a heterodyne receiver for atmospheric and astronomic spectroscopy.
Author
*Frequency Control; Oscillators; Phase Control; Quantum Cascade Lasers*

**20070018848** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Cryogenic Temperature-dependent Refractive Index Measurements of N-BK7, BaLKN3, and SF15 for NOTES PDI**
Frey, Bradley J.; Leviton, Douglas F.; Madison, Timothy J.; [2007]; 14 pp.; In English; SPIE Optics and Photonics, 26-30 Aug. 2007, San Diego, CA, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018848

In order to enable high quality lens designs using N-BK7, BaLKN3, and SF15 at cryogenic temperatures, we have measured the absolute refractive index of prisms of these three materials using the Cryogenic, High-Accuracy Refraction Measuring System (CHARMS) at NASA's Goddard Space Flight Center, as a function of both wavelength and temperature. For N-BK7, we report absolute refractive index and thermo-optic coefficient (dn/dT) at temperatures ranging from 50 to 300 K at wavelengths from 0.45 to 2.7 micrometers; for BaLKN3 we cover temperatures ranging from 40 to 300 K and wavelengths from 0.4 to 2.6 micrometers; for SF15 we cover temperatures ranging from 50 to 300 K and wavelengths from 0.45 to 2.6 micrometers. We compare our measurements with others in the literature and provide temperature-dependent Sellmeier coefficients based on our data to allow accurate interpolation of index to other wavelengths and temperatures. While we generally find good agreement (plus or minus 2 x 10(exp -4) for N-BK7, less than 1 x 10(exp -4) for the other materials) at room temperature between our measured values and those provided by the vendor, there is some variation between the datasheets provided with the prisms we measured and the catalog values published by the vendor. This underlines the importance of measuring the absolute refractive index of the material when precise knowledge of the refractive index is required.
Author
*Cryogenic Temperature; Temperature Dependence; Mathematical Models; Refractivity; Lenses*

**20070019042** Naval Research Lab., Washington, DC USA
**Fast Steering Mirror Implementation for Reduction of Focal-Spot Wander in a Long-Distance Free-Space Communication Link**
Suite, M R; Burris, H R; Moore, C I; Vilcheck, M J; Mahon, R; Jackson, Carmen; Stella, M F; Davis, M A; Rabinovich, W S; Jan 2004; 9 pp.; In English
Report No.(s): AD-A465347; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465347

One of the causes of power loss in a free-space optical communication link is beam motion or received spot wander. The

power spectrum of the spot motion indicates that most of the frequency content is less than ~500 Hz. A fast steering mirror (FSM) controlled by a position-sensing detector (PSD) has the potential to correct for a significant portion of the focal spot position fluctuations and thus the power loss. A FSM controlled with a Germanium PSD was installed on the receiver at the NRL Chesapeake Bay free-space lasercomm test facility. Results are presented from the initial tests performed using this system to measure and correct for wander of an optical beam propagated across the bay (20 mile round-trip).
DTIC
*Communication Networks; Mirrors; Optical Communication; Steering*

**20070019120** Florida Univ., Gainesville, FL USA
**Parallel Algorithms for Adaptive Matched-Field Processing in Distributed Array Systems**
Cho, Kilseok; George, Alan D; Subramaniyan, Raj; Kim, Keonwook; Jan 2003; 24 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-99-1-0278
Report No.(s): AD-A465545; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465545

Matched-field processing (MFP) localizes sources more accurately than plane-wave beamforming by employing full-wave acoustic propagation models for the cluttered ocean environment. The minimum variance distortionless response MFP (MVDR-MFP) algorithm incorporates the MVDR technique into the MFP algorithm to enhance beamforming performance. Such an adaptive MFP algorithm involves intensive computational and memory requirements due to its complex acoustic model and environmental adaptation. The real-time implementation of adaptive MFP algorithms for large surveillance areas presents a serious computational challenge where high-performance embedded computing and parallel processing may be required to meet real-time constraints. In this paper, three parallel algorithms based on domain decomposition techniques are presented for the MVDR-MFP algorithm on distributed array systems. The parallel performance factors in terms of execution times, communication times, parallel efficiencies, and memory capacities are examined on three potential distributed systems including two types of digital signal processor arrays and a cluster of personal computers. The performance results demonstrate that these parallel algorithms provide a feasible solution for real-time, scalable, and cost-effective adaptive beamforming on embedded, distributed array systems.
DTIC
*Algorithms; Beamforming; Parallel Processing (Computers)*

**20070019355** Massachusetts Inst. of Tech., Cambridge, MA, USA
**Distributed-feedback Terahertz Quantum-cascade Lasers with Laterally Corrugated Metal Waveguides**
Williams, Benjamin S.; Kumar, Sushil; Hu, Qing; Reno, John L.; Optics Letters; November 1, 2005; ISSN 0146-9592; Volume 30, No. 21; 6 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): DE-AC04-94AL85000; NNG04GC11G; Copyright; Avail.: Other Sources

We report the demonstration of distributed-feedback terahertz quantum-cascade lasers based on a first-order grating fabricated via a lateral corrugation in a double-sided metal ridge waveguide. The phase of the facet reflection was precisely set by lithographically defined facets by dry etching. Single-mode emission was observed at low to moderate injection currents, although multimode emission was observed far beyond threshold owing to spatial hole burning. Finite-element simulations were used to calculate the modal and threshold characteristics for these devices, with results in good agreement with experiments.
Author
*Corrugated Waveguides; Quantum Cascade Lasers; Waveguides*

## 75
## PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**20070019143** Saint Petersburg State Univ., Saint Petersburg, Russian Federation
**Effect of Electron Detachment on the Wall Potential and Plasma Evolution in the Afterglow Stage**
Bogdanov, E A; DeJoseph, Jr , C A; Demidov, V I; Kudryavtsev, A A; Jun 2006; 5 pp.; In English
Contract(s)/Grant(s): F33615-03-C-2348; Proj-3145
Report No.(s): AD-A465611; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465611

It is demonstrated that detachment of electrons in the afterglow of an electronegative plasma can lead to a significant increase in negative wall potential with respect to the plasma potential. This effect can be used to modify the near-wall sheath electric field and thickness, which are important for plasma processing applications. Also in the afterglow, this effect can lead to an increase in electron density with time, and a reduction (up to total exclusion) in diffusion cooling of electrons and can thus be used to modify the electron temperature.
DTIC
*Afterglows; Detachment; Electrons; Plasmas (Physics); Walls*

## 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*.

**20070019044** North Carolina State Univ., Raleigh, NC USA
**Measuring Nanomechanical Properties of a Dynamic Contact Using an Indenter Probe and Quartz Crystal Microbalance**
Borovsky, B; Krim, J; Syed Asif, S A; Wahl, K J; Dec 25, 2001; 7 pp.; In English
Contract(s)/Grant(s): F49620-99-1-0006; DMR0072030
Report No.(s): AD-A465351; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465351

A study of the contact mechanics of a probe tip interacting with a quartz crystal microbalance (QCM) has been performed, involving simultaneous measurements of normal load, displacement, and contact stiffness with changes in QCM resonant frequency. For metal and glass metal contacts in air, the QCM frequency shifts were observed to be positive, and directly proportional to the contact area as inferred from the contact stiffness. Interfacial characteristics of the probe tip contact (elasticity, contact size, and an estimate of the number of contacting asperities) were deduced by extending a prior model of single asperity contact to the case of multiple contacts. The extended model clarifies a number of seemingly disparate experimental results that have been reported in the literature.
DTIC
*Crystals; Displacement; Frequency Shift; Microbalances; Quartz Crystals*

## 77
## 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*.

**20070019219** Air Force Research Lab., Wright-Patterson AFB, OH USA
**Newly Developed Direct-Connect High-Enthalpy Supersonic Combustion Research Facility**
Gruber, Mark; Donbar, Jeffrey; Jackson, Kevin; Mathur, Tarun; Baurle, Robert; Eklund, Dean; Smith, Charles; Nov 2001; 11 pp.; In English
Contract(s)/Grant(s): Proj-3012
Report No.(s): AD-A465791; AFRL-PR-WP-TP-2006-260; No Copyright; Avail.: Defense Technical Information Center (DTIC)

A new continuous-flow, direct-connect, high-enthalpy, supersonic combustion research facility is described. This test facility provides combustor inlet flow conditions corresponding to flight Mach numbers between 3.5 and 7, at dynamic pressures up to 95.8 kPa. Most of the major components of the new facility are water cooled (including the vitiated heater, the instrumentation and transition sections, and the facility nozzle and isolators). The current exception is the variable-geometry heat-sink combustor. A variety of conventional and advanced instrumentation, including a steam calorimeter and a thrust stand, exists for accurate documentation of combustor inlet and exit conditions and performance parameters. In a recent calibration effort, pitot pressure surveys, total temperature surveys, and wall static pressure distributions were obtained for a

wide range of inlet conditions using Mach 1.8 and 2.2 facility nozzles. In addition, three-dimensional numerical simulations of each test case were completed.
DTIC
*Combustion Chambers; Enthalpy; Research Facilities; Supersonic Combustion; Test Facilities*

## 81
## ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**20070019280** Government Accountability Office, Washington, DC, USA
**Federal Real Property: Progress Made Toward Addressing Problems, but Underlying Obstacles Continue to Hamper Reform**
April 2007; 89 pp.; In English; Original contains black and white illustrations
Report No.(s): GAO-07-349; No Copyright; Avail.: CASI: A05, Hardcopy

The administration and real property-holding agencies have made progress toward strategically managing federal real property and addressing long-standing problems. In response to the President s Management Agenda real property initiative and a related executive order, agencies have, among other things, established asset management plans; standardized data reporting; and adopted performance measures. Also, the administration has created a Federal Real Property Council (FRPC) and plans to work with Congress to provide agencies with tools to better manage real property. These are positive steps, but underlying problems still exist. For example, the Departments of Energy (Energy) and Homeland Security (DHS) and the National Aeronautics and Space Administration (NASA) reported during this review that over 10 percent of their facilities are excess or underutilized. Also, Energy, NASA, the General Services Administration (GSA), and the Departments of the Interior (Interior), State (State), and Veterans Affairs (VA) reported repair and maintenance backlogs for buildings and structures that total over $16 billion. The Department of Defense (DOD) reported a $57 billion restoration and modernization backlog. Also, Energy, Interior, GSA, State, and VA reported an increased reliance on leasing to meet space needs. While agencies have made progress in collecting and reporting standardized real property data, data reliability is still a challenge at DOD and other agencies, and agencies lack a standard framework for data validation. Finally, agencies reported using risk-based approaches to prioritize security needs, which GAO has suggested, but some cited obstacles such as a lack of resources for security enhancements. In past high-risk updates, GAO called for a transformation strategy to address the long-standing problems in this area. While the administration s approach is generally consistent with what GAO envisioned, certain areas warrant further attention. Specifically, problems are exacerbated by underlying obstacles that include competing stakeholder interests, legal and budgetary limitations, and the need for improved capital planning. For example, agencies cited local interests as barriers to disposing of excess property, and agencies limited ability to pursue ownership leads them to lease property that may be more cost-effective to own over time.
Author
*Buildings; Cost Effectiveness; Management Planning*

**20070019344** NASA Johnson Space Center, Houston, TX, USA
**Making Technology Ready: Integrated Systems Health Management**
Malin, Jane T.; Oliver, Patrick J.; May 07, 2007; 7 pp.; In English; AIAA Infotech\@Aerospace 2007 Conference, 7-10 May 2007, Rohnert Park, CA, USA
Contract(s)/Grant(s): 292487.08.05.06
Report No.(s): AIAA-2007-2833; Copyright; Avail.: CASI: A02, Hardcopy

This paper identifies work needed by developers to make integrated system health management (ISHM) technology ready and by programs to make mission infrastructure ready for this technology. This paper examines perceptions of ISHM technologies and experience in legacy programs. Study methods included literature review and interviews with representatives of stakeholder groups. Recommendations address 1) development of ISHM technology, 2) development of ISHM engineering processes and methods, and 3) program organization and infrastructure for ISHM technology evolution, infusion and migration.
Author
*Management Systems; Health; Systems Management; Systems Integration*

## 82
## 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*.

**20070018940** Naval Research Lab., Washington, DC USA
**An Integrated Framework for Database Privacy Protection**
Chang, LiWu; Moskowitz, Ira A; Jan 2001; 14 pp.; In English
Report No.(s): AD-A465125; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465125

One of the central objectives of studying database privacy protection is to protect sensitive information held in a database from being inferred by a generic database user. In this paper, we present a framework to assist in the formal analysis of the database inference problem. The framework is based on an association network which is composed of a similarity measure and a Bayesian network model.
DTIC
*Data Bases; Information Systems; Privacy; Protection*

**20070018942** Naval Research Lab., Washington, DC USA
**An Infrastructure for Secure Interoperability of Agents**
Bharadwaj, Ramesh; Froscher, Judith; Khashnobish, Amit; Tracy, James; Jul 2002; 7 pp.; In English
Report No.(s): AD-A465135; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465135

Introduction Building distributed applications is difficult. Therefore, it is hardly surprising that in spite of all the hoopla surrounding the Internet and distributed computing, truly distributed applications are few and far between. The problem seems to be with the tools available to developers of distributed applications. For example, the most widely used mechanism for distributed computation is the remote procedure call (RPC), the first implementation of which dates back to the early 1980s. Typically, a remote procedure call is executed on a server on behalf of a client (the so-called client-server model). It is hardly surprising therefore that most distributed applications today are exclusively based on the client server architecture. A lot can be (and has been) accomplished with this architecture, as exemplified by the World Wide Web and HTTP, a protocol that implements RPC. However, the client-server model has a number of limitations. There are problems of fault tolerance, load balancing, survivability, dynamic reconfiguration, rollover recovery, and distribution of control. Attempts in the past to break through this bottleneck have had only limited success.
DTIC
*Applications Programs (Computers); Client Server Systems; Interoperability*

**20070018944** Texas A&M Univ., College Station, TX USA
**An Extended Framework for the Validation and Verification of Situation-Aware Middleware Architectures**
Kim, SangEun; In, Peter; Bharadwaj, Ramesh; Mar 2003; 4 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465139; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465139

Model checking is a technique that has been successfully applied for the validation and verification of hardware specifications and communication protocols. In mission critical systems of NASA and the DoD, various mobile devices generate information dynamically, and their state changes with time. Most often, a situation serves as a trigger for a new situation. Therefore, it is necessary to extend existing model checking methods and tools in order to apply them for the validation and verification of situation-aware, mission-critical applications such as DoD command and control systems or the Navy's Total Ship Computing Environment. However, there are several problems to be overcome before these techniques become practical, such as overcoming the state explosion problem and adapting the V&V systems and algorithms to this application area. In this paper, we propose a new technique, founded on combining existing techniques in theorem proving and model checking to extend the application area of existing pure model checking methods. This paper also introduces state space reduction methods based on abstraction that ameliorate the state explosion problem. Future distributed real-time and embedded system must necessarily be highly adaptable, secure, and reliable. Existing system development techniques therefore need to be extended so that future systems have the capability to meet these new system requirements.
DTIC
*Algorithms; Applications Programs (Computers); Models*

**20070018976** Naval War Coll., Newport, RI USA

**A Smarter Intelink: Intelligence Information Management to Support the Operational Commander**

Vandermolen, Thomas D; Feb 14, 2005; 24 pp.; In English

Report No.(s): AD-A465240; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465240

Intelink is the U.S. Government's classified version of the World Wide Web. Unfortunately, like the World Wide Web, Intelink's information is often difficult or impossible to easily locate, and indeed a large portion of Intelink data is inaccessible to the average user because of security-related, organizational, or technical reasons. Because Intelink plays such a pivotal role in providing intelligence support to the operational commander, any information management problems or inefficiencies in Intelink will create potentially large-scale perturbations in the intelligence process, ultimately affecting how well the operational-level commander and his subordinate units will be able to carry out their mission. The newly created Office of the Director of National Intelligence must assume responsibility for Intelink and conduct the organizational and technical changes that must occur for Intelink to truly leverage the power of the entire Intelligence Community.

DTIC

*Information Management; Information Retrieval; Information Systems; Intelligence; Internets; United States; User Requirements*

**20070019008** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**Geospatial Informational Security Risks and Concerns of the U.S. Air Force GeoBase Program**

Bryant, Scott A; Mar 2007; 166 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465293; AFIT/GEM/ENV/07-M1; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465293

Technological advancements such as Geospatial Information Systems (GIS) and the Internet have made it easier and affordable to share information, which enables complex and time sensitive decisions to be made with higher confidence. Further, advancements in information technology have dramatically increased the ability to store, manage, integrate, and correlate larger amounts of data to improve operational efficiency. However, the same technologies that enable increased productivity also provide increased capabilities to those wishing to do harm. Today?s military leaders are faced with the challenge of deciding how to make geospatial information collected on military installations and organizations available to authorized communities of interest while simultaneously restricting access to protect operational security. Often, these decisions are made without understanding how the sharing of certain combinations of data may pose a significant risk to protecting critical information, infrastructure or resources. Information security has been an area of growing concern in the GeoBase community since, by definition, it is required to strike a balance between competing interests, each supported by federal policy: (1) the availability of data paid for by tax dollars and (2) the protection of data as required to mitigate risks. In this research we will explore the security implications of the US Air Force GeoBase (the US Air Force?s applied Geospatial Information System) program. We examine the rapid expansion of the use of GeoBase to communities outside of the civil engineering field; examine the intrinsic and extrinsic security risks of the unconstrained sharing of geospatial information; explore difficulties encountered when attempting to rate the sensitivity of information, discuss new policies and procedures that have been implemented undertaken to protect the information, and propossharing geospatial inf

DTIC

*Confidence Limits; Information Management; Information Systems; Risk; Security; System Effectiveness*

**20070019014** Naval Research Lab., Washington, DC USA

**Using TAME to Prove Invariants of Automata Models: Two Case Studies**

Archer, Myla; Heitmeyer, Constance; Riccobene, Elvinia; Aug 2000; 13 pp.; In English

Report No.(s): AD-A465302; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465302

TAME is a special-purpose interface to PVS designed to support developers of software systems in proving properties of automata models. One of TAME's major goals is to allow a software developer who has basic knowledge of standard logic, and can do hand proofs, to use PVS to represent and to prove properties about an automaton model without first becoming a PVS expert. A second goal is for a human to be able to read and understand the content of saved TAME proofs without running them through the PVS proof checker. A third goal is to make proving properties of automata with TAME less costly in human time than proving such properties using PVS directly. Recent work by Romijn and Devillers et al., based on the I/O automata model, has provided the basis for two case studies on how well TAME achieves these goals. Romijn specified the

RPC-Memory Problem and its solution, while Devillers et al. specified a tree identify protocol. Hand proofs of specification properties were provided by the authors. In addition, Devillers et al. used PVS directly to mechanize the specifications and proofs of the tree identify protocol. In one case study, the third author, a new TAME user with no previous PVS experience, used TAME to create PVS specifications of the I/O automata presented by Romijn and Devillers et al. and to check the hand proofs of invariant properties. The PVS specifications and proofs of Devillers et al. provide the basis for the other case study, which compares the TAME approach to an alternate approach which uses PVS directly.
DTIC
*Automata Theory; Computer Programming; Computers; Logic Design; Software Engineering; Theorem Proving*

**20070019019** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
**Mapping Change Management: A Co-citation Analysis**
Low, Brian R; Mar 2007; 141 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465310; AFIT/GEM/ENV/07-M8; No Copyright; Avail.: CASI: A07, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465310

Today's organizations are continually undergoing changes to make improvements in their efficiency and effectiveness. The ability of organizations to effectively implement and sustain successful change, however, has been limited, with most change initiatives failing to attain the desired success. To counter this trend, researchers across several disciplines have worked to provide practitioners better insight into how to facilitate change within their organizations. This research has resulted in many theories as to what constitutes change and how best to implement it, but it lacks a unifying theory that encompasses all aspects of change research. This effort takes a step toward a better understanding of the change management field and its nature. Using a co-citation methodology, 141 influential authors from the field of change management were identified. Their works were then categorized into identifiable sub-groups within the field and mapped, providing insight into the level of integration that has occurred within the field and across the disciplines that have explored change. Also, the extent to which the existing theories have begun to converge toward a unifying theory is observed. The purpose of this effort is to point future researchers in a direction that will lead to a unifying theory of change management. This unifying theory can then be translated into practices that will enable organizations to successfully transition through needed change initiatives.
DTIC
*Mapping; Organizations*

