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Langley Research Center

Scientific and Technical Information Program Office

Scientific and Technical Aerospace Reports

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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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- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.

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  NASA Center for AeroSpace Information
  7115 Standard Drive
  Hanover, MD 21076-1320

Introduction

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

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

STAR includes citations to R&D results reported in:

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

The NASA STI Program

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

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces, and disseminates both NASA's internal STI and 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.

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

The Federal Depository Library Program (FDLP)

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

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

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

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Subject Term Index

Personal Author Index

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.

20070017321 NASA Langley Research Center, Hampton, VA, USA, Purdue Univ., West Lafayette, IN, USA
Modeling and Optimization for Morphing Wing Concept Generation
Skillen, Michael D.; Crossley, William A.; March 2007; 27 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNL06AA04G; WBS 659877.02.07.05.
Report No.(s): NASA/CR-2007-214860; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017321

This report consists of two major parts: 1) the approach to develop morphing wing weight equations, and 2) the approach to size morphing aircraft. Combined, these techniques allow the morphing aircraft to be sized with estimates of the morphing wing weight that are more credible than estimates currently available; aircraft sizing results prior to this study incorporated morphing wing weight estimates based on general heuristics for fixed-wing flaps (a comparable 'morphing' component) but, in general, these results were unsubstantiated. This report will show that the method of morphing wing weight prediction does, in fact, drive the aircraft sizing code to different results and that accurate morphing wing weight estimates are essential to credible aircraft sizing results.
Author
Wings; Fixed Wings; Weight Analysis; Predictions; Estimates

02
AERODYNAMICS

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

20070016787 Air Force Research Lab., Wright-Patterson AFB, OH USA
Feedback Control for Aerodynamics (Preprint)
Camphouse, R C; Djouadi, Seddik M; Myatt, James H; Sep 2006; 14 pp.; In English
Contract(s)/Grant(s): Proj-A03D
Report No.(s): AD-A464781; AFRL-VA-WP-TP-2006-348; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464781

The two-dimensional Burgers equation is used as a surrogate for the governing equations to test order-reduction and control design approaches. This scalar equation is selected because it has a nonlinearity that is similar to the Navier-Stokes equation, but it can be accurately simulated using far fewer states. However, the number of states required is still well above that for which a controller can be designed directly. Two approaches for order reduction are used. In both approaches, proper orthogonal decomposition (POD), also known as Karhunen-Loeve decomposition or principal component analysis, is used with Galerkin projection. In the first method, the traditional POD approach of selecting the modes to be retained in the

reduced-order model is based on the energy content of the modes. In the second method, balanced truncation is used to select the appropriate modes. Both approaches capture the dynamics of the input-output system and are used for control design.
DTIC
Aerodynamics; Boundaries; Feedback Control; Fluid Mechanics; Navier-Stokes Equation

20070016823 Computational Simulation and Design Center, Mississippi, MS USA
HI-ARMS Technical Objective A-TC-3: Unstructured Solver Performance Evaluation
Sheng, Chunhua; Marcum, David; Wang, Xiaoa; Sutherland, Kevin; May 2006; 24 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W911NF-06-1-0048
Report No.(s): AD-A465024; MSSU-COE-ERC-05-06; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465024

The objective of the current grant is to conduct Unstructured Solver Performance Evaluation activity for HPC Institute for Advanced Rotorcraft Modeling and Simulation (HI-ARMS). Specified deliverables are provided to the HI-ARMS evaluation team for solutions and computational statistics for a common test problem on a NACA0015 wing, and optional deliverables are provided for solutions on a realistic helicopter rotor, which will be used as the basis for measuring the attributes of the current unstructured solver to meet long-term HI-ARMS objectives and program requirements.
DTIC
Evaluation; Flow Visualization; Performance Tests; Rotary Wing Aircraft; Viscous Flow

20070016836 Naval Research Lab., Washington, DC USA
The Atmospheric Neutral Density Experiment (ANDE) and Modulating Retroreflector in Space (MODRAS): Combined Flight Experiments for the Space Test Program
Nicholas, A C; Gilbreath, G C; Thonnard, S E; Kessel, R; Kessel, R; Lucke, R; Sillman, C P; Jan 2003; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465046; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465046

The Atmospheric Neutral Density Experiment (ANDE) is a low cost mission proposed by the Naval Research Laboratory to demonstrate a method to monitor the thermospheric neutral density at an altitude of 400 km. The primary mission objective is to provide total neutral density along the orbit for improved orbit determination of resident space objects. The ANDE mission also serves as a test platform for a new space-to-ground optical communications technique, the Modulating Retro-reflector Array in Space (MODRAS) experiment. Both are sponsored in part by the Department of Defense Space Test Program. The mission consists of two spherical spacecraft fitted with retro-reflectors for satellite laser ranging (SLR). One spacecraft is completely passive; the other carries three active instruments; a miniature Wind And Temperature Spectrometer (WATS) to measure atmospheric composition, cross-track winds and neutral temperature; a Global Positioning Sensor (GPS); and a Thermal Monitoring System (TMS) to monitor the temperature of the sphere. A design requirement of the active satellite is to telemeter the data to the ground without external protrusions from the spherical spacecraft (i.e. an antenna). The active satellite will be fitted with the MODRAS system, which is an enabling technology for the ANDE mission. The MODRAS system consists of a set of multiple quantum well (MQW) modulating retro-reflectors coupled with an electronics package, which will telemeter data to the ground by modulating the reflected light from laser interrogation beam. This paper presents a mission overview and emphasis will be placed on the design, optical layout, performance, ground station, and science capabilities of the combined missions.
DTIC
Atmospheric Density; Flight Tests; Laser Beams; Lasers; Modulation; Reflectors; Retroreflectors; Spaceborne Experiments