**20070019023** Massachusetts Univ., Amherst, MA USA
**Identifying Predictive Structures in Relational Data Using Multiple Instance Learning**
McGovern, Amy; Jensen, David; Jan 2003; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-00-2-0597
Report No.(s): AD-A465314; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465314

This paper introduces an approach for identifying predictive structures in relational data using the multiple-instance framework. By a predictive structure, we mean a structure that can explain a given labeling of the data and can predict labels of unseen data. Multiple-instance learning has previously only been applied to flat, or propositional, data and we present a modification to the framework that allows multiple-instance techniques to be used on relational data. We present experimental results using a relational modification of the diverse density method (Maron, 1998; Maron & Lozano-P erez, 1998) and of a method based on the chi-squared statistic (McGovern & Jensen, 2003). We demonstrate that multiple instance learning can be used to identify predictive structures on both a small illustrative data set and the Internet Movie Database. We compare the classification results to a kappa-nearest neighbor approach.
DTIC
*Data Processing; Identifying; Predictions*

**20070019028** Michigan Univ., Ann Arbor, MI USA
**Agent Communication with Differentiated Ontologies: Eight New Measures of Description Compatibility**
Weinstein, Peter C; Birmingham, William P; Jan 1999; 39 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465320; NSF-IIS-9872057; CERA-IRI-9411287; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465320

We propose an approach to achieve appropriate exchange of services and data in distributed systems subject to semantic heterogeneity. We assume differentiated ontologies: that terms have formal definitions as concepts related to other concepts,

that local concepts inherit from concepts that are shared, and that most or all primitives are shared. We then develop measures of description compatibility using the structure of the source and target definitions. We evaluate these measures by generating description-logic ontologies in artificial worlds. In our simulations, the meaning of a concept is its denotation in a finite universe of instances. The accuracy of the description- compatibility measures can thus be judged by their success in predicting the overlap of concept denotations. Description compatibility can be used to guide agent search for services across communities that subscribe to differentiated ontologies.
DTIC
*Compatibility; Semantics*

**20070019048** Library of Congress, Washington, DC USA
**Consular Identification Cards: Domestic and Foreign Policy Implications, the Mexican Case, and Related Legislation**
Bruno, Andorra; Storrs, K L; May 26, 2005; 22 pp.; In English
Report No.(s): AD-A465370; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465370

The current debate about consular identification cards in the USA has centered around the matricula consular, the consular identification card issued by Mexican consulates to Mexican citizens in the USA. In May 2003, the Treasury Department issued regulations allowing acceptance of the cards as proof of identity for the purpose of opening a bank account, and the cards are accepted for other purposes as well, including issuance of drivers licenses. Consular identification cards raise issues for domestic policy and foreign policy. With respect to domestic policy, supporters argue that acceptance of the cards is necessary in a post-September 11, 2001 America, where photo identification is required to conduct daily business. They maintain that the card is a secure and fraud-resistant document that improves security and brings people into the open financial community where transactions can be monitored more easily. Opponents argue that the cards are not secure and are needed only by aliens who are illegally present in the USA and serve to undermine U.S. immigration policy. In the area of foreign policy, supporters maintain that U.S. acceptance of the cards has improved bilateral relations with an important neighboring country. determination that the applicant is lawfully present in the USA and that specify that an official passport is the only acceptable foreign identity document.
DTIC
*Foreign Policy; Law (Jurisprudence)*

**20070019049** Library of Congress, Washington, DC USA
**Implications of the Vienna Convention on Consular Relations upon the Regulation of Consular Identification Cards**
Elsea, Jennifer K; Garcia, Michael J; May 23, 2005; 7 pp.; In English
Report No.(s): AD-A465372; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465372

Recent controversy regarding the use of consular identification cards (IDs) by aliens within the USA, in particular Mexico's matricula consular, has led to calls for legislation to regulate the issuance of the cards by foreign missions or their acceptance by U.S. government and private entities. This report identifies possible implications that U.S. regulation or monitoring of the issuance of these cards by foreign missions might have upon U.S. obligations under the Vienna Convention on Consular Relations (VCCR), which protects foreign missions in the exercise of their legitimate consular functions and codifies customary international law with respect to the inviolability of consular premises and documents. The REAL ID Act (P.L. 109-13, Division B) prohibits states, when issuing drivers licenses or state ID cards, from accepting for purposes of personal identification foreign documents other than valid passports, if such drivers licenses or ID cards are to be accepted for federal purposes. Other recent legislative proposals aimed at restricting the acceptance (but not the issuance) of consular IDs include H.R. 688, the SAFER Act, introduced by Representative J. Gresham Barrett on February 9, 2005; H.R. 815, the Financial Customer Identification Verification Improvement Act, introduced by Representative Scott Garrett on February 15, 2005; and H.R. 925, the Identification Integrity Act of 2005, introduced by Representative Elton Gallegly on February 17, 2005.
DTIC
*Conventions; International Law; Law (Jurisprudence)*

**20070019051** Rensselaer Polytechnic Inst., Troy, NY USA
**Information Fusion for High Level Situation Assessment and Prediction**
Ji, Qiang; Mar 2007; 18 pp.; In English
Contract(s)/Grant(s): F49620-03-1-0160
Report No.(s): AD-A465378; 2007-01-FR; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465378

This is the final report for our AFOSR sponsored project: Information Fusion for High Level Situation Assessment and Prediction. Through this project, we developed a probabilistic framework for performing high level information fusion. In addition, we developed algorithms for performing active information fusion to improve both fusion accuracy and efficiency so that decision making and situation assessment can be made in a timely and efficient manner. Finally, we applied the framework and the algorithms to a military application to demonstrate its feasibility and validity for high level information fusion. In this report, we first summarize our technical accomplishments, followed by a discussion of transitions related to this project. The related paper reprints are attached with this report. In addition, the latest paper reprints, publications, and software demos from this project may also be found at http://www.ecse.rpi.edu/~cvrl/lwh/.
DTIC
*Algorithms; Multisensor Fusion; Probability Theory; Situational Awareness*

**20070019063** George Mason Univ., Fairfax, VA USA
**Maintaining Multilevel Transaction Atomicity in MLS Database Systems with Kernelized Architecture**
Costich, Oliver; Jajodia, Sushil; Jan 1993; 20 pp.; In English
Contract(s)/Grant(s): N00014-89-C-2389
Report No.(s): AD-A465420; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465420

In most models of trusted database systems, transactions are considered to be single-level subjects. As a consequence, users are denied the ability to execute some transactions which can be run on conventional (untrusted) database systems, namely those that perform functions that become inherently multilevel in the MLS environment. This paper introduces a notion of multilevel transaction and proceeds to an algorithm for their concurrent execution. The algorithm is proven to be correct in the sense that resulting schedules for executing the multilevel transactions is one-copy serializable.
DTIC
*Data Bases; Microwave Landing Systems*

**20070019075** Library of Congress, Washington, DC USA
**The National Telecommunications and Information Administration (NTIA): Budget, Programs, and Issues**
McLoughlin, Glenn J; Apr 11, 2005; 6 pp.; In English
Report No.(s): AD-A465448; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465448

The National Telecommunications and Information Administration (NTIA), a part of the Department of Commerce, is the executive branch's principal advisory office on domestic and international telecommunications and information issues and policies. Congressional policymakers generally have supported the NTIA's mandate through the appropriations process. Because of its role in setting telecommunications policy for the federal government in the information age, the NTIA has a significant impact on both the public and private sector. Still, this role is changing. In FY2005, Congress agreed with President Bush's request to terminate funding for NTIA's Technology Opportunity Program; for FY2006, Congress is considering whether to also agree with the Administration to terminate NTIA's Public Telecommunications Facilities, Planning and Construction Program. In addition, the Administration is seeking to seek a larger role for NTIA NTIA's spectrum management and domain name registration. Some congressional policymakers see this proposed change as streamlining policymaking; others are concerned that the important functions and mission of NTIA will be subsumed and lost in the merger. The total funding for NTIA in FY2005 is $38.7 million. For FY2006, the Bush Administration has requested $23.5 million. This report will be updated as events warrant.
DTIC
*Federal Budgets; Information; Organizations; Telecommunication*

**20070019076** Naval Research Lab., Washington, DC USA

**The Paradoxical Value of Privacy**

Syverson, Paul; Mar 14, 2003; 5 pp.; In English

Report No.(s): AD-A465451; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465451

We consider some common assumptions about the value placed on privacy in society. We observe that: 1. Contrary to popular accounts, individuals are not obviously irrational in how they value privacy. 2. Current governmental and economic structures do not properly place the cost of privacy, thus skewing incentives and behavior. 3. Security of institutions may decrease and infrastructure costs may be increased by a reduction in privacy.

DTIC

*Costs; Economic Analysis; Privacy; Security*

**20070019102** Naval Research Lab., Washington, DC USA

**Implementation of IPv6 in 4.4 BSD**

Atkinson, Randall J; McDonald, Daniel L; Phan, Bao G; Metz, Craig W; Chin, Kenneth C; Jan 1996; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465508; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465508

The widespread availability of the TCP/IP protocols in early versions of BSD UNIX fostered the currently widespread use of those protocols in commercial products. Rapid depletion of the IPv4 address space has caused the Internet Engineering Task Force to design version 6 of the Internet Protocol (IPv6). IPv6 has some similarities with IPv4, but it also has many differences, most notably in address size. This paper describes our experience creating a freely distributable implementation of IPv6 inside 4.4 BSD, with focus on the areas that have changed between the IPv4 and IPv6 implementations.

DTIC

*Cryptography; Internets; Messages; Protocol (Computers); Security*

**20070019106** Naval Research Lab., Washington, DC USA

**The Role of Trust in Information Integrity Protocols**

Simmons, G J; Meadows, Catherine; Jan 1995; 12 pp.; In English

Report No.(s): AD-A465516; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465516

Paradoxically, one of the most important - and at the same time, probably one of the least understood - functions performed by information integrity protocols is to transfer trust from where it exists to where it is needed. Initially in any protocol, there are at least two types of trust: trust that designated participants, or groups of participants, will faithfully execute their assigned function in the protocol and trust in the integrity of the transfer mechanism(s) integral to the protocol. Consequently, almost all protocols enforce a set of restrictions as to who may exercise them - either spelled out explicitly or left implicit in the protocol specification. In addition there may be unanticipated or even unacceptable groupings of participants who can also exercise the protocol as a result of actions taken by some of the participants reflecting trusts that exist among them. Formal methods are developed to analyze trust as a fundamental dimension in protocol analysis and proof.

DTIC

*Information; Information Transfer; Protocol (Computers)*

**20070019112** Virginia Univ., Charlottesville, VA USA

**Performance Evaluation of a Firm Real-Time DataBase System**

Shih, Stuart; Kim, Young-Kuk; Son, Sang H; Jan 1995; 10 pp.; In English

Report No.(s): AD-A465528; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465528

In conventional database systems, performance is primarily measured by the number of transactions completed within a unit time. In real-time applications, timing and criticality characteristics of transactions must be taken into account. In this paper, we examine the performance of StarBase, a firm real-time database system. The deadline guarantee ratio and average response times are the primary performance measures. There have been performance studies on real-time data-base systems,

but most of them were performed using simulation. This work demonstrates the feasibility of developing a real-time database system with an acceptable performance.
DTIC
*Data Bases; Evaluation; Performance Tests; Real Time Operation*

**20070019113** Virginia Univ., Charlottesville, VA USA
**Information Survivability Control Systems**
Sullivan, Kevin; Knight, John C; Du, Xing; Geist, Steve; Jan 1999; 10 pp.; In English
Contract(s)/Grant(s): F30602-96-1-0314
Report No.(s): AD-A465530; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465530

We address the dependence of critical infrastructures-including electric power, telecommunications, finance and transportation-on vulnerable information systems. Our approach is based on the notion of control systems. We envision hierarchical, adaptive, multiple model, discrete-state distributed control systems to monitor infrastructure information systems and respond to disruptions (e.g., security attacks) by changing operating modes and design configurations to minimize loss of utility. To explore and evaluate our approach, we have developed a toolkit for building distributed dynamic models of infrastructure information systems. We used this toolkit to build a model of a simple subset of the USA payment system and a control system for this model information system.
DTIC
*Control; Information Systems*

**20070019115** Northwestern Univ., Evanston, IL USA
**Sketching for Knowledge Capture: A Progress Report**
Forbus, Kenneth D; Usher, Jeffrey; Jan 16, 2002; 9 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465534; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465534

Many concepts and situations are best explained by sketching. This paper describes our work on sKEA, the sketching Knowledge Entry Associate, a system designed for knowledge capture via sketching. We discuss the key ideas of sKEA: blob semantics for glyphs to sidestep recognition for visual symbols, qualitative spatial reasoning to provide richer visual and conceptual understanding of what is being communicated, arrows to express domain relationships, layers to express within sketch segmentation (including a meta-layer to express subsketch relationships themselves via sketching), and analogical comparison to explore similarities and differences between sketched concepts. Experiences with sKEA to date and future plans are also discussed.
DTIC
*Knowledge Based Systems; Semantics*

**20070019135** Naval Research Lab., Washington, DC USA
**A Practical Approach to High Assurance Multilevel Secure Computing Service**
Froscher, J N; Kang, M; McDermott, J; Costich, O; Landwehr, C E; Dec 1994; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465588; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465588

Current projects aimed at providing MLS computing services rarely seem to exploit advances in related fields. Specifically, the concepts of data distribution, replication, and interoperation are currently receiving much attention in the commercial database system sector but have yet to be applied to the delivery of MLS computing services. This paper explains how these concepts might help deliver MLS computing services relatively quickly and cheaply, and how they can ease integration of legacy systems and new technology into future MLS cooperative, distributed computing environments.
DTIC
*Computer Information Security; Data Bases*

**20070019160** Naval Research Lab., Washington, DC USA
**Parsimonious Downgrading and Decision Trees Applied to the Inference Problem**
Chang, LiWu; Moskowitz, Ira S; Jan 1998; 9 pp.; In English
Report No.(s): AD-A465437; No Copyright; Avail.: CASI: A02, Hardcopy

In this paper we present our new paradigm for dealing with the inference problem which arises from downgrading. Our new paradigm has two main parts: the application of decision tree analysis to the inference problem, and the concept of parsimonious downgrading. We also include a new thermodynamically motivated way of dealing with the deduction of inference rules from partial data.
DTIC
*Decision Theory; Inference; Information Retrieval*

**20070019164** Virginia Univ., Charlottesville, VA USA
**A New Approach to Real-Time Transaction Scheduling**
Son, Sang H; Lee, Juhnyoung; Jan 1992; 7 pp.; In English
Report No.(s): AD-A465532; No Copyright; Avail.: CASI: A02, Hardcopy

A real-time database system differs from a conventional database system because in addition to the consistency constraints of the database, timing constraints of individual transaction need to be satisfied. Various real-time transaction scheduling algorithms have been proposed which employ either a pessimistic or an optimistic approach to concurrency control. In this paper, we present new real-time transaction scheduling algorithms which employ a hybrid approach, i.e., a combination of both pessimistic and optimistic approaches. These protocols make use of a new conflict resolution scheme called dynamic adjustment of serialization order, which supports priority-driven scheduling, and avoids unnecessary aborts. Our experimental results indicate that hybrid protocols outperform other real-time concurrency control protocols in certain performance metrics.
DTIC
*Data Bases; Real Time Operation; Scheduling*

**20070019165** Civil Aeromedical Inst., Oklahoma City, OK USA
**Comparison of Amplification Methods to Produce Affymetrix GeneChip(Trademark) Target Material**
Burian, Dennis; White, Vicky; Huggins, Mark; Kupfer, Doris; Canfield, Dennis V; Whinnery, James E; Apr 2007; 9 pp.; In English
Report No.(s): AD-A465656; No Copyright; Avail.: CASI: A02, Hardcopy

Whole blood from living subjects is a convenient matrix to use as a source of RNA for microarray experiments with human subjects especially when subject material is collected at a location other than the collaborating site conducting the microarray work. Collection methods for whole blood that include stabilization of the RNA are known but suffer from issues of decreased sensitivity due to the large amount of globin RNA present from reticulocyte lysis. The experiments presented here were designed to test a globin-RNA reduction protocol in conjunction with three different amplification methods. Statistical analysis of the six different protocols, coupled with post-hybridization quality assurance methods, revealed that an amplification protocol that yielded a fragmented biotin-labeled cDNA product resulted in the highest Percent Present calls from the Affymetrix analysis software and the least methodology based variability. Based on these results, this amplification protocol is expected to lead to the greatest sensitivity and accuracy for differential expression testing of the six amplification methods tested.
DTIC
*Amplification; Information Retrieval; Statistical Analysis; Targets*

**20070019171** Government Printing Office, Washington, DC USA
**A Strategic Vision for the 21st Century**
Dec 1, 2004; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465671; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The USA Government Printing Office is at the epicenter of change in the ways humans create and use information to communicate, remain informed, research a topic and preserve a record. We estimate that as many as 50% of all U.S. Government documents are now born digital, published to the Web and will never be printed by the Federal government. Therein lies the biggest challenge for the Government Printing Office. Recently, Congress asked the Government Accountability Office to examine the current state of printing and dissemination of public government information. The study, which is summarized in Appendix A, has proven a very useful guide and benchmark in the preparation of this Strategic Vision for the future of the Government Printing Office. While GPO's mission will remain essentially the same in the future, the introduction of digital technology has changed the ways its products and services will be created and how they will look and function to meet the ever changing needs of the Federal government and the way public users of Government information now prefer it. It is the reorganization of the Government Printing Office to carry out its mission to meet the changing requirements

of the Federal government that this document addresses. The Vision: To deliver Federal information products and services from a flexible digital platform.
DTIC
*Information Systems; Printing; United States*

**20070019177** Naval War Coll., Newport, RI USA
**Organizational Structure and Dynamic Information Awareness in Command Teams**
Baker, Keith; Entin, Elliot E; See, Katrina; Baker, Bonnie S; Downes-Martin, Stephen; Cecchetti, Jon; Jun 2004; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465691; No Copyright; Avail.: CASI: A03, Hardcopy

The Navy has embraced the concept of network centric warfare as a means to develop innovative and effective command and control (C2) structures for the future. One such C2 structure is FORCEnet. Modeling of various FORCEnet-derived structures produced a prediction that a C2 structure that includes an intelligence, surveillance, and reconnaissance (ISR) coordinator would significantly improve mission performance. Network centric warfare, however, has increased the information load commanders must deal with. As part of this effort we investigated the effects of information load on certain decision making heuristics. Counter to modeling predictions, a FORCEnet derived organization with an ISR coordinator was not superior in performance to an organization without an ISR coordinator. There was evidence, however, that increased familiarity and practice with a structure including an ISR coordinator may produce findings supportive of model predictions. Findings also indicate that high information load may exacerbate the negative effects of certain decision making heuristics.
DTIC
*Command and Control; Information Systems; Warfare*

**20070019178** Missile Defense Agency, Washington, DC USA
**On Cyber Warfare Command and Control Systems**
Howes, Norman R; Mezzino, Michael; Sarkesain, John; Jun 2004; 44 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465692; No Copyright; Avail.: CASI: A03, Hardcopy

As Defense agencies and services expand their reliance on computer networks, risk to information availability and integrity increases. It is no longer adequate to rely solely on the now traditional defense-in-depth strategy. We must recognize that we are engaged in a form of warfare, cyber warfare, and deploy our resources using the strategy and tactics of warfare. Most Defense organizations have not yet developed strategies or tactics for cyber warfare. This causes security devices to be used ineffectively and responses to be untimely. Cyber warfare then becomes a one-sided battle where the attacker makes all the strikes and the target of the attack responds so slowly that the attacker usually gets away without being identified. Employing cyber warfare strategy and tactics requires a cyber warfare command and control system. Responses to cyber attacks do not require offensive measures outside our own network boundaries to be effective, but they do require timely responses. Timely offensive action taken within our own network boundaries can lead to an identification of the attacker. During the past two years we have developed a prototype cyber warfare command and control system to demonstrate that defense-in-depth can be taken to a new level that is active and anticipatory rather than passive and reactive.
DTIC
*Command and Control; Computer Networks; Warfare*

**20070019180** Naval Research Lab., Washington, DC USA
**Fair On-line Auctions Without Special Trusted Parties**
Stubblebine, Stuart G; Syverson, Paul F; Feb 1999; 12 pp.; In English
Report No.(s): AD-A465695; No Copyright; Avail.: CASI: A03, Hardcopy

Traditional face-to-face (English) auctions rely on the auctioneer to fairly interact with bidders to accept the highest bid on behalf of the seller. On-line auctions also require fair negotiation. However, unlike face-to-face auctions, on-line auctions are inherently subject to attacks because the bidders and auctioneer are not co-present. These attacks include selectively blocking bids based on the bidder and amount and selectively closing the auction after a particular bid is received. In this paper, the authors present an on-line English auction in which bids are processed fairly and the auction closes fairly without specialized trusted parties (i.e., there is no need to trust the auctioneer to obtain a fair outcome to the auction).
DTIC
*Cryptography; Electronic Commerce; Internets; On-Line Systems; Requirements*

**20070019187** Military Academy, Brno, Czech Republic

**The Concept of C2 Communication and Information Support**

Lukas, Ludek; Hruza, Petr; Jun 2004; 20 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465711; No Copyright; Avail.: CASI: A03, Hardcopy

In the Czech Armed Forces, we have taken a new look at the communication and information systems function. This new opinion and approach issue from integration of functions and downsizing of CIS equipment. GSM telephone is a typical example of this matter. It is an equipment of communication system but information system as well. In many cases the border between an information system and a communication system is hardly identifiable. That is why integrated C2 Communication and Information Support (CISu) should be mentioned rather than communication support and information support separately. CISu is a process (information activity) that sustains Command a Control by battle information. CISu is provided by the Communication and Information System (CIS). CISu is the result of CIS function. C2 information responsibility is one of the reasons for CISu definition. O-6 is responsible for providing communication on mechanized brigade level. Not only communication is important, but information system function too. By this concept, we can centralize our CISu request on O-6 and signal company. In the past, we used to separate information support and communication. Now, according to this concept, we have specified a single integrated process, the Communication and Information Support of C2.

DTIC

*Command and Control; Information Systems; Telecommunication*

**20070019198** General Dynamics Advanced Information Systems, Dayton, OH USA

**A Compendium on Glyph/Icon Research Including MIL 2525B**

Repperger, D W; Kuperman, G; Thomas-Meyers, G; Aleva, D; Fullenkamp, S; Sep 2006; 50 pp.; In English

Contract(s)/Grant(s): Proj-2313

Report No.(s): AD-A465727; No Copyright; Avail.: CASI: A03, Hardcopy

An overview is conducted on the vast area of visualization when applied to icons and their application is map-type displays. The early history and motivation of the use of icons is examined. Displaying complex information is surveyed in multiple areas. The possible use of animation is both researched and hypothesized for application in military scenarios. The genesis of the military standard MIL2525B is discussed. Suggestions are made on means of improving and the rendering of the multiple dimensions of MIL2525B to maximize information transferred to a human operator.

DTIC

*Cognition; Display Devices*

**20070019202** Virginia Univ., Charlottesville, VA USA

**Survivability Architectures: Issues and Approaches**

Knight, John C; Sullivan, Kevin J; Elder, Matthew C; Wang, Chenxi; Jan 2000; 16 pp.; In English

Contract(s)/Grant(s): F30602-96-1-0314

Report No.(s): AD-A465737; No Copyright; Avail.: CASI: A03, Hardcopy

Survivability architectures enhance the survivability of critical information systems by providing a mechanism that allows the detection and treatment of various types of faults. In this paper, we discuss four of the issues that arise in the development of such architectures and summarize approaches that we are developing for their solution.

DTIC

*Architecture (Computers); Information Systems*

**20070019210** Science Applications International Corp., McLean, VA USA

**A Network-Centric Enterprise Service for Mediation and Interoperability: The Dynamic Operational Object Registration Service (DOORS)**

Bollers, Jonathan C; Jun 2004; 21 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465772; No Copyright; Avail.: CASI: A03, Hardcopy

Warfighters conducting joint and coalition task force operations and inter-governmental agency operations supporting homeland security must interoperate with C2/C4I systems that possess disparate mapping/visualization and information management infrastructures. These C2/C4I systems are generally built upon dissimilar data representations and stovepipe interfaces. To achieve information superiority while engaged in such operations, commanders must transform component C2/C4I system data into interoperable information and shared knowledge, making the result available for exchange to multiple levels and nodes bases upon need and choice. This level of interoperability is critical for geo-spatially and temporally

registered operational object information that comprises situation understanding aspects of a common operational picture, which also extends to supporting drill down information. SAIC's Dynamic Operational Object Registration Service (DOORS) was developed in the anticipation that a properly conceived C2/C4I vocabulary of domain knowledge representation, supported by an ontology-driven adaptive system, and employing meta-data based translation services (mapping of data from each participating system to a common representation) will provide the requisite basis for a network-centric enterprise data mediation service that addresses current interoperability challenges. DOORS provides the mechanism to exchange interoperable information for joint/combined task force operations according to a register-publish-subscribe metaphor that reflects the commander's information exchange requirements.
DTIC
*Doors; Information Systems; Interoperability*

**20070019217** Strategic Consulting, Inc., Fairfax Station, VA USA
**Command & Control as an Operational Function of Information Warfare**
Curts, Raymond J; Campbell, Douglas E; Jun 2004; 33 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465787; No Copyright; Avail.: CASI: A03, Hardcopy

Data - the competition for information is as old as the first conflict. It involves increasing and protecting our own store of information while limiting and penetrating the adversary's. As it pertains to C2 as an operational function of information warfare - targeting the enemy's information functions, while protecting ours, with the intent of degrading his will or capability to fight. Management e.g., advanced battlefield management (e.g., using information and information systems to provide information on which to base military decisions when prosecuting a war); and Risk Management for the risks potentially associated with information and information technology (IT) to be identified and managed cost effectively, it is essential that the process of analyzing and assessing risk is well understood by all parties and executed on a timely basis. Process - Information Warfare processes are making dramatic changes in how we fight wars. The process must allow a commander's vision and view of the battlespace to be shared at the lowest possible level. From the unique perspectives of soldiers, sailors, marines and airmen, the process must forge a common understanding of how to use information warfare to enhance joint C2 warfighting capabilities. The Global Information Grid (GIG) is an example of such a process.
DTIC
*Command and Control; Information Systems; Warfare*

**20070019221** Air Force Research Lab., Rome, NY USA
**From Garage-Band to World Tour: Technical, Security, and Scalability Challenges of a Web-Based Program Management Tool from Workgroup-Level to Enterprise-Class in 24 Months**
Rico, Helen M; Hall, Fred; Maciolek, II, Michael J; Jun 2004; 46 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465793; No Copyright; Avail.: CASI: A03, Hardcopy

The Air Force Research Laboratory (AFRL) has a web-based application used for program management which provides its scientists and engineers a clearer, more rapid picture of their contractual and in-house R&D efforts financial and technical status, by allowing the contractor to enter information directly into the tool. This web application, called Jiffy, began as a tool developed by two engineers in AFRL's Information Directorate (IF) using ASP pages talking to a Microsoft Access database and was initially used by a handful of people. Senior management saw Jiffy as a tool that would benefit all of IF's engineers and scientists (approximately 450 people). Jiffy became recognized by AFRL as a best-practice and an effort was started to scale Jiffy up for use by all Air Force Research Laboratory engineers (approximately 3000 users). In this paper, the authors will describe the issues and solutions in migrating the application from an Access database to an Oracle database (and the technical architecture used), how the security of the application was improved, and how the application performance was enhanced to allow the application to scale up from a handful of users to thousands of users.
DTIC
*Architecture (Computers); Data Bases; Project Management; Security*

**20070019222** National Coordination Office for Computing, Information and Communications, Arlington, VA USA
**Human-Computer Interaction and Information Management Research Needs**
Oct 2003; 51 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465797; No Copyright; Avail.: CASI: A04, Hardcopy

In a visionary future, Human-Computer Interaction (HCI) and Information Management (TM) have the potential to enable humans to better manage their lives through the use of synergistic human-computer empowered information systems. This

report identifies and illustrates the problems that underlie HCI&IM R&D and provides a context and snapshot of Government approaches to HCI&IM R&D for the development and use of integrated on-line information technologies to achieve benefits such as: * Changing the way scientific research is conducted * Expanding the science and engineering knowledge base * Enabling a more knowledgeable, capable, and productive workforce. The report is built on a one-day multi-agency workshop held on October 22, 2001, that documented ongoing Government efforts and identified programmatic gaps where solutions are critical to meet agency mission goals and objectives.
DTIC
*Human-Computer Interface; Information Management; Information Systems*

**20070019259** Library of Congress, Washington, DC USA
**Postal Reform Bills: A Side-by-Side Comparison of H.R. 22 and S. 662**
Kosar, Kevin R; Aug 4, 2005; 56 pp.; In English
Report No.(s): AD-A465391; CRS-RL32903; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465391

The 109th Congress is considering two bipartisan bills that would reform the U.S. Postal Service (USPS) H.R. 22 and S. 662. H.R. 22 was introduced and referred to the House Government Reform Committee on the first day of the 109th Congress (January 4, 2005). On April 14, the Government Reform Committee marked up H.R. 22 and approved it by a vote of 39-0. Thereafter, H.R. 22 was referred to the House Committee on the Judiciary on April 28, discharged therefrom May 27, and placed on Union Calendar No. 55 that same day. The House passed H.R. 22 on July 26, 2005, by a vote of 420 to 10 and it was placed on the Senate Legislative Calendar (Calendar No. 176). S. 662 was introduced into the Senate on March 17, 2005, and referred to the Committee on Homeland Security and Governmental Affairs. On June 22, S. 662 was amended and reported by a vote of 15-1. H.R. 22 and S. 662 are similar to two bills from the 108th Congress H.R. 4341 and S. 2468 which cleared committee by unanimous votes but were not brought to the floor. Like these previous bills, H.R. 22 and S. 662 would attempt to make the Postal Service focus on its core mission (universal delivery of the mail) by defining the term postal services. The bills would define the categories of postal services and products as 'competitive' or market-dominant and prohibit the Postal Service from subsidizing competitive products with revenues from market-dominant products.
DTIC
*Air Mail; Governments; Law (Jurisprudence)*

**20070019263** Naval Research Lab., Washington, DC USA
**Proxies for Anonymous Routing**
Reed, Michael G; Syverson, Paul F; Goldschlag, David M; Jan 1996; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465331; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465331

Using traffic analysis, it is possible to infer who is talking to whom over a public network. This paper describes a flexible communications infrastructure, onion routing, which is resistant to traffic analysis. Onion routing lives just beneath the application layer, and is designed to interface with a wide variety of unmodified Internet services by means of proxies. Onion routing has been implemented on Sun Solaris 2.4; in addition, proxies for World Wide Web browsing (HTTP), remote logins (RLOGIN), e-mail (SMTP), and file transfers (FTP) have been implemented. Onion routing provides application independent, real-time, and bi-directional anonymous connections that are resistant to both eavesdropping and traffic analysis. Applications making use of onion routings anonymous connections may (and usually should) identify their users over the anonymous connection. User anonymity may be layered on top of the anonymous connections by removing identifying information from the data stream. Our goal here is anonymous connections, not anonymous communication. The use of a packet switched public network should not automatically reveal who is talking to whom. This is the traffic analysis that onion routing complicates.
DTIC
*Communication Networks; Computer Information Security; Applications Programs (Computers); Packets (Communication)*

**20070019267** Illinois Univ., Urbana-Champaign, IL USA
**Efficient Concurrency Control in Multidimensional Access Methods**
Chakrabarti, Kaushik; Mehrotra, Sharad; Jan 1999; 13 pp.; In English
Contract(s)/Grant(s): IIS-9734300; DAAL01-96-2-0003
Report No.(s): AD-A465777; No Copyright; Avail.: CASI: A03, Hardcopy

The importance of multidimensional index structures to numerous emerging database applications is well established.

However, before these index structures can be supported as access methods (AMs) in a commercial-strength database management system (DBMS), efficient techniques to provide transactional access to data via the index structure must be developed. Concurrent accesses to data via index structures introduce the problem of protecting ranges specified in the retrieval from phantom insertions and deletions (the phantom problem). This paper presents a dynamic granular locking approach to phantom protection in Generalized Search Trees (GiSTs), an index structure supporting an extensible set of queries and data types. The granular locking technique offers a high degree of concurrency and has a low lock overhead. Our experiments show that the granular locking technique (1) scales well under various system loads and (2) similar to the B-tree case, provides a significantly more efficient implementation compared to predicate locking for multidimensional AMs as well. Since a wide variety of multidimensional index structures can be implemented using GiST, the developed algorithms provide a general solution to concurrency control in multidimensional AMs. To the best of our knowledge, this paper provides the first such solution based on granular locking.
DTIC
*Data Bases; Data Base Management Systems; Insertion*

**20070019272** Executive Office of the President, Washington, DC USA
**Strengthening National, Homeland, and Economic Security. Networking and Information Technology Research and Development Supplement to the President's FY 2003 Budget**
Marburger, III, John H; Jul 2002; 58 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465669; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This Supplement to the President's FY 2003 Budget describes the Federal Networking and Information Technology Research and Development (NITRD) Program, the unique endeavor of Federal agencies collaboratively engaged in advanced research and development in these technologies. The multiagency NITRD portfolio spans a balanced, diverse set of long-term, fundamental research efforts in all aspects of large-scale and broadband networking and information technologies. This ongoing research provides leading-edge networks, technologies, and tools for vital Federal missions, drives innovation throughout the U.S. economy, and supports the research talent that sustains U.S. global leadership in science and technology. The first computers, the Internet, the graphical user interface, high-end parallel processing, the first end-to-end optical networks, advanced computational modeling and simulation, and search engine technologies are just a few of the results of Federal information technology (IT) research that have fueled the digital revolution from which we all benefit. Today the NITRD Program continues to be the Nation's primary source of fundamental technological breakthroughs and skilled human resources in the advanced computing, networking, software, and information management technologies on which our 21st century infrastructure and quality of life will rely.
DTIC
*Economics; Information Systems; Security; Technology Assessment*

**20070019278** Air Force Research Lab., Wright-Patterson AFB, OH USA
**Defining a Security Architecture for Real-Time Embedded Systems**
Reinhart, Tod; Boettcher, Carolyn; Gandara, G A; Hama, Mark; Jun 2004; 33 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465687; No Copyright; Avail.: CASI: A03, Hardcopy

Providing information assurance (IA) for embedded aerospace platforms in a network centric battlespace presents new challenges for information-intensive system development and deployment. This paper will discuss ongoing research being conducted by Raytheon under two Air Force programs. As part of this research, Raytheon is assessing the vulnerability of mission-critical platforms to information warfare attacks on the infrastructure required to achieve interoperability and information sharing. This paper discusses Air Force missions, the technologies that are likely to be used to achieve interoperability, ongoing research in IA that can be leveraged, any IA vulnerabilities that are not yet being addressed, and approaches to mitigating those vulnerabilities. Recommendations for promising future research directions are described.
DTIC
*Embedding; Interoperability; Real Time Operation; Security; Warfare*

**20070019281** Naval Research Lab., Washington, DC USA
**Using Invariants to Optimize Formal Specifications Before Code Synthesis**
Jeffords, Ralph D; Leonard, Elizabeth I; Jan 2004; 11 pp.; In English
Report No.(s): AD-A465307; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465307

Formal specifications of required system behavior can be analyzed, verified, and validated, giving high confidence that the specification captures the desired behavior. Transferring this confidence to the system implementation depends on a formal link between requirements and implementation. The automatic generation of provably correct code provides just such a link. While optimization is usually performed on code to achieve efficiency, we propose to optimize the formal specification before generating code, thus providing optimization independent of the particular code generation method. This paper investigates the use of invariants in optimizing code generated from formal specifications in the Software Cost Reduction (SCR) tabular notation. We show that invariants: (1) provide the basis for simplifying expressions that otherwise cannot be improved using traditional compiler optimization techniques, and (2) allow detection and elimination of parts of the specification that would lead to unreachable code.
DTIC
*Specifications; Proving*

**20070019340** Naval Research Lab., Washington, DC USA
**The b2/c3 Problem: How Big Buffers Overcome Covert Channel Cynicism in Trusted Database Systems**
McDermott, J; Jan 1994; 12 pp.; In English
Report No.(s): AD-A465578; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465578

We present a mechanism for communication from low to high security classes that allows partial acknowledgments and flow control without introducing covert channels. By restricting our mechanism to the problem of maintaining mutual consistency in replicated architecture database systems, we overcome the negative general results in this problem area. A queueing theory model shows that big buffers can be practical mechanisms for real database systems.
DTIC
*Data Bases; Consistency; Security*

**20070019352** Executive Office of the President, Washington, DC USA
**Methylmercury in the Gulf of Mexico: State of Knowledge and Research Needs**
Jun 2004; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465647; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465647

The Interagency Working Group on Methylmercury was formed in response to concern about potential adverse effects on human health associated with consumption of fish and shellfish in the Gulf of Mexico that contain methylmercury. The purpose of the Working Group is to assess the current state of knowledge and activities in Federal agencies regarding methylmercury in the environment and to make recommendations for research and monitoring. The Working Group focused on research and activities that will advance our understanding of methylmercury formation and fate in natural systems, to improve assessment of the risk of human exposure to the health effects of methylmercury, and to facilitate technological solutions to these problems. This report does not address the current state of scientific understanding of the biological mechanisms for adverse health outcomes that might be related to exposure to methylmercury. The Interagency Working Group is considering addressing this and other mercury related topics, as appropriate, in the future.
DTIC
*Earth Resources; Gulf of Mexico; Gulfs; Information Management; Mercury Compounds; Methyl Compounds; Radicals*

## 85
## TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety, 16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

**20070019299** National Technology Transfer Center, Wheeling, VA, USA
**Spinoff 2006**
September 2006; 154 pp.; In English; See also 20070019300 - 20070019339; Original contains color illustrations
Report No.(s): NASA/NP-2006-10-445-HQ; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019299

NASA seeks to create industry partnerships to develop technology that both applies to NASA mission needs and

contributes to competitiveness in global markets. As part of NASA s mission, the Agency facilitates the transfer and commercialization of NASA-sponsored research and technology. These efforts not only support NASA, they enhance the quality of life here on Earth. While NASA does not manufacture, market or sell commercial products, many commercial products are derived from NASA technology. Many NASA originated technologies are adapted by private industry for use by consumers like you. Spinoff developments highlighted in this publication are based on information provided by individual and private industry users of NASA originated aerospace technology who acknowledge that such technology contributed wholly or in part to development of the product or process described. NASA cannot accept responsibility or liability for the misinterpretation or misrepresentation of the enclosed information provided by these third party users. Publication herein does not constitute NASA endorsement of the product or process, nor confirmation of manufacturers performance claims related to any particular spinoff development.
Derived from text
*Commercialization; Market Research; Industries; Consumers; Technology Transfer; Technology Utilization*

**20070019300** Spacelabs, Inc., USA
**Space-Proven Medical Monitor: The Total Patient-Care Package**
Spinoff 2006; September 2006, pp. 14-15; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019300

The primary objective of the Gemini Program was to develop techniques that would allow for advanced, long-duration space travel, a prerequisite of the ensuing Apollo Program that would put man safely on the Moon before the end of the decade. In order to carry out this objective, NASA worked with a variety of innovative companies to develop propulsion systems, onboard computers, and docking capabilities that were critical to the health of Gemini spacecraft, as well as life-support systems and physiological-monitoring devices that were critical to the health of Gemini astronauts. One of these companies was Spacelabs Medical, Inc., the pioneer of what is commonly known today as medical telemetry. Spacelabs Medical helped NASA better understand man s reaction to space through a series of bioinstrumentation devices that, for the first time ever, were capable of monitoring orbiting astronauts physical conditions in real time, from Earth. The company went on to further expand its knowledge of monitoring and maintaining health in space, and then brought it down to Earth, to dramatically change the course of patient monitoring in the field of health care.
Author
*Life Support Systems; Telemetry; Health; Bioinstrumentation; Gemini Spacecraft; Physiology; Patients; Real Time Operation*

**20070019301** A and P Technology, Inc., Cincinnati, OH, USA
**Damage-Tolerant Fan Casings for Jet Engines**
Spinoff 2006; September 2006, pp. 18-19; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019301

All turbofan engines work on the same principle. A large fan at the front of the engine draws air in. A portion of the air enters the compressor, but a greater portion passes on the outside of the engine this is called bypass air. The air that enters the compressor then passes through several stages of rotating fan blades that compress the air more, and then it passes into the combustor. In the combustor, fuel is injected into the airstream, and the fuel-air mixture is ignited. The hot gasses produced expand rapidly to the rear, and the engine reacts by moving forward. If there is a flaw in the system, such as an unexpected obstruction, the fan blade can break, spin off, and harm other engine components. Fan casings, therefore, need to be strong enough to contain errant blades and damage-tolerant to withstand the punishment of a loose blade-turned-projectile. NASA has spearheaded research into improving jet engine fan casings, ultimately discovering a cost-effective approach to manufacturing damage-tolerant fan cases that also boast significant weight reduction. In an aircraft, weight reduction translates directly into fuel burn savings, increased payload, and greater aircraft range. This technology increases safety and structural integrity; is an attractive, viable option for engine manufacturers, because of the low-cost manufacturing; and it is a practical alternative for customers, as it has the added cost saving benefits of the weight reduction.
Author
*Fan Blades; Casing; Turbofan Engines; Damage Assessment*

**20070019302** KAIROS Scientific, Inc., CA, USA

**From Planetary Imaging to Enzyme Screening**

Spinoff 2006; September 2006, pp. 16-17; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019302

Based in San Diego, KAIROS Scientific develops molecular biology methods, instrumentation, and computer algorithms to create solutions to challenging problems in the medical and chemical industries. company s pioneering efforts in digital imaging spectroscopy (DIS) enable researchers to obtain spectral and/or time-dependent information for each pixel or group of pixels in a two-dimensional scene. In addition to having Yang s NASA experience at its foundation, KAIROS Scientific was established with the support of many government grants and contracts. Its first was a NASA Small Business Innovation Research (SBIR) grant, from Ames Research Center, to develop HIRIM, a high-resolution imaging microscope embodying both novel hardware and software that can be used to simultaneously acquire hundreds of individual absorbance spectra from microscopic features. Using HIRIM s graphical user interface, MicroDIS, scientists and engineers are presented with a revolutionary new tool which enables them to point to a feature in an image and recall its associated spectrum in real time. Derived from text

*Enzymes; Imaging Techniques; Molecular Biology; Real Time Operation; Graphical User Interface*

**20070019303** Hyper-Therm High-Temperature Composites, Inc., Huntington Beach, CA, USA

**The Cutting Edge of High-Temperature Composites**

Spinoff 2006; September 2006, pp. 99; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019303

NASA s Ultra-Efficient Engine Technology (UEET) program was formed in 1999 at Glenn Research Center to manage an important national propulsion program for the Space Agency. The UEET program s focus is on developing innovative technologies to enable intelligent, environmentally friendly, and clean-burning turbine engines capable of reducing harmful emissions while maintaining high performance and increasing reliability. Seven technology projects exist under the program, with each project working towards specific goals to provide new technology for propulsion. One of these projects, Materials and Structures for High Performance, is concentrating on developing and demonstrating advanced high-temperature materials to enable high-performance, high-efficiency, and environmentally compatible propulsion systems. Materials include ceramic matrix composite (CMC) combustor liners and turbine vanes, disk alloys, turbine airfoil material systems, high-temperature polymer matrix composites, and lightweight materials for static engine structures.

Author

*Polymer Matrix Composites; High Temperature; Turbine Engines; Clean Fuels; Propulsion System Configurations*

**20070019304** NAVSYS Corp., Colorado Springs, CO, USA

**GPS Eye-in-the-Sky Software Takes Closer Look Below**

Spinoff 2006; September 2006, pp. 88-89; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019304

At NASA, GPS is a vital resource for scientific research aimed at understanding and protecting Earth. The Agency employs the band of GPS satellites for such functions as mapping Earth s ionosphere and developing earthquake-prediction tools. Extending this worldly wisdom beyond Earth, NASA researchers are even discussing the possibility of developing global positioning satellites around Mars, in anticipation of future manned missions. Despite all of its terrestrial accomplishments, traditional GPS still has its limitations. The Space Agency is working to address these with many new advances, including a 'Global Differential GPS' technology that instantaneously provides a position to within 4 inches horizontally and 8 inches vertically, anywhere on Earth. According to NASA's Jet Propulsion Laboratory, no other related system provides the same combination of accuracy and coverage. Furthermore, traditional GPS cannot communicate beyond latitudes of 75deg. That means that most of Greenland and Antarctica cannot receive GPS signals. The Global Differential GPS technology approaches this area of the world using several different GPS signals. These signals overlap to compensate for the gaps in coverage. Now, scientists working in the extreme northernmost and southernmost areas of the world can have access to the same GPS technology that other scientists around the world rely on.

Derived from text

*Global Positioning System; Navigation Satellites; Earth Ionosphere; Manned Space Flight; Positioning*

**20070019305** Inframat Corp., Farmington, CT, USA

**Nano Goes Magnetic to Attract Big Business**

Spinoff 2006; September 2006, pp. 100-101; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019305

Glenn Research Center has combined state-of-the-art electrical designs with complex, computer-aided analyses to develop some of today s most advanced power systems, in space and on Earth. The center s Power and On-Board Propulsion Technology Division is the brain behind many of these power systems. For space, this division builds technologies that help power the International Space Station, the Hubble Space Telescope, and Earth-orbiting satellites. For Earth, it has woven advanced aerospace power concepts into commercial energy applications that include solar and nuclear power generation, battery and fuel cell energy storage, communications and telecommunications satellites, cryocoolers, hybrid and electric vehicles, and heating and air-conditioning systems.

Author

*Nuclear Electric Power Generation; Energy Storage; Solar Generators; Communication Satellites*

**20070019306** Silicon Graphics, Inc., Mountain View, CA, USA

**A History of High-Performance Computing**

Spinoff 2006; September 2006, pp. 90-91; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019306

Faster than most speedy computers. More powerful than its NASA data-processing predecessors. Able to leap large, mission-related computational problems in a single bound. Clearly, it s neither a bird nor a plane, nor does it need to don a red cape, because it s super in its own way. It's Columbia, NASA s newest supercomputer and one of the world s most powerful production/processing units. Named Columbia to honor the STS-107 Space Shuttle Columbia crewmembers, the new supercomputer is making it possible for NASA to achieve breakthroughs in science and engineering, fulfilling the Agency s missions, and, ultimately, the Vision for Space Exploration. Shortly after being built in 2004, Columbia achieved a benchmark rating of 51.9 teraflop/s on 10,240 processors, making it the world s fastest operational computer at the time of completion. Putting this speed into perspective, 20 years ago, the most powerful computer at NASA s Ames Research Center, home of the NASA Advanced Supercomputing Division (NAS), ran at a speed of about 1 gigaflop (one billion calculations per second). The Columbia supercomputer is 50,000 times faster than this computer and offers a tenfold increase in capacity over the prior system housed at Ames. What s more, Columbia is considered the world s largest Linux-based, shared-memory system. The system is offering immeasurable benefits to society and is the zenith of years of NASA/private industry collaboration that has spawned new generations of commercial, high-speed computing systems.

Derived from text

*High Speed; Data Processing; Supercomputers; Memory (Computers); Unix (Operating System)*

**20070019307** Advanced Flexible Materials, Inc, Ridgewood, NJ, USA

**Reflecting on Space Benefits: A Shining Example**

Spinoff 2006; September 2006, pp. 60-65; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019307

NASA has long been known for having developed the thin, shiny reflective material used to insulate everything from the Hubble Space Telescope to hikers, from the Mars rovers to marathon runners, from computers to campers, from satellites to sun shields, and from rockets to residences. It is one of the simplest, yet most versatile spinoffs to come out of the Agency. The insulating material, a strong, plastic, vacuum-metallized film with a highly-efficient, infrared-reflective, vapor-deposited coating of aluminum, was created to be very lightweight in order to minimize weight impact on vehicle payload while also protecting spacecraft, equipment, and personnel from the extreme temperature fluctuations of space. It has been employed on virtually all manned and unmanned NASA missions. The shiny insulation which coated the base of the Apollo lunar landing vehicles is perhaps one of the most memorable early displays of this technology, and the bright, reflective honeycomb on the James Webb Space Telescope prototype is a testament to its lasting usefulness.

Derived from text

*Insulation; Reflection; Metal Films; Vacuum; NASA Programs; Polymeric Films; Spacecraft Equipment*

**20070019308** AeroTech Research, Inc., USA

**Steering Aircraft Clear of Choppy Air**

Spinoff 2006; September 2006, pp. 20-21; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019308

AeroTech Research (U.S.A.), Inc., a leader in turbulence-detection and warning systems, has been involved with NASA Aviation Safety research since 1998. AeroTech served as a contractor for the TPAWS government/industry development project, and was funded by NASA to develop the E-Turb Mode Radar algorithms and the TAPS software. (Other contributors to this project include the National Center for Atmospheric Research, the FAA, North Carolina State University, and the Research Triangle Institute.) The radar algorithms combine an aircraft's turbulenceresponse characteristics with radar measurements to determine the predicted turbulence loads the aircraft will experience, and present this information to the pilot. The TAPS software monitors and processes onboard aircraft sensor data; generates automatic reports when an aircraft encounters turbulence and a set turbulence threshold is exceeded; and then displays the reports and underlying information to ground personnel to improve situational awareness of the location and the severity of the turbulence encounter.

Derived from text

*Turbulence; Situational Awareness; Aircraft Safety; Display Devices; Warning Systems; Loads (Forces); Detection; Radar Measurement*

**20070019309** weAttract.com, Inc., Portland, OR, USA

**A Match Made in Space**

Spinoff 2006; September 2006, pp. 42-43; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019309

Just before the space shuttle reaches orbit, its three main engines shut down so that it can achieve separation from the massive external tank that provided the fuel required for liftoff and ascent. In jettisoning the external tank, which is completely devoid of fuel at this point in the flight, the space shuttle fires a series of thrusters, separate from its main engines, that gives the orbiter the maneuvering ability necessary to safely steer clear of the descending tank and maintain its intended flight path. These thrusters make up the space shuttle s Reaction Control System. While the space shuttle s main engines only provide thrust in one direction (albeit a very powerful thrust), the Reaction Control System engines allow the vehicle to maneuver in any desired direction (via small amounts of thrust). The resulting rotational maneuvers are known as pitch, roll, and yaw, and are very important in ensuring that the shuttle docks properly when it arrives at the International Space Station and safely reenters the Earth s atmosphere upon leaving. To prevent the highly complex Reaction Control System from malfunctioning during space shuttle flights, and to provide a diagnosis if such a mishap were to occur, NASA turned to a method of artificial intelligence that truly defied the traditional laws of computer science.

Author

*Thrust Control; Complex Systems; Spacecraft Orbits; Maneuvers; Flight Paths; Artificial Intelligence; Drydocks; Space Transportation System Flights; Earth Atmosphere*

**20070019310** Syscom Technology, Inc., Columbus,OH, USA

**Electrical Conductivity in Textiles**

Spinoff 2006; September 2006, pp. 104-105; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019310

Copper is the most widely used electrical conductor. Like most metals, though, it has several drawbacks: it is heavy, expensive, and can break. Fibers that conduct electricity could be the solutions to these problems, and they are of great interest to NASA. Conductive fibers provide lightweight alternatives to heavy copper wiring in a variety of settings, including aerospace, where weight is always a chief concern. This is an area where NASA is always seeking improved materials. The fibers are also more cost-effective than metals. Expenditure is another area where NASA is always looking to make improvements. In the case of electronics that are confined to small spaces and subject to severe stress, copper is prone to breaking and losing connection over time. Flexible conductive fibers eliminate that problem. They are more supple and stronger than brittle copper and, thus, find good use in these and similar situations. While clearly a much-needed material, electrically conductive fibers are not readily available. The cost of new technology development, with all the pitfalls of troubleshooting production and the years of testing, and without the guarantee of an immediate market, is often too much of a financial hazard for companies to risk. NASA, however, saw the need for electrical fibers in its many projects and sought

out a high-tech textile company that was already experimenting in this field, Syscom Technology, Inc., of Columbus, Ohio. Syscom was founded in 1993 to provide computer software engineering services and basic materials research in the areas of high-performance polymer fibers and films. In 1999, Syscom decided to focus its business and technical efforts on development of high-strength, high-performance, and electrically conductive polymer fibers. The company developed AmberStrand, an electrically conductive, low-weight, strong-yet-flexible hybrid metal-polymer YARN.
Author
*Electrical Resistivity; Textiles; Wiring; Conductors; Copper; Yarns*

**20070019311** Photon-X, Inc., Huntsville, AL, USA
**Spatial Phase Imaging**
Spinoff 2006; September 2006, pp. 106-107; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019311

Frequently, scientists grow crystals by dissolving a protein in a specific liquid solution, and then allowing that solution to evaporate. The methods used next have been, variously, invasive (adding a dye that is absorbed by the protein), destructive (crushing protein/salt-crystal mixtures and observing differences between the crushing of salt and protein), or costly and time-consuming (X-ray crystallography). In contrast to these methods, a new technology for monitoring protein growth, developed in part through NASA Small Business Innovation Research (SBIR) funding from Marshall Space Flight Center, is noninvasive, nondestructive, rapid, and more cost effective than X-ray analysis. The partner for this SBIR, Photon-X, Inc., of Huntsville, Alabama, developed spatial phase imaging technology that can monitor crystal growth in real time and in an automated mode. Spatial phase imaging scans for flaws quickly and produces a 3-D structured image of a crystal, showing volumetric growth analysis for future automated growth.
Derived from text
*Imaging Techniques; Crystallography; Defects; Crystal Growth; Proteins; Volumetric Analysis*

**20070019312** Clever Fellows Innovation Consortium, Inc., Melrose, NY, USA
**Cryogenic Cooling for Myriad Applications-A STAR Is Born**
Spinoff 2006; September 2006, pp. 92-93; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019312

Cryogenics, the science of generating extremely low temperatures, has wide applicability throughout NASA. The Agency employs cryogenics for rocket propulsion, high-pressure gas supply, breathable air in space, life support equipment, electricity, water, food preservation and packaging, medicine, imaging devices, and electronics. Cryogenic liquid oxygen and liquid hydrogen systems are also replacing solid rocket motor propulsion systems in most of the proposed launch systems, a reversion to old-style liquid propellants. In the late 1980s, NASA wanted a compact linear alternator/motor with reduced size and mass, as well as high efficiency, that had unlimited service life for use in a thermally driven power generator for space power applications. Prior development work with free-piston Stirling converters (a Stirling engine integrated with a linear actuator that produces electrical power output) had shown the promise of that technology for high-power space applications. A dual use for terrestrial applications exists for compact Stirling converters for onsite combined heat and power units. The Stirling cycle is also usable in reverse as a refrigeration cycle suitable for cryogenic cooling, so this Stirling converter work promised double benefits as well as dual uses. The uses for cryogenic coolers within NASA abound; commercial applications are similarly wide-ranging, from cooling liquid oxygen and nitrogen, to cryobiology and bio-storage, cryosurgery, instrument and detector cooling, semiconductor manufacturing, and support service for cooled superconducting power systems.
Derived from text
*Electric Generators; Cryogenics; Life Support Systems; Linear Alternators; Liquid Hydrogen; Oxygen Supply Equipment; Liquid Rocket Propellants; Low Temperature*

**20070019313** Integrinautics Corp., Menlo Park,CA, USA
**Saving Space and Time: The Tractor That Einstein Built**
Spinoff 2006; September 2006, pp. 78-79; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019313

In 1984, NASA initiated the Gravity Probe B (GP-B) program to test two unverified predictions of Albert Einstein s theory

of general relativity, hypotheses about the ways space, time, light, and gravity relate to each other. To test these predictions, the Space Agency and researchers at Stanford University developed an experiment that would check, with extreme precision, tiny changes in the spin direction of four gyroscopes contained in an Earth satellite orbiting at a 400-mile altitude directly over the Earth s poles. When the program first began, the researchers assessed using Global Positioning System (GPS) technology to control the attitude of the GP-B spacecraft accurately. At that time, the best GPS receivers could only provide accuracy to nearly 1 meter, but the GP-B spacecraft required a system 100 times more accurate. To address this concern, researchers at Stanford designed high-performance, attitude-determining hardware that used GPS signals, perfecting a high-precision form of GPS called Carrier-Phase Differential GPS that could provide continuous real-time position, velocity, time, and attitude sensor information for all axes of a vehicle. The researchers came to the realization that controlling the GP-B spacecraft with this new system was essentially no different than controlling an airplane. Their thinking took a new direction: If this technology proved successful, the airlines and the Federal Aviation Administration (FAA) were ready commercial markets. They set out to test the new technology, the 'Integrity Beacon Landing System,' using it to automatically land a commercial Boeing 737 over 100 times successfully through Real-Time Kinematic (RTK) GPS technology. The thinking of the researchers shifted again, from automatically landing aircraft, to automating precision farming and construction equipment.
Derived from text
*Attitude (Inclination); Relativity; Global Positioning System; Gravity Probe B; Earth Orbits; Spacecraft Control; Kinematics; Gyroscopes*

**20070019314** Dynamic Systems Integration, Inc., Virginia Beach, VA, USA
**NASA Helps Design the 'Cockpit of the Future'**
Spinoff 2006; September 2006, pp. 24-25; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019314

One of the initiatives at Langley involved the research and development of a Small Aircraft Transportation System Network (SATS-Net), which was the communications infrastructure for NASA s SATS program.The primary goal of SATS-Net was to develop secure virtual travel portals for the Nation s general aviation airports and to offer an alternative to commercial air and ground transportation through general aviation. The secondary goals were to increase mobility, reduce door-to- door travel times, and provide air transportation to underserved markets at an affordable cost. One of the specific plans was to create a network of information about the 2,000-plus non-tower, non-radar airports in the Nation. This information would be accessible from a person s home, office, PDA, or local airport. This network provides real-time information and would be a 'one-stop shop' portal with dynamic access to real-time Web cameras for weather conditions, flight planning information, local lodging, restaurants, and attraction information. SATS-Net would provide membership services much like that of AAA.
Derived from text
*General Aviation Aircraft; Air Transportation; Real Time Operation; Flight Plans; Airports; Transportation Networks*

**20070019315** Ciencia, Inc., East Hartford, CT, USA
**FLIPPER: Validation for Remote Ocean Imaging**
Spinoff 2006; September 2006, pp. 72-73; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019315

one of the determining factors in the planet s ability to support life is the same factor that makes the Blue Planet blue: water. Therefore, NASA researchers have a focused interest in understanding Earth s oceans and their ability to continue sustaining life. A critical objective in this study is to understand the global processes that control the changes of carbon and associated living elements in the oceans. Since oceans are so large, one of the most widely used methods of this research is remote sensing, using satellites to observe changes in the ocean color that may be indicative of changes occurring at the surface. Major changes in carbon are due to photosynthesis conducted by phytoplankton, showing, among other things, which areas are sustaining life. Although valuable for large-scale pictures of an ocean, remote sensing really only provides a surface, and therefore incomplete, depiction of that ocean s sustainability. True and complete testing of the water requires local testing in conjunction with the satellite images in order to generate the necessary algorithm parameters to calculate ocean health. For this reason, NASA has spearheaded research to provide onsite validation for its satellite imagery surveys.
Derived from text
*Oceans; Remote Sensing; Satellite Imagery; Imaging Techniques; Photosynthesis; Phytoplankton*

**20070019316** SpectraSensors, Inc., San Dimas, CA, USA
**Water Vapor Sensors Go Sky-High to Assure Aircraft Safety**
Spinoff 2006; September 2006, pp. 26-29; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019316

JPL used a special tunable diode laser, which NASA scientists could tune to different wavelengths, like a radio being tuned to different frequencies, to accurately target specific molecules and detect small traces of gas. This tunable diode laser was designed to emit near-infrared light at wavelengths absorbed by the gas or gases being detected. The light energy being absorbed by the target gas is related to the molecules present. This is usually measured in parts per million or parts per billion. Multiple measurements are made every second, making the system quick to respond to variations in the target gas. NASA scientists developed this technology as part of the 1999 Mars Polar Lander mission to explore the possibility of life-giving elements on Mars. NASA has since used the tunable diode laser-based gas sensor on aircraft and on balloons to successfully study weather and climate, global warming, emissions from aircraft, and numerous other areas where chemical gas analysis is needed. SpectraSensors, Inc., was formed in 1999 as a spinoff company of JPL, to commercialize tunable diode laser-based analyzers for industrial gas-sensing applications (Spinoff 2000). Now, the San Dimas, California-based firm has come back to the market with a new product featuring the NASA-developed instrument for atmospheric monitoring. This instrument is now helping aircraft avoid hazardous weather conditions and enabling the National Weather Service to provide more accurate weather forecasts.
Derived from text
*Gas Detectors; Water Vapor; Chemical Analysis; Diodes; Gas Analysis; Safety; Environmental Monitoring; Tunable Lasers*

**20070019317** Luxel Corp., Friday Harbor, WA, USA
**Robust, Thin Optical Films for Extreme Environments**
Spinoff 2006; September 2006, pp. 98; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019317

The environment of space presents scientists and engineers with the challenges of a harsh, unforgiving laboratory in which to conduct their scientific research. Solar astronomy and X-ray astronomy are two of the more challenging areas into which NASA scientists delve, as the optics for this high-tech work must be extremely sensitive and accurate, yet also be able to withstand the battering dished out by radiation, extreme temperature swings, and flying debris. Recent NASA work on this rugged equipment has led to the development of a strong, thin film for both space and laboratory use.
Author
*Thin Films; Optical Materials; X Ray Astronomy; Solar X-Rays; Debris*

**20070019318** Universal Remediation, Inc., Pittsburgh, PA, USA
**PRP: The Proven Solution for Cleaning Up Oil Spills**
Spinoff 2006; September 2006, pp. 66-67; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019318

The basic technology behind PRP is thousands of microcapsules, tiny balls of beeswax with hollow centers. Water cannot penetrate the microcapsule s cell, but oil is absorbed right into the beeswax spheres as they float on the water s surface. This way, the contaminants, chemical compounds that originally come from crude oil such as fuels, motor oils, or petroleum hydrocarbons, are caught before they settle. PRP works well as a loose powder for cleaning up contaminants in lakes and other ecologically fragile areas. The powder can be spread over a contaminated body of water or soil, and it will absorb contaminants, contain them in isolation, and dispose of them safely. In water, it is important that PRP floats and keeps the oil on the surface, because, even if oil exposure is not immediately lethal, it can cause long-term harm if allowed to settle. Bottom-dwelling fish exposed to compounds released after oil spills may develop liver disease, in addition to reproductive and growth problems. This use of PRP is especially effective for environmental cleanup in sensitive areas like coral reefs and mangroves.
Derived from text
*Oil Slicks; Powder (Particles); Environmental Cleanup; Contaminants; Disposal; Exposure; Hydrocarbons*

**20070019319** Ophir Corp., Littleton, CO, USA

**Advanced Air Data Systems for Commercial Aircraft**

Spinoff 2006; September 2006, pp. 22-23; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019319

It is possible to get a crude estimate of wind speed and direction while driving a car at night in the rain, with the motion of the raindrop reflections in the headlights providing clues about the wind. The clues are difficult to interpret, though, because of the relative motions of ground, car, air, and raindrops. More subtle interpretation is possible if the rain is replaced by fog, because the tiny droplets would follow the swirling currents of air around an illuminated object, like, for example, a walking pedestrian. Microscopic particles in the air (aerosols) are better for helping make assessments of the wind, and reflective air molecules are best of all, providing the most refined measurements. It takes a bright light to penetrate fog, so it is easy to understand how other factors, like replacing the headlights with the intensity of a searchlight, can be advantageous. This is the basic principle behind a lidar system. While a radar system transmits a pulse of radiofrequency energy and interprets the received reflections, a lidar system works in a similar fashion, substituting a near-optical laser pulse. The technique allows the measurement of relative positions and velocities between the transmitter and the air, which allows measurements of relative wind and of air temperature (because temperature is associated with high-frequency random motions on a molecular level). NASA, as well as the National Oceanic and Atmospheric Administration (NOAA), have interests in this advanced lidar technology, as much of their explorative research requires the ability to measure winds and turbulent regions within the atmosphere. Lidar also shows promise for providing warning of turbulent regions within the National Airspace System to allow commercial aircraft to avoid encounters with turbulence and thereby increase the safety of the traveling public. Both agencies currently employ lidar and optical sensing for a variety of weather-related research projects, such as analyzing the water content of snow and forecasting lightning.

Derived from text

*Commercial Aircraft; Air Data Systems; National Airspace System; Wind Velocity; Temperature Measurement; Turbulence; Raindrops; Optical Radar; Moisture Content*

**20070019320** Laser Techniques Company, LLC, Bellevue, WA, USA

**Laser Mapping for Visual Inspection and Measurement**

Spinoff 2006; September 2006, pp. 102-103; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019320

Each space shuttle orbiter has 38 Primary Reaction Control System (PRCS) thrusters to help power and position the vehicle for maneuvers in space, including reentry and establishing Earth orbit. Minor flaws in the ceramic lining of a thruster, such as a chip or crack, can cripple the operations of an orbiter in space and jeopardize a mission. The ability to locate, measure, and monitor tiny features in difficult-to-inspect PRCS thrusters improves their overall safety and lifespan. These thrusters have to be detached and visually inspected in great detail at one of two NASA facilities, the White Sands Test Facility or the Kennedy Space Center, before and after each mission, which is an expense of both time and money.

Author

*Lasers; Mapping; Space Shuttle Orbiters; Thrustors; Earth Orbits; Inspection; Chips; Cracks; Ceramics*

**20070019321** Systems and Processes Engineering Corp., Austin, TX, USA

**Temperature Sensing for Oil, Gas, and Structural Analysis**

Spinoff 2006; September 2006, pp. 94-97; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019321

In 1996, Systems and Processes Engineering Corporation (SPEC), of Austin, Texas, undertook a NASA Small Business Innovation Research (SBIR) contract with Langley Research Center to develop a compact and lightweight digital thermal sensing (DTS) system for monitoring the cryogenic tanks on the X-33 prototype aircraft. That technology, along with a processor developed by SPEC for Goddard Space Flight Center, was space-qualified and integrated into several NASA missions. SPEC formed an ancillary organization, SensorTran, Inc., to continue work developing the DTS technology for a variety of commercial and industrial applications.

Derived from text

*X-33 Reusable Launch Vehicle; Temperature Sensors; Cryogenics; Gas Analysis; Oils; Structural Analysis; Detection; NASA Programs*

**20070019322** GCS Research, LLC, Missoula, MT, USA

**Modern Exploration of the Lewis and Clark Expedition**

Spinoff 2006; September 2006, pp. 56-59; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019322

The Lewis and Clark Geosystem is an online collection of private, state, local, and Federal data resources associated with the geography of the Lewis and Clark Expedition. Data were compiled from key partners including NASA s Stennis Space Center, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the U.S. Geological Survey (USGS), the University of Montana, the U.S. Department of Agriculture Forest Service, and from a collection of Lewis and Clark scholars. It combines modern views of the landscape with historical aerial photography, cartography, and other geographical data resources and historical sources, including: The Journals of the Lewis and Clark Expedition, the Academy of Natural Science's Lewis and Clark Herbarium, high-resolution copies of the American Philosophical Society s primary-source Lewis and Clark Journals, The Library of Congress Lewis and Clark cartography collection, as well as artifacts from the Smithsonian Institution and other sources.

Derived from text

*Geological Surveys; Topography; Aerial Photography; Expeditions; Geography; Terrain; Forests*

**20070019323** Human Technologies, Inc., Saint Petersburg, FL, USA

**Ingestible Thermometer Pill Aids Athletes in Beating the Heat**

Spinoff 2006; September 2006, pp. 10-13; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019323

Developed by Goddard Space Flight Center and the Johns Hopkins University Applied Physics Laboratory to monitor the core body temperature of astronauts during space flight, the ingestible 'thermometer pill' has a silicone-coated exterior, with a microbattery, a quartz crystal temperature sensor, a space-aged telemetry system, and microminiaturized circuitry on the interior.

Derived from text

*Temperature Sensors; Microminiaturization; Astronauts; Athletes; Circuits; Silicones; Body Temperature*

**20070019324** Imaging Systems Technology, Inc., Toledo, OH, USA

**Microspheres in Plasma Display Panels**

Spinoff 2006; September 2006, pp. 48-49; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019324

Filling small bubbles of molten glass with gases is just as difficult as it sounds, but the technical staff at NASA is not known to shy away from a difficult task. When Microsphere Systems, Inc. (MSI), of Ypsilanti, Michigan, and Imaging Systems Technology, Inc. (IST), of Toledo, Ohio, were trying to push the limits of plasma displays but were having difficulty with the designs, NASA s Glenn Garrett Morgan Commercialization Initiative (GMCI) assembled key personnel at Glenn Research Center and Ohio State University for a brainstorming session to come up with a solution for the companies. They needed a system that could produce hollow, glass micro-sized spheres (microspheres) that could be filled with a variety of gasses. But the extremely high temperature required to force the micro-sized glass bubbles to form at the tip of a metal nozzle resulted in severe discoloration of the microspheres. After countless experiments on various glass-metal combinations, they had turned to the GMCI for help. NASA experts in advanced metals, ceramics, and glass concluded that a new design approach was necessary. The team determined that what was needed was a phosphate glass composition that would remain transparent, and they went to work on a solution. Six weeks later, using the design tips from the NASA team, Tim Henderson, president of MSI, had designed a new system in which all surfaces in contact with the molten glass would be ceramic instead of metal. Meanwhile, IST was able to complete a Phase I Small Business Innovation Research (SBIR) grant supported by the National Science Foundation (NSF) and supply a potential customer with samples of the microspheres for evaluation as filler materials for high-performance insulations.

Derived from text

*Plasma Bubbles; Microparticles; Imaging Techniques; Display Devices; Bubbles; High Temperature; Transparence*

**20070019325** Water Security Corporation, Inc., Sparks, NV, USA

**Clean Water for Remote Locations**

Spinoff 2006; September 2006, pp. 30-31; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019325

Marshall Space Flight Center engineers are working on creating the Regenerative Environmental Control and Life Support System, a complex system of devices intended to sustain the astronauts living on the ISS and, in the future, sustain those who are blasting off to the Moon or Mars. The devices make use of the available resources, by turning wastewater from respiration, sweat, and urine into drinkable water. One of the devices that Marshall has been working on is the Water Recovery System (WRS). Marshall has teamed with long-time NASA contractor, Hamilton Sundstrand Space Systems International, Inc., of Windsor Locks, Connecticut. Hamilton Sundstrand, the original designer of the life support devices for the space suits, developed the Water Processor Assembly (WPA). It, along with the Urine Processor Assembly (UPA) developed by Marshall, combines to make up the total system, which is about the size of two refrigerators, and will support up to a six-member crew. The system is currently undergoing final testing and verification. 'The Water Processor Assembly can produce up to about 28 gallons of potable recycled water each day,' said Bob Bagdigian, Marshall Regenerative Environmental Control and Life Support System project manager. After the new systems are installed, annual delivered water to the ISS should decrease by approximately 15,960 pounds, or about 1,600 gallons.

Derived from text

*Water Reclamation; Potable Water; Environmental Control; Life Support Systems; Aerospace Systems; Complex Systems; Systems Management; Waste Water*

**20070019326** INVOCON, Conroe, TX, USA

**Miniature Wireless Sensors Size Up to Big Applications**

Spinoff 2006; September 2006, pp. 108-109; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019326

Like the environment of space, the undersea world is a hostile, alien place for humans to live. But far beneath the waves near Key Largo, Florida, an underwater laboratory called Aquarius provides a safe harbor for scientists to live and work for weeks at a time. Aquarius is the only undersea laboratory in the world. It is owned by the National Oceanic and Atmospheric Administration (NOAA), administered by NOAA s National Undersea Research Program, and operated by the National Undersea Research Center at the University of North Carolina at Wilmington. Aquarius was first deployed in underwater operations in 1988 and has since hosted more than 200 scientists representing more than 90 organizations from around the world. For NASA, Aquarius provides an environment that is analogous to the International Space Station (ISS) and the space shuttle. As part of its NASA Extreme Environment Mission Operations (NEEMO) program, the Agency sends personnel to live in the underwater laboratory for up to 2 weeks at a time, some of whom are crew members or 'aquanauts' who are subjected to the same tasks and challenges underwater that they would face in space. In fact, many participants have found the deep-sea diving experience to be much akin to spacewalking. To maintain Aquarius, the ISS, and the space shuttle as safe, healthy living/research habitats for its personnel, while keeping costs in mind, NASA, in 1997, recruited the help of Conroe, Texas-based Invocon, Inc., to develop wireless sensor technology that monitors and measures various environmental and structural parameters inside these facilities.

Derived from text

*NASA Programs; Habitats; Diving (Underwater); Miniaturization; Flight Crews; Deployment; Monitors; Structural Design*

**20070019327** Aeroponics International, Berthoud, CO, USA

**Progressive Plant Growing Has Business Blooming**

Spinoff 2006; September 2006, pp. 68-71; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019327

In 1997, AgriHouse, Inc. (d.b.a. Aeroponics International), a leading agri-biology company, united with NASA and BioServe Space Technologies, a nonprofit, NASA-sponsored partnership research center, to design a soil-less plant-growth experiment to be performed in microgravity, aboard the Mir space station. This experiment aimed to gauge the effectiveness of a non-pesticide solution on the immune responses of bean plants. In essence, the research consortium was looking for a means of keeping plants free from infection, without having to rely on the use of pesticides. This research, combined with follow-on grants from NASA, has helped Berthoud, Colorado-based AgriHouse gain credibility in the commercial

marketplace with related technology and gross the capital necessary to conduct further research in a new-age field known as bio-pharming.
Derived from text
*Vegetation Growth; Microgravity; Leguminous Plants; Aerospace Engineering; Soils; Mir Space Station; Immunity*

**20070019328** GoldSim Technology Group, LLC, Issaquah, WA, USA
**Difficult Decisions Made Easier**
Spinoff 2006; September 2006, pp. 84-85; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019328

NASA missions are extremely complex and prone to sudden, catastrophic failure if equipment falters or if an unforeseen event occurs. For these reasons, NASA trains to expect the unexpected. It tests its equipment and systems in extreme conditions, and it develops risk-analysis tests to foresee any possible problems. The Space Agency recently worked with an industry partner to develop reliability analysis software capable of modeling complex, highly dynamic systems, taking into account variations in input parameters and the evolution of the system over the course of a mission. The goal of this research was multifold. It included performance and risk analyses of complex, multiphase missions, like the insertion of the Mars Reconnaissance Orbiter; reliability analyses of systems with redundant and/or repairable components; optimization analyses of system configurations with respect to cost and reliability; and sensitivity analyses to identify optimal areas for uncertainty reduction or performance enhancement.
Derived from text
*NASA Programs; Mars Reconnaissance Orbiter; Complex Systems; Systems Engineering; Sensitivity Analysis; Reliability Analysis*

**20070019329** WorldSource, Inc., Palm Desert, CA, USA
**Preventing Ice Before it Forms**
Spinoff 2006; September 2006, pp. 46-47; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019329

In the late 1990s, a team of engineers at Ames Research Center invented an anti-icing fluid to keep ice from building up on airplane wings. Ice on wings can be a serious safety hazard, especially during takeoff, when a sheet of ice the thickness of a compact disc can reduce lift by 25 percent or more. The typical approach to clearing off the ice is to use a deicing solution once the ice has built up. The fluid created by the Ames team, though, when applied to a dry surface, prevents the ice from even forming a surface bond, which saves deicing time and money, while also preventing excessive use of chemical solvents. If, however, the solution is not applied before ice forms, it also serves as a traditional deicing formula. The formula contains propylene glycol, which has a very low freezing point, and a thickener, which helps the fluid adhere to the surface. Ice gathers on top of the formula, and then it can be wiped off with little effort. This thickening agent, a pseudo-plastic, sprays on as a liquid, like lemonade, gels like a lemon sherbet, turns back to a liquid when wiped, and then gels again into its sherbet consistency when left to solidify. The sherbet-gel stage is especially important when the formula is sprayed onto a vertical or steeped surface, as it clings better than a liquid would.
Derived from text
*Ice Prevention; Glycols; Deicing; Melting Points; Safety; Gels*

**20070019330** Pearson Blueprint Technologies, Inc., Arlington, VA, USA
**The Echoes of Earth Science**
Spinoff 2006; September 2006, pp. 86-87; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019330

NASA s Earth Observing System Data and Information System (EOSDIS) acquires, archives, and manages data from all of NASA s Earth science satellites, for the benefit of the Space Agency and for the benefit of others, including local governments, first responders, the commercial remote sensing industry, teachers, museums, and the general public. EOSDIS is currently handling an extraordinary amount of NASA scientific data. To give an idea of the volume of information it receives, NASA s Terra Earth-observing satellite, just one of many NASA satellites sending down data, sends it hundreds of gigabytes a day, almost as much data as the Hubble Space Telescope acquires in an entire year, or about equal to the amount

of information that could be found in hundreds of pickup trucks filled with books. To make EOSDIS data completely accessible to the Earth science community, NASA teamed up with private industry in 2000 to develop an Earth science 'marketplace' registry that lets public users quickly drill down to the exact information they need. It also enables them to publish their research and resources alongside of NASA s research and resources. This registry is known as the Earth Observing System ClearingHOuse, or ECHO. The charter for this project focused on having an infrastructure completely independent from EOSDIS that would allow for more contributors and open up additional data access options. Accordingly, it is only fitting that the term ECHO is more than just an acronym; it represents the functionality of the system in that it can echo out and create interoperability among other systems, all while maturing with time as industry technologies and standards change and improve.
Derived from text
*Earth Sciences; Earth Observing System (EOS); EOS Data and Information System; Interoperability; Data Systems*

**20070019331** Vision Videogames, LLC, Towson, MD, USA
**Affordable Space Tourism: SpaceStationSim**
Spinoff 2006; September 2006, pp. 44-45; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019331

For over 5 years, people have been living and working in space on the International Space Station (ISS), a state-of-the-art laboratory complex orbiting high above the Earth. Offering a large, sustained microgravity environment that cannot be duplicated on Earth, the ISS furthers humankind s knowledge of science and how the body functions for extended periods of time in space all of which will prove vital on long-duration missions to Mars. On-orbit construction of the station began in November 1998, with the launch of the Russian Zarya Control Module, which provided battery power and fuel storage. This module was followed by additional components and supplies over the course of several months. In November 2000, the first ISS Expedition crew moved in. Since then, the ISS has continued to change and evolve. The space station is currently 240 feet wide, measured across the solar arrays, and 171 feet long, from the NASA Destiny Laboratory to the Russian Zvezda Habitation Module. It is 90 feet tall, and it weighs approximately 404,000 pounds. Crews inhabit a living space of about 15,000 cubic feet. To date, 90 scientific investigations have been conducted on the space station. New results from space station research, from basic science to exploration research, are being published each month, and more breakthroughs are likely to come. It is not all work on the space station, though. The orbiting home affords many of the comforts one finds on Earth. There is a weightless 'weight room' and even a musical keyboard alongside research facilities. Holidays are observed, and with them, traditional foods such as turkey and cobbler are eaten, with lemonade to wash them down
Author
*International Space Station; Destiny Laboratory Module; Microgravity; Research Facilities; Solar Arrays; Spacecrews*

**20070019332** Alertness Solutions, Inc., Cupertino, CA, USA
**Feeling Well Rested and Wide Awake When it Counts**
Spinoff 2006; September 2006, pp. 34-37; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019332

Responding to a congressional concern about aviation safety, NASA's Ames Research Center created the Ames Fatigue/Jet Lag Program in 1980 to examine the extent to which fatigue, sleep loss, and circadian disruption affect pilot performance. The program s primary research was conducted in field settings, as well as in a variety of aviation, controlled laboratory, and full-mission flight-simulation environments, to study fatigue factors and circadian disruption in short-haul, long-haul, military, cargo, and helicopter operations. In 1990, NASA changed the program s name to the Fatigue Countermeasures Group, to provide a greater emphasis on the development and evaluation of countermeasures that would mitigate the adverse effects of fatigue and maximize flight crew performance and alertness. The research conducted by this group at Ames included field studies of cockpit rest, quantity and quality of onboard sleep, and performance changes associated with long-haul flights.
Author
*Pilot Performance; Flight Crews; Human Performance; Alertness; Aircraft Safety; Flight Simulation; Jet Lag; Sensory Feedback; Flight Control*

**20070019333** KeyMaster Technologies, Inc., Kennewick, WA, USA

**X-ray Device Makes Scrubbing Rugs Clean a Spotless Effort**

Spinoff 2006; September 2006, pp. 38-41; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019333

If 'pulling the rug out from under' means suddenly withdrawing support and assistance, then NASA is pretty good at 'putting the rug under' when it comes to offering technical support and assistance to private industry. In the case of a new X-ray fluorescence (XRF) sensor featuring enhancements compliments of NASA, the Space Agency not only provided the rug, but helped give private industry a means to ensure it keeps clean. This sensor, utilized by NASA to read chemical bar codes concealed by paint and other coatings, perform on-the-spot chemical analyses in field conditions, and detect difficult-to-identify contaminants, has found another use as a tool that can measure how much soil is removed from household and commercial carpets. The original technology was developed in 2002 to conduct quality control for critical aluminum alloy parts destined for the space shuttle. Evaluation of these parts is critical for the Space Agency, as any signs of contamination, corrosion, or material deviation could compromise a shuttle mission.

Author

*X Ray Fluorescence; Quality Control; Chemical Analysis; Contamination; Corrosion; Coding; Soils*

**20070019334** Iowa Thin Film Technologies, Inc., Ames, IA, USA

**Paper-Thin Plastic Film Soaks Up Sun to Create Solar Energy**

Spinoff 2006; September 2006, pp. 74-77; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019334

A non-crystallized silicon known as amorphous silicon is the semiconductor material most frequently chosen for deposition, because it is a strong absorber of light. According to the U.S. Department of Energy, amorphous silicon absorbs solar radiation 40 times more efficiently than single-crystal silicon, and a thin film only about 1-micrometer (one one-millionth of a meter) thick containing amorphous silicon can absorb 90 percent of the usable light energy shining on it. Peak efficiency and significant reduction in the use of semiconductor and thin film materials translate directly into time and money savings for manufacturers. Thanks in part to NASA, thin film solar cells derived from amorphous silicon are gaining more and more attention in a market that has otherwise been dominated by mono- and poly-crystalline silicon cells for years. At Glenn Research Center, the Photovoltaic & Space Environments Branch conducts research focused on developing this type of thin film solar cell for space applications. Placing solar cells on thin film materials provides NASA with an attractively priced solution to fabricating other types of solar cells, given that thin film solar cells require significantly less semiconductor material to generate power. Using the super-lightweight solar materials also affords NASA the opportunity to cut down on payload weight during vehicle launches, as well as the weight of spacecraft being sent into orbit.

Derived from text

*Semiconductors (Materials); Solar Cells; Amorphous Silicon; Solar Energy Conversion; Silicon Films; Polymeric Films; Phase Change Materials; Crystallization*

**20070019335** Eagle Eye Optics, Beverley, UK

**Look Sharp While Seeing Sharp**

Spinoff 2006; September 2006, pp. 50-51; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070019335

The two scientists James B. Stephens and Dr. Charles G. Miller were tasked with studying the harmful properties of light in space, as well as the artificial radiation produced during laser and welding work, for the purpose of creating an enhanced means of eye protection in industrial welding applications. While working to apply their space research to these terrestrial applications, Stephens and Miller became engrossed with previously discovered research showing evidence that the eyes of hawks, eagles, and other birds of prey contain unique oil droplets that actually protect them from intensely radiated light rays (blue, violet, ultraviolet) while allowing vision-enhancing light rays (red, orange, green) to pass through. These oil droplets absorb short wavelength light rays which, in turn, reduce glare and provide heightened color contrast and definition for optimal visual acuity. Accordingly, birds of prey possess the ability to distinguish their targeted prey in natural surroundings and from great distances. Pairing the findings from their initial studies with what they learned from the bird studies, the scientists devised a methodology to incorporate the light-filtering/vision-enhancing dual-action benefits into a filtering system, using

light-filtering dyes and tiny particles of zinc oxide. (Zinc oxide, which absorbs ultraviolet light, is also found in sunscreen lotions that protect the skin from sunburn.)
Derived from text
*Eye Protection; Laser Welding; Ultraviolet Radiation; Visual Acuity; Dyes; Glare*

**20070019336** International Paint, LLC, Houston, TX, USA
**Fire-Resistant Reinforcement Makes Steel Structures Sturdier**
Spinoff 2006; September 2006, pp. 32-33; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019336

Built and designed by Avco Corporation, the Apollo heat shield was coated with an ablative material whose purpose was to burn and, thus, dissipate energy. The material charred to form a protective coating which blocked heat penetration beyond the outer surface. Avco Corporation subsequently entered into a contract with Ames Research Center to develop spinoff applications of the heat shield in the arena of fire protection, specifically for the development of fire-retardant paints and foams for aircraft. This experience led to the production of Chartek 59, manufactured by Avco Specialty Materials (a subsidiary of Avco Corporation eventually acquired by Textron, Inc.) and marketed as the world s first intumescent epoxy material. As an intumescent coating, Chartek 59 expanded in volume when exposed to heat or flames and acted as an insulating barrier. It also retained its space-age ablative properties and dissipated heat through burn-off. Further applications were discovered, and the fireproofing formulation found its way into oil refineries, chemical plants, and other industrial facilities working with highly flammable products.
Derived from text
*Reinforcement (Structures); Steel Structures; Heat Shielding; Protective Coatings; Ablative Materials; Fireproofing; Flame Retardants; Insulation*

**20070019337** The Relief Globe Company, Boulder Creek, CA, USA
**Raised Relief Mars Globe Brings the Red Planet Closer**
Spinoff 2006; September 2006, pp. 52-55; In English; See also 20070019299; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019337

The Mars Globe 20x is the first digitally produced raised relief globe to be sold at retail establishments. The rises and dips of the Martian landscape have been multiplied by 20 to make the shapes more noticeable to human touch and sight. They make this globe, with its over 1 million elevation points, a visually stunning introduction to the planet. Spectrum 3D used the NASA digital land elevation data to aim lasers that then shaped and defined the master globe s surface. Subsequent copies were then made by creating a master globe mold. The molded copies are hand finished by workers who remove errant edges or lines that may appear on the raw globes and then paint the surfaces. The result is a globe that measures in at 18 inches in diameter, roughly 1:15,729,473 scale of the actual planet. The exaggerated raised relief is like having a 3-D digital microscope for planetary shapes. This makes the landmarks easier to learn and understand, as it provides easy visuals for orientation. People have a natural propensity for understanding 3-D shapes more easily than numbers or words. The 3-D globes appeal to both the kinetic and visual learning aspects of the brain, making it easy for people to readily memorize the landmarks and to make a mental model that they will remember for a long time.
Derived from text
*Visual Perception; Mars (Planet); Elevation; Terrain; Digital Data*

**20070019338** Stottler Henke Associates, Inc., San Mateo, CA, USA
**Scheduling Software for Complex Scenarios**
Spinoff 2006; September 2006, pp. 82-83; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019338

Preparing a vehicle and its payload for a single launch is a complex process that involves thousands of operations. Because the equipment and facilities required to carry out these operations are extremely expensive and limited in number, optimal assignment and efficient use are critically important. Overlapping missions that compete for the same resources, ground rules, safety requirements, and the unique needs of processing vehicles and payloads destined for space impose numerous constraints that, when combined, require advanced scheduling. Traditional scheduling systems use simple

algorithms and criteria when selecting activities and assigning resources and times to each activity. Schedules generated by these simple decision rules are, however, frequently far from optimal. To resolve mission-critical scheduling issues and predict possible problem areas, NASA historically relied upon expert human schedulers who used their judgment and experience to determine where things should happen, whether they will happen on time, and whether the requested resources are truly necessary.
Derived from text
*Software Engineering; Scheduling; Launching; Payloads*

**20070019339** Integrated Software Metrics, Inc., Fairmont, WV, USA
**A Predictive Approach to Eliminating Errors in Software Code**
Spinoff 2006; September 2006, pp. 80-81; In English; See also 20070019299; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019339

NASA s Metrics Data Program Data Repository is a database that stores problem, product, and metrics data. The primary goal of this data repository is to provide project data to the software community. In doing so, the Metrics Data Program collects artifacts from a large NASA dataset, generates metrics on the artifacts, and then generates reports that are made available to the public at no cost. The data that are made available to general users have been sanitized and authorized for publication through the Metrics Data Program Web site by officials representing the projects from which the data originated. The data repository is operated by NASA s Independent Verification and Validation (IV&V) Facility, which is located in Fairmont, West Virginia, a high-tech hub for emerging innovation in the Mountain State. The IV&V Facility was founded in 1993, under the NASA Office of Safety and Mission Assurance, as a direct result of recommendations made by the National Research Council and the Report of the Presidential Commission on the Space Shuttle Challenger Accident. Today, under the direction of Goddard Space Flight Center, the IV&V Facility continues its mission to provide the highest achievable levels of safety and cost-effectiveness for mission-critical software. By extending its data to public users, the facility has helped improve the safety, reliability, and quality of complex software systems throughout private industry and other government agencies. Integrated Software Metrics, Inc., is one of the organizations that has benefited from studying the metrics data. As a result, the company has evolved into a leading developer of innovative software-error prediction tools that help organizations deliver better software, on time and on budget.
Derived from text
*Software Engineering; Errors; Data Bases; Complex Systems; Reliability; Predictions*

## 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*.

**20070018750** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Summary of NASA Advanced Telescope and Observatory Capability Roadmap**
Stahl, H. Philip; Feinberg, Lee; [2007]; 12 pp.; In English; 2007 IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018750

The NASA Advanced Telescope and Observatory (ATO) Capability Roadmap addresses technologies necessary for NASA to enable future space telescopes and observatories operating in all electromagnetic bands, from x-rays to millimeter waves, and including gravity-waves. It lists capability priorities derived from current and developing Space Missions Directorate (SMD) strategic roadmaps. Technology topics include optics; wavefront sensing and control and interferometry; distributed and advanced spacecraft systems; cryogenic and thermal control systems; large precision structure for observatories; and the infrastructure essential to future space telescopes and observatories.
Author
*Spaceborne Telescopes; Observatories; X Rays; Millimeter Waves; Gravity Waves; Cryogenics; Space Missions*

**20070018783** California Inst. of Tech., Pasadena, CA, USA, Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Interaction Between Eddies and Mean Flow in Jupiter's Atmosphere: Analysis of Cassini Imaging Data**

Salyk, Colette; Ingersoll, Andrew P.; Lorre, Jean; Vasavada, Ashwin; DelGenio, Anthony D.; Icarus; 2006; ISSN 0019-1035; Volume 185, pp. 430-442; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-13238; Copyright; Avail.: Other Sources

ONLINE: http://dx.doi.org/10.1016/j.icarus.2006.08.007

Beebe et al. [Beebe, R.F., et al., 1980. Geophys. Res. Lett. 17, 1-4] and Ingersoll et al. [Ingersoll, A.P., et al., 1981. J. Geophys. Res. 86, 8733-8743] used images from Voyagers 1 and 2 to analyze the interaction between zonal winds and eddies in Jupiter's atmosphere. They reported a high positive correlation between Jupiter's eddy momentum flux, pu'v', and the variation of zonal velocity with latitude, du/dy. This correlation implied a surprisingly high rate of conversion of energy from eddies to zonal flow: approx. 1.5-3.0 W/sq m, a value more than 10% of Jupiter s thermal flux emission. However, Sromovsky et al. [Sromovsky, L.A., et al., 1982. J. Atmos. Sci. 39,1413-1432] argued that possible biases in the analysis could have caused an artificially high correlation. In addition, significant differences in the derived eddy flux between datasets put into question the robustness of any one result. We return to this long-standing puzzle using images of Jupiter from the Cassini flyby of December 2000. Our method is similar to previous analyses, but utilizes an automatic feature tracker instead of the human eye. The number of velocity vectors used in this analysis is over 200,000, compared to the 14,000 vectors used by Ingersoll et al. We also find a positive correlation between u'v' and du/dy and derive a global average power per unit mass, u'v' du/dy, ranging from (7.1-12.3) x 10(exp -5)W/kg. Utilizing Ingersoll et al.'s estimate of the mass per unit area involved in the transport, this would imply a rate of energy conversion of approx.0.7-1.2 W/sq m. We discuss the implications of this result and employ several tests to demonstrate its robustness.

Author

*Jupiter Atmosphere; Vortices; Voyager 1 Spacecraft; Voyager 2 Spacecraft; Tracking (Position); Energy Conversion; Imaging Techniques; Turbulent Diffusion*

**20070018784** California Inst. of Tech., Pasadena, CA, USA

**Interaction of Moist Convection with Zonal Jets on Jupiter and Saturn**

Li, Liming; Ingersoll, Andrew P.; Huang, Xianglei; Icarus; 2006; ISSN 0019-1035; Volume 180, pp. 113-123; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-13238; Copyright; Avail.: Other Sources

ONLINE: http://dx.doi.org/10.1016/j.icarus.2005.08.016

Observations suggest that moist convection plays an important role in the large-scale dynamics of Jupiter s and Saturn s atmospheres. Here we use a reduced-gravity quasigeostrophic model, with a parameterization of moist convection that is based on observations, to study the interaction between moist convection and zonal jets on Jupiter and Saturn. Stable jets with approximately the same width and strength as observations are generated in the model. The observed zonal jets violate the barotropic stability criterion but the modeled jets do so only if the flow in the deep underlying layer is westward. The model results suggest that a length scale and a velocity scale associated with moist convection control the width and strength of the jets. The length scale and velocity scale offer a possible explanation of why the jets of Saturn are stronger and wider than those of Jupiter.

Author

*Convection; Jupiter (Planet); Saturn (Planet); Microgravity; Jet Control; Atmospheric Models*

**20070018785** California Inst. of Tech., Pasadena, CA, USA

**Liquid Water Oceans in Ice Giants**

Wiktorowicz, Sloane J.; Ingersoll, Andrew P.; Icarus; 2007; ISSN 0019-1035; Volume 186, pp. 436-447; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAG5-13238; Copyright; Avail.: Other Sources

ONLINE: http://dx.doi.org/10.1016/j.icarus.2006.09.003

Aptly named, ice giants such as Uranus and Neptune contain significant amounts of water. While this water cannot be present near the cloud tops, it must be abundant in the deep interior. We investigate the likelihood of a liquid water ocean existing in the hydrogen-rich region between the cloud tops and deep interior. Starting from an assumed temperature at a given upper tropospheric pressure (the photosphere), we follow a moist adiabat downward. The mixing ratio of water to hydrogen in the gas phase is small in the photosphere and increases with depth. The mixing ratio in the condensed phase is near unity in the photosphere and decreases with depth; this gives two possible outcomes. If at some pressure level the mixing ratio of

water in the gas phase is equal to that in the deep interior, then that level is the cloud base. The gas below the cloud base has constant mixing ratio. Alternately, if the mixing ratio of water in the condensed phase reaches that in the deep interior, then the surface of a liquid ocean will occur. Below this ocean surface, the mixing ratio of water will be constant. A cloud base occurs when the photospheric temperature is high. For a family of ice giants with different photospheric temperatures, the cooler ice giants will have warmer cloud bases. For an ice giant with a cool enough photospheric temperature, the cloud base will exist at the critical temperature. For still cooler ice giants, ocean surfaces will result. A high mixing ratio of water in the deep interior favors a liquid ocean. We find that Neptune is both too warm (photospheric temperature too high) and too dry (mixing ratio of water in the deep interior too low) for liquid oceans to exist at present. To have a liquid ocean, Neptune s deep interior water to gas ratio would have to be higher than current models allow, and the density at 19 kbar would have to be approx. equal to 0.8 g/cu cm. Such a high density is inconsistent with gravitational data obtained during the Voyager flyby. In our model, Neptune s water cloud base occurs around 660 K and 11 kbar, and the density there is consistent with Voyager gravitational data. As Neptune cools, the probability of a liquid ocean increases. Extrasolar 'hot Neptunes,' which presumably migrate inward toward their parent stars, cannot harbor liquid water oceans unless they have lost almost all of the hydrogen and helium from their deep interiors.
Author
*Uranus (Planet); Neptune (Planet); Mixing Ratios; Hydrogen; Water; Temperature Ratio; Ice; Ocean Surface; Stellar Temperature; Critical Temperature*

**20070019675** NASA Johnson Space Center, Houston, TX, USA
**An Experimental Approach to Understanding the Optical Effects of Space Weathering**
Noble, Sarah K.; Keller, Lindsay P.; Pieters, Carle M.; [2007]; 51 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NGT9-66; NAG5-11763; NAG5-13609; RTOP 344-31-40-07; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070019675

The creation and accumulation of nanophase iron (npFe(sup 0)) is the primary mechanism by which spectra of materials exposed to the space environment incur systematic changes referred to as 'space weathering.' The optical effects of this npFe(sup 0) on lunar soils are well documented. Space weathering though, should occur on the surface of any planetary body that is not protected by an atmosphere. There is no reason to assume that cumulative space weathering products throughout the solar system will be the same as those found in lunar soils. In fact, these products are likely to be very dependent on the specific environmental conditions under which they were produced. We have prepared a suite of analog soils to explore the optical effects of npFe(sup 0). By varying the size and concentration of npFe(sup 0) in the analogs we found significant systematic changes in the Vis/NIR spectral properties of the materials. Smaller npFe(sup 0) (\h10 nm in diameter) dramatically reddens spectra in the visible wavelengths while leaving the infrared region largely unaffected. Larger npFe(sup 0) (\g40 nm in diameter) lowers the albedo across the Vis/NIR range with little change in the overall shape of the continuum. Intermediate npFe(sup 0) sizes impact the spectra in a distinct pattern that changes with concentration. The products of these controlled experiments have implications for space-weathered material throughout the inner solar system. Our results indicate that the lunar soil continuum is best modeled by npFe(sup 0) particles with bulk properties in the approx.15-25 nm size range. Larger npFe0 grains result in spectra that are similar in shape to the Mercury continuum. The continuum of S-type asteroid spectra appear to be best represented by small amounts of npFe(sup 0) that is similar to, but slightly smaller on average, than the npFe(sup 0) in lunar soils (approx.10-15 nm).
Author
*Space Weathering; Iron; Aerospace Environments; Optical Properties*

## 89
## ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

**20070018760** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**The Energy-Dependent X-Ray Timing Characteristics of the Narrow Line Seyfert 1 MKN 766**
Markowitz, A.; Papadakis, I.; Arevalo, P.; Turner, T. J.; Miller, L.; Reeves, J. N.; [2007]; 18 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

We present the energy-dependent power spectral density (PSD) and cross-spectral properties of Mkn 766, obtained from combining data obtained during an XMM-Newton observation spanning six revolutions in 2005 with data obtained from an XMM-Newton long-look in 2001. The PSD shapes and rms-flux relations are found to be consistent between the 2001 and 2005 observations, suggesting the 2005 observation is simply a low-flux extension of the 2001 observation and permitting us to combine the two data sets. The resulting PSD has the highest temporal frequency resolution for any AGN PSD measured to date. Applying a broken power-law model yields break frequencies which increase in temporal frequency with photon energy. Obtaining a good fit when assuming energy-independent break frequencies requires the presence of a Lorentzian at 4.6 +/- 0.4 x 10(exp -4)Hz whose strength increases with photon energy, a behavior seen in black hole X-ray binaries. The cross-spectral properties are measured; temporal frequency-dependent soft-to-hard time lags are detected in this object for the first time. Cross-spectral results are consistent with those for other accreting black hole systems. The results are discussed in the context of several variability models, including those based on inwardly-propagating viscosity variations in the accretion disk.
Author
*X Ray Binaries; Time Lag; Black Holes (Astronomy); Accretion Disks; Temporal Resolution; X Ray Sources*

**20070018762** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**The Role of Evolutionary Age and Metallicity in the Formation of Classical BE Circumstellar Disks II. Assessing the True Nature of Candidate Disk Systems**
Wisniewski, J. P.; Bjorkman, K. S.; Magalhaes, A. M.; Bjorkman, J. E.; Meade, M. R.; Pereyra, Antonio; [2007]; 24 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNH06CC03B; NGT5-50469; NAG5-8054; NSF AST-03-07686; Copyright; Avail.: CASI: A03, Hardcopy

Photometric 2-color diagram (2-CD) surveys of young cluster populations have been used to identify populations of B-type stars exhibiting excess Ha emission. The prevalence of these excess emitters, assumed to be 'Be stars'. has led to the establishment of links between the onset of disk formation in classical Be stars and cluster age and/or metallicity. We have obtained imaging polarization observations of six SMC and six LMC clusters whose candidate Be populations had been previously identified via 2-CDs. The interstellar polarization (ISP) associated with these data has been identified to facilitate an examination of the circumstellar environments of these candidate Be stars via their intrinsic polarization signatures, hence determine the true nature of these objects. We determined that the ISP associated with the SMC cluster NGC 330 was characterized by a modified Serkowski law with a lambda(sub max) of approx. 4500Angstroms, indicating the presence of smaller than average dust grains. The morphology of the ISP associated with the LMC cluster NGC 2100 suggests that its interstellar environment is characterized by a complex magnetic field. Our intrinsic polarization results confirm the suggestion of Wisniewski et al. that a substantial number of bona-fide classical Be stars are present in clusters of age 5-8 Myr. Hence, our data contradict recent assertions that the Be phenomenon develops in the second half of a B star's main sequence lifetime, i.e. no earlier than 10 Myr. These data imply that a significant number of B-type stars must emerge onto the zero-age-main-sequence rotating at near-critical rotation rates, although we can not rule out the possibility that these data instead reveal the presence of a sub-group of the Be phenomenon characterized by sub-critically rotating objects. Comparing the polarimetric properties of our dataset to a similar survey of Galactic classical Be stars, we find that the prevalence of polarimetric Balmer jump signatures decreases with metallicity. We speculate that these results might indicate that either it is more difficult to form large disk systems in low metallicity environments, or that the average disk temperature is higher in these low metallicity environments. We have characterized the polarimetric signatures of all candidate Be stars in our data sample and find approx. 25% are unlikely to arise from true classical Be star-disk systems. This detection of such a substantial number 'contaminants' suggests one should proceed with caution when attempting to determine the role of evolutionary age and/or metallicity in the Be phenomenon purely via 2-CD results.
Author
*B Stars; Metallicity; Magellanic Clouds; Main Sequence Stars; Stellar Envelopes; Star Clusters*

**20070018861** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The GLAST Burst Monitor**
Meegan, Charles; Bhat, Narayana; Connaughton, Valerie; Briggs, Michael; Diehl, Roland; Fishman, Gerald; Greiner, Jochen; Kippen, R. Marc; vonKienlin, Andreas; Kouveliotou, Chryssa; Lichti, Giselher; Paciesas, William; Preece, Robert; Steinle, Helmut; Wilson-Hodge, Colleen; [2007]; 3 pp.; In English; First GLAST Symposium, 2-5 Feb. 2007, Palo Alto, CA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): 50-QV-0301; Copyright; Avail.: CASI: A01, Hardcopy

The GLAST Burst Monitor (GBM) comprises an array of NaI and BGO scintillation detectors designed to enhance the scientific return from GLAST in the study of gamma-ray bursts (GRBs). By observing in the 10 keV to 30 MeV energy range, GBM extends the spectral coverage of GRBs more than 3 decades below the LAT energy threshold. GBM computes burst locations on-board, allowing repointing of the GLAST Observatory to place strong bursts within the LAT field-of-view to observe delayed high-energy emission.
Author
*Gamma Ray Bursts; Scintillation Counters; Position (Location); Electrical Measurement; Electric Potential*

**20070019011** Naval Observatory, Washington, DC USA
**SDSS Spectroscopic Survey of Stars**
Ivezic, Z; Schlegel, D; Uomoto, A; Bond, N; Beers, T; Prieto, C A; Wilhelm, R; Lee, Y S; Sivarani, T; Juric, M; Lupton, R; Jan 2006; 9 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465299; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465299
In addition to optical photometry of unprecedented quality, the Sloan Digital Sky Survey (SDSS) is also producing a massive spectroscopic database. We discuss determination of stellar parameters, such as effective temperature, gravity and metallicity from SDSS spectra, describe correlations between kinematics and metallicity, and study their variation as a function of the position in the Galaxy. We show that stellar parameter estimates by Beers et al. show a good correlation with the position of a star in the g - r vs. u - g color-color diagram, thereby demonstrating their robustness as well as a potential for photometric parameter estimation methods.
DTIC
*Spectroscopy; Surveys; Variable Stars*

**20070019275** Executive Office of the President, Washington, DC USA
**Strategic Plan for the U.S. Climate Change Science Program**
Jul 2003; 212 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465661; No Copyright; Avail.: Defense Technical Information Center (DTIC)
This Strategic Plan for the Climate Change Science Program describes a strategy for developing knowledge of variability and change in climate and related environmental and human systems, and for encouraging the application of this knowledge. The strategy seeks to optimize the benefits of research that is conducted, sponsored, or applied by 13 agencies and departments of the U.S. government. These agencies coordinate their research through the Climate Change Science Program (CCSP), which incorporates the U.S. Global Change Research Program (USGCRP) and the Climate Change Research Initiative (CCRI). Scientists and research program managers from the 13 participating agencies and the Climate Change Science Program Office drafted the Strategic Plan. It reflects a commitment by its authors to high-quality science, which requires openness to review and criticism by the wider scientific community. The process by which the plan was drafted proceeded with the transparency essential for scientific credibility.
DTIC
*Climate; Climate Change; Environmental Surveys; Organizations; Research Management*

**20070019353** Executive Office of the President, Washington, DC USA
**Our Changing Planet**
Jan 2003; 131 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465634; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465634
The U.S. Global Change Research Program (USGCRP) supports research on the interactions of natural and human-induced changes in the global environment and their implications for society. The USGCRP began as a presidential initiative in 1989 and was codified by Congress in the Global Change Research Act of 1990 (P.L. 101-606), which mandates development of a coordinated interagency research program. Participants in the USGCRP include the Departments of Agriculture, Commerce (National Oceanic and Atmospheric Administration), Defense, Energy, Health and Human Services, Interior (U.S. Geological Survey), State, and Transportation; the U.S. Environmental Protection Agency; the National Aeronautics and Space Administration; the National Science Foundation; and the Smithsonian Institution. The Office of Science and Technology Policy, the Office of Management and Budget, and the Council on Environmental Quality provide oversight on behalf of the Executive Office of the President. Since its inception, USGCRP-supported research and

observational activities, in collaboration with several other national and international science programs, have documented and characterized important aspects of the sources, abundances, and lifetimes of greenhouse gases; mounted extensive space-based systems for global monitoring of climate and ecosystem parameters; begun to address the complex issues of various aerosol species that may significantly influence climate parameters; advanced understanding of the global water and carbon cycles; and taken major strides in computer modeling of the global climate.
DTIC
*Ecosystems; Geological Surveys*

## 90
## ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

**20070018776** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Simulation Study of Magnetic Fields generated by the Electromagnetic Filamentation Instability driven by Pair Loading**
Nishikawa, K.-I.; Ramirez-Ruiz, E.; Hededal, C.; Hardee, P.; Mizuno, Y.; Fishman, G. J.; [2007]; 1 pp.; In English; THe Next Decade of Gamma-ray Bursts Afterglows, 19-23 Mar. 2007, Amsterdam, Netherlands; Copyright; Avail.: Other Sources; Abstract Only

Using a 3-D relativistic particle-in-cell (RPIC) code, we have investigated particle acceleration associated with a relativistic electron-positron (cold) jet propagating into ambient electron-positron and electron-ion plasmas without initial magnetic fields in order to investigate the nonlinear stage of the Weibel instability. We have also performed simulations with broad Lorentz factor distribution of jet electrons and positrons, which are assumed to be created by the photon annihilation. The growth time and nonlinear saturation levels depend on the initial jet parallel velocity distributions and ambient plasma. Simulations show that the Weibel instability created in the collisionless shocks accelerates jet and ambient particles both perpendicular and parallel to the jet propagation direction. The nonlinear fluctuation amplitude of densities, currents, electric, and magnetic fields in the electron-ion ambient plasma are larger than those in the electron-positron ambient plasma. We have shown that plasma instabilities driven by these streaming electron-positron pairs are responsible for the excitation of near-equipartition, turbulent magnetic fields. These fields maintain a strong saturated level on timescales much longer than the electron skin depth at least for the duration of the simulations. Our results reveal the importance of the electromagnetic filamentation instability in ensuring an effective coupling between electron-positron pairs and ions, and may help explain the origin of large upstream fields in GRB shock.
Author
*Particle Acceleration; Electron-Positron Pairs; Magnetic Fields; Magnetohydrodynamic Stability; Relativistic Particles; Plasma Jets*

**20070018790** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Quasi-Periodic Variability in NGC 5408 X-1**
Strohmayer, Tod E.; Mushotzky, Richard F.; Winter, Lisa; Soria, Roberto; Uttley, Phil; Cropper, Mark; [2007]; 21 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

We report the discovery with XMM-Newton of quasiperiodic variability in the 0.2 - 10 keV X-ray flux from the ultraluminous X-ray source NGC 5408 X-1. The average power spectrum of all EPIC-pn data reveals a strong 20 mHz QPO with an average amplitude (rms) of 9%, and a coherence, Q identical with nu(sub 0)/sigma approximately equal to 6. In a 33 ksec time interval when the 20 mHz QPO is strongest we also find evidence for a 2nd QPO peak at 15 mHz, the first indication for a close pair of QPOs in a ULX source. Interestingly, the frequency ratio of this QPO pair is inconsistent with 3:2 at the 3 sigma level, but is consistent with a 4:3 ratio. A powerlaw noise component with slope near 1.5 is also present below 0.1 Hz with evidence for a break to a flatter slope at about 3 mHz. The source shows substantial broadband variability, with a total amplitude (rms) of about 30% in the 0.1 - 100 mHz frequency band, and there is strong energy dependence to the variability. The power spectrum of hard X-ray photons (greater than 2 keV) shows a 'classic' flat-topped continuum breaking to a power law with index 1.5 - 2. Both the break and 20 mHz QPO are detected in the hard band, and the 20 mHz QPO is essentially at the break. The QPO is both strong and narrow in this band, having an amplitude (rms) of 15%, and Q approx. equal to 25. The energy spectrum is well fit by three components, a 'cool' disk with kT = 0.15 keV, a steep power law with index 2.56, and a thermal plasma at kT = 0.87 keV. The disk, power law, and thermal plasma components contribute 35, 60, and 5% of the 0.3 - 10 keV flux, respectively. Both the timing and spectral properties of NGC 5408 X-1 are strikingly reminiscent of

Galactic black hole systems at high inferred accretion rates, but with its characteristic frequencies (QPO and break frequencies) scaled down by a factor of 10 - 100. We discuss the implications of these findings in the context of models for ULXs, and their implications for the object's mass.
Author
*Black Holes (Astronomy); Astrophysics; X Ray Sources; Variability*

**20070018845** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Techniques for Binary Black Hole Simulations**
Baker, John G.; [2006]; 1 pp.; In English; Workshop on 'New Frontiers in Numerical Relativity', 17-21 Jul. 2006, Golm, Germany; No Copyright; Avail.: Other Sources; Abstract Only

Recent advances in techniques for numerical simulation of black hole systems have enabled dramatic progress in astrophysical applications. Our approach to these simulations, which includes new gauge conditions for moving punctures, AMR, and specific tools for analyzing black hole simulations, has been applied to a variety of black hole configurations, typically resulting in simulations lasting several orbits. I will discuss these techniques, what we've learned in applications, and outline some areas for further development.
Author
*Black Holes (Astronomy); Astrophysics; Binary Stars; Direct Numerical Simulation*

**20070018850** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Eta Carinae and the Homunculus: An Astrophysical Laboratory**
Gull, Theodore R.; [2006]; 1 pp.; In English; XXXVIth General Assembly of the International Astronomical Union, 15-24 Aug;. 2006, Prague, Czech Republic; No Copyright; Avail.: Other Sources; Abstract Only

High spatial resolution spectroscopy with HST/STIS between 1998.0 and 2004.2 has provided much exciting information about the central binary system and the physics of its N-rich, C,O-poor ejecta. Stellar He I profiles, noticeably blue-shifted relative to P Cygni H and Fe II line profiles, originate from the ionized wind region between two massive companions. Changes in profiles of He I singlet and triplet lines provide clues to the excitation mechanisms involved as the hot, UV companion moves in its highly eccentric orbit. For 90% of the 5.54-year period, the spectra of nearby Weigelt blobs and the Little Homunculus include highly excited emission lines of Ar, Ne, and Fe. During the few month-long spectroscopic minimum, these systems are deprived of Lyman continuum. Recombination, plus cooling, occurs. In the skirt region between the bipolar Homunculus, a neutral emission region, devoid of hydrogen emission, glows in Ti II, Fe I, Sr II, Sc II, etc. We find the ejecta to have Ti/Ni abundances nearly 100 times solar, not due to nuclear processing, but due to lack of oxygen. Many metals normally tied up in interstellar dust remain in gaseous phase. Much information is being obtained on the physical processes in these warm N-rich gases, whose excitation varies with time in a predictable pattern. Indeed recent GRB high dispersion spectra include signatures of circumGRB warm gases. This indicates that the early, primordial massive stars have warm massive ejecta reminiscent to that around Eta Carinae.
Author
*Spectroscopy; Stellar Atmospheres; Massive Stars; Laboratory Astrophysics*

**20070018984** Texas Univ. at Dallas, Richardson, TX USA
**Post-Launch Support for DMSP SSIES Sensors**
Heelis, R A; Dec 7, 2006; 11 pp.; In English
Contract(s)/Grant(s): F19628-97-C-0085; Proj-SMCO
Report No.(s): AD-A465253; 630940; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465253

This report summarizes activities related to the support of immediate post-launch activities related to the evaluation of sensor performance for the Special Sensor for Ions, Electrons, and Scintillation (SSIES) that is flown on the the Defense Meteorological Satellite Program (DMSP). The thermal plasma sensors that constitute the SSIES instrument complement provide measurements that describe the composition, velocity, and temperature of the ions and electrons. Each sensor has operational variables that may be adjusted to optimize the sensor performance. In addition, the ground software must be adjusted to accommodate the prevailing environmental conditions that can change dramatically during a solar cycle. Here, we describe support activities following the launch of each SSlES sensor that were undertaken to evaluate the sensor performance and optimize the subsequent routine operations.
DTIC
*Detectors; DMSP Satellites; Electrons; Ions; Launching; Meteorological Satellites; Solar Cycles*

**20070019022** Naval Observatory, Washington, DC USA

**On the Theory of Bodily Tides**

Efroimsky, Michael; Lainey, Valery; Jan 2007; 9 pp.; In English

Report No.(s): AD-A465313; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA465313

Different theories of bodily tides assume different forms of dependence of the angular lag (delta) upon the tidal frequency X (chi). In the old theory (Gerstenkorn 1955, MacDonald 1964, Kaula 1964) the geometric lag angle is assumed constant, while the new theory (Singer 1968; Mignard 1979, 1980) postulates constancy of the time lag (delta)-t. Each particular functional form of delta-X (chi) unambiguously determines the form of the frequency dependence of the tidal quality factor, and vice versa. Through the past 20 years, several teams of geophysicists have undertaken a large volume of experimental research of attenuation at low frequencies. This research, carried out both for mineral samples in the lab and for vast terrestrial basins, has led to a complete reconsideration of the shape of Q(x). While in late 70s - early 80s it was universally accepted that at low frequencies the quality factor scales as inverse frequency, by now it is firmly established that Q(x)(chi-alpha), where the positive fractional power alpha varies, for different minerals, from 0.2 through 0.4 (leaning toward 0.2 for partial melts) - see the paper by Efroimsky (2006) and references therein. That paper also addresses some technical difficulties emerging in the conventional theory of land tides, and offers a possible way of their circumvention - a new model that is applicable both for high inclinations and high eccentricities. Here we employ this new model to explore the long-term evolution of Phobos and to provide a more exact estimate for the time it needs to fall on Mars. This work is a pilot paper that anticipates a more comprehensive study in preparation (Efroimsky & Lainey 2007).

DTIC

*Earth Tides; Tides*

**20070019223**

**Physics-Based Analysis Using the Empirical High Accuracy Satellite Dray Model (HASD)**

Wu, S T; Zhang, T W; Feng, Xueshang; Tan, Arjun; Sep 18, 2002; 25 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-02-1-0310; Proj-4113/HX

Report No.(s): AD-A465798; No Copyright; Avail.: CASI: A03, Hardcopy

In this study, we have employed a 2.5D time-dependent streamer-flux rope MHD model to investigate the role of magnetic reconnection in the CME acceleration processes. To implement this simulation, two distinct types of initial magnetic topology (i.e., Inverse and Normal prominence configuration) are used. The results showed: The normal prominence magnetic configuration forms a current sheet in the region of leading edge of the flux-rope, thus the magnetic reconnection occurs to open the closed field of the streamer which allows the flux rope to escape to launch a fast CME as suggested by Low and Zhang (2002). On the other hand, when the initial magnetic topology in the initial prominence configuration, the magnetic reconnection occurs at trailing edge of the flux-rope. In this case, the streamer confined the flux-rope until the magnetic reconnection occurs, this confined force removed which enlaced the CME acceleration (Wu et al. 2004) Both inverse and normal prominence configurations are able to produce fast CMEs.

DTIC

*Coronal Mass Ejection; Magnetic Fields; Spacecraft Models*

## 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*.

**20070018744** NASA Marshall Space Flight Center, Huntsville, AL, USA

**International Collaboration in Lunar Exploration**

Morris, K. Bruce; Horack, John M.; March 16, 2007; 2 pp.; In English; To Moon and Beyond, 14-16 Mar. 2007, Bremen, Germany; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070018744

The U.S. Vision for Space Exploration commits the USA to return astronauts to the moon by 2020 using the Ares I Crew Launch Vehicle and Ares V Cargo Launch Vehicle. Like the Apollo program of the 1960s and 1970s, this effort will require preliminary reconnaissance in the form of robotic landers and probes. Unlike Apollo, some of the data NASA will rely upon to select landing sites and conduct science will be based on international missions as well, including SMART-1, SELENE, and

Lunar Reconnaissance Orbiter (LRO). Opportunities for international cooperation on the moon also lie in developing lunar exploration technologies. The European Space Agency's SMART-1 orbiter (Figure 1) is making the first comprehensive inventory of key chemical elements in the lunar surface. It is also investigating the impact theory of the moon's formation.' Author

*Space Exploration; International Cooperation; Lunar Exploration; Landing Sites; Ares 5 Cargo Launch Vehicle; Ares 1 Launch Vehicle; Robotics; Lunar Orbiter*

**20070018777** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Imaging Thermal He(+)in Geospace from the Lunar Surface**

Gallagher, D. L.; Sandel, B. R.; Adrian, Mark L.; Goldstein, Jerry; Jahn, Joerg-Micha; Spasojevic, Maria; Griffin, Brand; [2007]; 2 pp.; In English; 2007 NASA/NAC Lunar Exploration Architecture Workshop, 27 Feb. - 2 Mar. 2007, Tempe, AZ, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

By mass, thermal plasma dominates near-earth space and strongly influences the transport of energy and mass into the earth's atmosphere. It is proposed to play an important role in modifying the strength of space weather storms by its presence in regions of magnetic reconnection in the dayside magnetopause and in the near to mid-magnetotail. Ionospheric-origin thermal plasma also represents the most significant potential loss of atmospheric mass from our planet over geological time. Knowledge of the loss of convected thermal plasma into the solar wind versus its recirculation across high latitudes and through the magnetospheric flanks into the magnetospheric tail will enable determination of the mass balance for this mass-dominant component of the Geospace system and of its influence on global magnetospheric processes that are critical to space weather prediction and hence to the impact of space processes on human technology in space and on Earth. Our proposed concept addresses this basic issue of Geospace dynamics by imaging thermal He(+) ions in extreme ultraviolet light with an instrument on the lunar surface. The concept is derived from the highly successful Extreme Ultraviolet imager (EUV) flown on the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) spacecraft. From the lunar surface an advanced EUV imager is anticipated to have much higher sensitivity, lower background noise, and higher communication bandwidth back to Earth. From the near-magnetic equatorial location on the lunar surface, such an imager would be ideally located to follow thermal He(+) ions to high latitudes, into the magnetospheric flanks, and into the magnetotail.

Derived from text

*Imaging Techniques; Thermal Plasmas; Helium Ions; Lunar Surface; Geophysics*

**20070018778** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Estimating and Modeling S-Band Lunar Radar Backscatter**

Thompson, Tommy; Ustinov, Eugene; July 17, 2006; 20 pp.; In English; Chandrayan Mini-RF Science Team Meeting, Applied Physics Laboratory, 17 Jul. 2006, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39868

This viewgraph presentation reviews the estimates and modeling for S-band Lunar radar backscatter. By way of basic review it shows the average lunar radar behavior, the average lunar radar cross-section at 3.8-cm, 23-cm and 68-cm wavelengths. It also reviews the equations for estimating 13 cm scattering from 3.8 and 23 cm data. Charts show the inferred 13-cm average scattering derived from interpolation of the 1960's observations and the modeled 13-cm average scattering. It also reviews the scattering differences: between linear polarizations from slopes from roughness.

CASI

*Backscattering; Radar; Estimates; Mathematical Models; Interpolation; Lunar Radar Echoes; Lunar Surface*

**20070018802** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Microwave Extraction of Water from Lunar Regolith Simulant**

Ethridge, Edwin C.; Kaukler, William; [2007]; 1 pp.; In English; Space Technology and Applications International Forum (STAIF-2007), 11-15 Feb. 2007, Albuquerque, NM, USA; Copyright; Avail.: Other Sources; Abstract Only

Nearly a decade ago the DOD Clementine lunar orbital mission obtained data indicating that the permanently shaded regions at the lunar poles may have permanently frozen water in the lunar soil. Currently NASA's Robotic Lunar Exploration Program, RLEP-2, is planned to land at the lunar pole to determine if water is present. The detection and extraction of water from the permanently frozen permafrost is an important goal for NASA. Extraction of water from lunar permafrost has a high priority in the In-Situ Resource Utilization, ISRU, community for human life support and as a fuel. The use of microwave processing would permit the extraction of water without the need to dig, drill, or excavate the lunar surface. Microwave

heating of regolith is potentially faster and more efficient than any other heating methods due to the very low thermal conductivity of the lunar regolith. Also, microwaves can penetrate into the soil permitting water removal from deep below the lunar surface. A cryogenic vacuum test facility was developed for evaluating the use of microwave heating and water extraction from a lunar regolith permafrost simulant. Water is obtained in a cryogenic cold trap even with soil conditions below 0 C. The results of microwave extraction of water experiments will be presented.
Author
*Extraction; Microwaves; Water; Regolith; Lunar Rocks; Permafrost*

**20070018818** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Lunar In Situ Materials-Based Surface Structure Technology Development Efforts at NASA/MSFC**
Fiske, M. R.; McGregor, W.; Pope, R.; McLemore, C. A.; Kaul, R.; Smithers, G.; Ethridge, E.; Toutanji, H.; [2007]; 7 pp.; In English; Space Technology and Applications International Forum (STAIF) 2007, 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations
Contract(s)/Grant(s): NNM05AB50C; Copyright; Avail.: CASI: A02, Hardcopy

For long-duration missions on other planetary bodies, the use of in situ materials will become increasingly critical. As man's presence on these bodies expands, so must the structures to accommodate them, including habitats, laboratories, berms, radiation shielding for surface reactors, garages, solar storm shelters, greenhouses, etc. The use of in situ materials will significantly offset required launch upmass and volume issues. Under the auspices of the In Situ Fabrication & Repair (ISFR) Program at NASA/Marshall Space Flight Center (MSFC), the Surface Structures project has been developing materials and construction technologies to support development of these in situ structures. This paper will report on the development of several of these technologies at MSFC's Prototype Development Laboratory (PDL). These technologies include, but are not limited to, development of extruded concrete and inflatable concrete dome technologies based on waterless and water-based concretes, development of regolith-based blocks with potential radiation shielding binders including polyurethane and polyethylene, pressure regulation systems for inflatable structures, production of glass fibers and rebar derived from molten lunar regolith simulant, development of regolithbag structures, and others, including automation design issues. Results to date and lessons learned will be presented, along with recommendations for future activities.
Author
*In Situ Resource Utilization; Radiation Shielding; Inflatable Structures; Binders (Materials); Lunar Rocks; Lunar Soil*

**20070018820** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Poisoning of Heat Pipes**
Gillies, Donald; Lehoczky, Sandor; Palosz, Witold; Carpenter, Paul; Salvail, Pat; [2007]; 10 pp.; In English; Space Technoogy and Applications International Forum (STAIF), 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

Thermal management is critical to space exploration efforts. In particular, efficient transfer and control of heat flow is essential when operating high energy sources such as nuclear reactors. Thermal energy must be transferred to various energy conversion devices, and to radiators for safe and efficient rejection of excess thermal energy. Applications for space power demand exceptionally long periods of time with equipment that is accessible for limited maintenance only. Equally critical is the hostile and alien environment which includes high radiation from the reactor and from space (galactic) radiation. In space or lunar applications high vacuum is an issue, while in Martian operations the systems will encounter a CO2 atmosphere. The effect of contact at high temperature with local soil (regolith) in surface operations on the moon or other terrestrial bodies (Mars, asteroids) must be considered.
Author
*Heat Pipes; Temperature Control; Contamination; Chemical Analysis; High Temperature; Lunar Soil*

**20070018825** NASA Marshall Space Flight Center, Huntsville, AL, USA
**From ESAS to Ares: A Chronology**
Cook, Stephen A.; [2007]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

Throughout my career, I have observed many launch vehicle efforts come and go. Although it may appear on the surface that those were dead-end streets, the knowledge we gained through them actually informs the work in progress. Following the tragic loss of the Space Shuttle Columbia's crew, the administration took the Columbia Accident Investigation Board's findings to heart and united the Agency behind the Vision for Space Exploration, with clear goals and objectives, including fielding a new generation of safe, reliable, and affordable space transportation. The genesis of the Ares I Crew Launch Vehicle

and Ares V Cargo Launch Vehicle activities now under way by a nationwide Government and industry team was the confirmation of the current NASA Administrator in April 2005. Shortly thereafter, he commissioned a team of aerospace experts to conduct the Exploration Systems Architecture Study (ESAS), which gave shape to launch vehicles that will empower America's resurgence in scientific discovery through human and robotic space exploration. In October 2005, I was asked to lead this effort, building the team and forming the partnerships that will, in turn, build America's next human-rated space transportation system. In November 2006, the Ares I team began conducting the System Requirements Review milestone, just 1 year after its formation. We are gaining momentum toward the first test flight of the integrated vehicle system in 2009, just a few short years away. The Agency is now poised to deliver on the commitment this nation has made to advance our interests in space. In its inaugural year, the Ares team has conducted the first human-rated launch vehicle major milestone in over 30 years. Using the Exploration Systems Architecture Study recommendations as a starting point, the vehicle designs have been evolved to best meet customer and stakeholder requirements to fulfill the strategic goals outlined in the Vision for Space Exploration.

Author

*Chronology; Systems Engineering; Ares 1 Launch Vehicle; Ares 5 Cargo Launch Vehicle*

**20070018827** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Exploration Challenges: Transferring Ground Repair Techniques to Space Flight Application**

McLemore, Carole A.; Kennedy, James P.; Rose, Frederick A.; Evans, Brian W.; [2007]; 9 pp.; In English; Space Technology and Applications International Forum (STAIF 2007), 11-15 Feb. 2007, Albuquerque, NM, USA

Contract(s)/Grant(s): NAS8-02060; Copyright; Avail.: CASI: A02, Hardcopy

Fulfilling NASA's Vision for Space Exploration will demand an extended presence in space at distances from our home planet that exceed our current experience in space logistics and maintenance. The ability to perform repairs in lieu of the customary Orbital Replacement Unit (ORU) process where a faulty part is replaced will be elevated from contingency to routine to sustain operations. The use and cost effectiveness of field repairs for ground based operations in industry and the military have advanced with the development of technology in new materials, new repair techniques and new equipment. The unique environments, accessibility constraints and Extra Vehicular Activity (EVA) issues of space operations will require extensive assessment and evolution of these technologies to provide an equivalent and expected level of assurance to mission success. Challenges include the necessity of changes in design philosophy and policy, extremes in thermal cycling, disruptive forces (such as static charge and wind entrainment) on developed methods for control of materials, dramatically increased volatility of chemicals for cleaning and other compounds due to extremely low pressures, the limits imposed on dexterity and maneuverability by current EVA equipment and practices, and the necessity of unique verification methodology. This paper describes these challenges in and discusses the effects on the established ground techniques for repair. The paper also describes the leading repair methodology candidates and their beneficial attributes for resolving these issues with the evolution of technology.

Author

*Space Exploration; Space Logistics; Maintenance; Extravehicular Activity; Thermal Cycling Tests*

**20070018828** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Prospecting Rovers for Lunar Exploration**

Graham, Jerry B.; Vaughn, Jason A.; Farmer, Jeffery T.; [2007]; 1 pp.; In English; 2007 IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT; No Copyright; Avail.: Other Sources; Abstract Only

A study of lunar rover options for exploring the permanently shadowed regions of the lunar environment is presented. The potential for nearly continuous solar illumination coupled with the potential for water ice, focus exploration planner's attention on the polar regions of the moon. These regions feature craters that scientists have reason to believe may contain water ice. Water ice can be easily converted to fuel cell reactants, breathing oxygen, potable water, and rocket propellant. For these reasons, the NASA Robotic Lunar Exploration Program (RLEP) sponsored a study of potential prospecting rover concepts as one part of the RLEP-2 Pre-Phase A. Numerous vehicle configurations and power, thermal, and communication options are investigated. Rover options in the 400kg to 530kg class are developed which are capable of either confirming the presence of water ice at the poles, or conclusively demonstrating its absence.

Author

*Roving Vehicles; Lunar Exploration; Craters; Robotics; Water; Lunar Environment*

**20070018853** NASA Johnson Space Center, Houston, TX, USA
**Recommendations for Exploration Space Medicine from the Apollo Medical Operations Project**
Scheuring, R. a.; Davis, J. R.; Duncan, J. M.; Polk, J. D.; Jones, J. A.; Gillis, D. B.; May 20, 2007; 59 pp.; In English; 16th Annual Humans in Space 2007, 20-24 May 2007, Beijing, China; Original contains color illustrations; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018853

This study followed a request made by the Medical Operations Branch, Space Medicine Division of NASA-JSC in December, 2005. The objective was to identify problems that occurred during the Apollo missions relevant to medical operations that had an impact on crew health and/or performance.
Derived from text
*Aerospace Medicine; Apollo Project; Manned Space Flight; Space Missions*

**20070018863** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Remote Collaboration on Task Scheduling for Humans at Mars**
Jaap, John; Meyer, Patrick; Davis, Elizabeth; Richardson, Lea; Nov. 17, 2006; 10 pp.; In English; IEEE Aerospace Conference 2007, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains black and white illustrations
Report No.(s): IEEEAC Paper 1415; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018863

As humans venture farther from Earth for longer durations, it will become essential for those on the journey to have significant control over the scheduling of their own activities as well as the activities of their companion systems and robots. However, the crew will not do all the scheduling; timelines will be the result of collaboration with ground personnel. Emerging technologies such as in-space message buses, delay-tolerant networks, and in-space internet will be the carriers on which the collaboration rides. Advances in scheduling technology, in the areas of task modeling, scheduling engines, and user interfaces will allow the crew to become virtual scheduling experts. New concepts of operations for producing the timeline will allow the crew and the ground support to collaborate while providing safeguards to ensure that the mission will be effectively accomplished without endangering the systems or personnel.
Author
*Scheduling; Manned Mars Missions; Mission Planning; Autonomy*

## 92
## SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

**20070018775** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The Coronal-Dimming Footprint of a Streamer-Puff Coronal Mass Ejection: Confirmation of the Magnetic-Arch-Blowout Scenario**
Moore, Ronald L.; Sterling, Alphonse C.; February 2007; 10 pp.; In English; Original contains black and white illustrations; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018775

In this paper, for a CME of the particular variety recently identified by Bemporad et al (2005), we present new evidence that strengthens the conclusion of Bemporad et al that for these CMEs the pre-eruption magnetic field that explodes to drive the CME is laterally far offset from the radial path of the full-blown CME in the outer corona. In CMEs of the particular variety of those found by Bemporad et al, the flare-site field that explodes is much more compact than the flare-site fields that explode in most major flares and large CMEs, and is located in a flank of the base of a streamer. After presenting our new evidence for how CMEs of this variety are produced, we cite and discuss examples of larger flare-producing magnetic explosions that are not necessarily in a flank of a streamer but occur together with a large CME that in the outer corona is laterally far offset from the flare. We conclude that there is a broad class of CMEs that come from flare-producing magnetic explosions of various sizes and that are laterally far offset from the flare. We propose that all CMEs of this broad class are produced in basically the same way as those of the particular variety of the one that we present in this paper. In this paper, it is therefore convenient and useful to refer to this broad class of CMEs (regardless of the pre-eruption size of the offset field that explodes and whether or not this field is in the flank of a streamer), as 'over-and-out' CMEs. Because the lack of recognition of this class of CMEs

has contributed to the confusion and controversy regarding the relation between flares and CMEs (e.g., Kahler 1992; Gosling 1993; Hudson et al 1995), it is important that this class of CME have an explicit name. We adopt the name over-and-out CME because it is a needed descriptive term, especially for the purpose of this paper.
Author
*Coronas; Magnetic Fields; Flares; Solar Flares; Coronal Mass Ejection*

**20070018817** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Solar Confocal interferometers for Sub-Picometer-Resolution Spectral Filters**
Gary, G. Allen; Pietraszewski, Chris; West, Edward A.; Dines. Terence C.; March 05, 2007; 10 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

The confocal Fabry-Perot interferometer allows sub-picometer spectral resolution of Fraunhofer line profiles. Such high spectral resolution is needed to keep pace with the higher spatial resolution of the new set of large-aperture solar telescopes. The line-of-sight spatial resolution derived for line profile inversions would then track the improvements of the transverse spatial scale provided by the larger apertures. In particular, profile inversion allows improved velocity and magnetic field gradients to be determined independent of multiple line analysis using different energy levels and ions. The confocal interferometer's unique properties allow a simultaneous increase in both etendue and spectral power. The higher throughput for the interferometer provides significant decrease in the aperture, which is important in spaceflight considerations. We have constructed and tested two confocal interferometers. A slow-response thermal-controlled interferometer provides a stable system for laboratory investigation, while a piezoelectric interferometer provides a rapid response for solar observations. In this paper we provide design parameters, show construction details, and report on the laboratory test for these interferometers. The field of view versus aperture for confocal interferometers is compared with other types of spectral imaging filters. We propose a multiple etalon system for observing with these units using existing planar interferometers as pre-filters. The radiometry for these tests established that high spectral resolution profiles can be obtained with imaging confocal interferometers. These sub-picometer spectral data of the photosphere in both the visible and near-infrared can provide important height variation information. However, at the diffraction-limited spatial resolution of the telescope, the spectral data is photon starved due to the decreased spectral passband.
Author
*Fabry-Perot Interferometers; Imaging Techniques; Spectral Resolution; Solar Physics; Optical Filters*

**20070018822** National Space Science and Technology Center, Huntsville, AL, USA
**Composition of the Solar Wind**
Suess, S. T.; [2007]; 1 pp.; In English; Workshop on Science Associated with the Lunar Exploration Architecture, 25 Feb. - 2 Mar. 2007, Tempe, AZ, USA; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018822

The solar wind reflects the composition of the Sun and physical processes in the corona. Analysis produces information on how the solar system was formed and on physical processes in the corona. The analysis can also produce information on the local interstellar medium, galactic evolution, comets in the solar wind, dust in the heliosphere, and matter escaping from planets.
Derived from text
*Solar Wind; Coronas; Interstellar Matter; Galactic Evolution; Comets; Heliosphere; Dust*

**20070018824** NASA Marshall Space Flight Center, Huntsville, AL, USA
**CIV Interferometer for a Solar Sounding Rocket Program**
Gary, G. A.; West, E. A.; Davis, J. M.; Rees, D.; [2007]; 1 pp.; In English; Copyright; Avail.: Other Sources; Abstract Only

A sounding rocket instrument consisting of two vacuum ultraviolet Fabry-Perot filters in series would allow high-spectral resolution over an extended field of view for solar observations of the transition region between the chromosphere and the corona.
Author
*Sounding Rockets; Fabry-Perot Interferometers; Solar Physics; Far Ultraviolet Radiation*

## 93
## 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*.

**20070018836** NASA Johnson Space Center, Houston, TX, USA

**M-BAND Analysis of Chromosome Aberration In Human Epithelial Cells exposed to Gamma-ray and Secondary Neutrons of Low Dose Rate**

Hada, M.; Saganti, P. B.; Gersey, B.; Wilkins, R.; Cucinotta, F. A.; Wu, H.; [2007]; 1 pp.; In English; 13th International Congress of Radiation Research, 8-12 Jul. 2007, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

High-energy secondary neutrons, produced by the interaction of galactic cosmic rays with the atmosphere, spacecraft structure and planetary surfaces, contribute to a significant fraction to the dose equivalent in crew members and passengers during commercial aviation travel, and astronauts in space missions. The Los Alamos Nuclear Science Center (LANSCE) neutron facility's '30L' beam line is known to generate neutrons that simulate the secondary neutron spectrum of the Earth's atmosphere at high altitude. The neutron spectrum is also similar to that measured onboard spacecraft like the MIR and the International Space Station (ISS). To evaluate the biological damage, we exposed human epithelial cells in vitro to the LANSCE neutron beams at an entrance dose rate of 2.5 cGy/hr or gamma-ray at 1.7cGy/hr, and assessed the induction of chromosome aberrations that were identified with mBAND. With this technique, individually painted chromosomal bands on one chromosome allowed the identification of inter-chromosomal aberrations (translocation to unpainted chromosomes) and intra-chromosomal aberrations (inversions and deletions within a single painted chromosome). Compared to our previous results for gamma-rays and 600 MeV/nucleon Fe ions of high dose rate, the neutron data showed a higher frequency of chromosome aberrations. However, detailed analysis of the inversion type revealed that all of the three radiation types in the study induced a low incidence of simple inversions. The low dose rate gamma-rays induced a lower frequency of chromosome aberrations than high dose rate gamma-rays, but the inversion spectrum was similar for the same cytotoxic effect. The distribution of damage sites on chromosome 3 for different radiation types will also be discussed.

Author

*Chromosome Aberrations; Gamma Rays; Neutron Spectra; Cells (Biology); Exposure; Radiation Dosage*

**20070019362** NASA Johnson Space Center, Houston, TX, USA

**Improvement of Risk Assessment from Space Radiation Exposure for Future Space Exploration Missions**

Kim, Myung-Hee Y.; Atwell, Bill; Ponomarev, Artem L.; Nounu, Hatem; Hussein, Hesham; Cucinotta, Francis A.; [2007]; 22 pp.; In English; 37th International Conference on Environmental Systems (ICES), 9-12 Jul. 2007, Chicago, IL, USA; Copyright; Avail.: CASI: A03, Hardcopy

Protecting astronauts from space radiation exposure is an important challenge for mission design and operations for future exploration-class and long-duration missions. Crew members are exposed to sporadic solar particle events (SPEs) as well as to the continuous galactic cosmic radiation (GCR). If sufficient protection is not provided the radiation risk to crew members from SPEs could be significant. To improve exposure risk estimates and radiation protection from SPEs, detailed variations of radiation shielding properties are required. A model using a modern CAD tool ProE (TM), which is the leading engineering design platform at NASA, has been developed for this purpose. For the calculation of radiation exposure at a specific site, the cosine distribution was implemented to replicate the omnidirectional characteristic of the 4 pi particle flux on a surface. Previously, estimates of doses to the blood forming organs (BFO) from SPEs have been made using an average body-shielding distribution for the bone marrow based on the computerized anatomical man model (CAM). The development of an 82-point body-shielding distribution at BFOs made it possible to estimate the mean and variance of SPE doses in the major active marrow regions. Using the detailed distribution of bone marrow sites and implementation of cosine distribution of particle flux is shown to provide improved estimates of acute and cancer risks from SPEs.

Author

*Radiation Dosage; Risk; Space Exploration; Space Missions; Extraterrestrial Radiation; Aerospace Medicine*

# Subject Term Index


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