20070016955 Combustion Research and Flow Technology, Inc., Pipersville, PA USA
Parallel Unstructured Mesh Adaptation for Transient Moving Body and Aeropropulsive Applications
Cavallo, P A; Sinha, N; Feldman, G M; Jan 2004; 12 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464881; No Copyright; Avail.: CASI: A03, Hardcopy

Adaptive, unstructured grid methods, in which the mesh is allowed to deform, and grid quality subsequently restored through localized coarsening and refinement, offer the potential of a more rapid, straightforward approach to generalized moving body problems. Automation of this mesh movement and quality correction strategy requires a close coupling with the

flow solution process. With parallel simulations now common, parallel coarsening and refinement methods for moving meshes are needed. In this work, parallel mesh adaptation strategies are developed to treat deforming, decomposed domains. Distortion of the moving mesh is assessed using a deformation matrix analysis. A two-pass approach is implemented in which cell migration shifts the interprocessor boundary, thereby accommodating coarsening and refinement of the interprocessor faces. The adapted grids are rebalanced among the processors using available techniques. Representative cases are presented to demonstrate the parallel approach and maintenance of cell quality for practical separation events.
DTIC
Aerodynamics; Flow; Simulation; Unstructured Grids (Mathematics)

20070017313 Minnesota Univ., Minneapolis, MN, USA
Experimental Investigation of Transition to Turbulence as Affected by Passing Wakes: Effects of High FSTI and Increased Rod Spacing
Kaszeta, Richard W.; Simon, Terrence W.; Jiang, Nan; Ottaviani, Federico; March 2007; 199 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NCC3-652; WBS 561581.02.08.03.02.01
Report No.(s): NASA/CR-2007-214678; E-15814; No Copyright; Avail.: CASI: A09, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017313

Experimental results from a study of the effects of passing wakes upon laminar-to-turbulent transition in a low-pressure turbine passage are presented. The test section geometry is designed to simulate the effects of unsteady wakes resulting from rotor-stator interaction upon laminar-to-turbulent transition in turbine blade boundary layers and separated flow regions over suction surfaces. Single-wire, thermal anemometry techniques are used to measure time-resolved and phase-averaged, wall-normal profiles of velocity, turbulence intensity and intermittency at multiple streamwise locations over the turbine airfoil suction surface. The Reynolds number based on suction surface length and stage exit velocity is 50,000. This study compares a previously documented base case flow having an approach flow turbulence intensity of 2.5 percent and a wake passing Strouhal number of 0.792 to two additional cases: one having an increased rod spacing case having a wake passing Strouhal number of 0.396, and another having an elevated approach flow turbulence intensity of 10 percent. From these data, the effects of increased rod spacing and elevated FSTI upon transition and separation processes in the near-wall flow are documented. The results show that a decreased wake passing Strouhal number results in an earlier separation with a larger separation bubble, while the elevated FSTI results in earlier separation, but with a shorter, thinner, separation bubble. The data and animations are included in an accompanying CD-ROM.
Author
Turbulence; Boundary Layers; Heat Transfer; Unsteady Flow; Rotors; Wakes; Reynolds Number; Base Flow

20070017478 NASA Dryden Flight Research Center, Edwards, CA, USA
In-Flight Subsonic Lift and Drag Characteristics Unique to Blunt-Based Lifting Reentry Vehicles
Saltzman, Edwin J.; Wang, K. Charles; Iliff, Kenneth W.; Journal of Spacecraft and Rockets; March-April 2007; Volume 44, No. 2, pp. 299-309; In English; 37th AIAA Aerospace Sciences Meeting and Exhibit, January 1999; Original contains black and white illustrations
Report No.(s): AIAA Paper 0383; Copyright; Avail.: CASI: A03, Hardcopy

Lift and drag measurements have been analyzed for subsonic flight conditions for seven blunt-based reentry-type vehicles. Five of the vehicles are lifting bodies (M2-F1, M2-F2, HL-10, X-24A, and X-24B) and two are wing-body configurations (the X-15 and the Space Shuttle Enterprise). Base pressure measurements indicate that the base drag for full-scale vehicles is approximately three times greater than predicted by Hoerner's equation for three-dimensional bodies. Base drag and forebody drag combine to provide an optimal overall minimum drag (a drag 'bucket') for a given configuration. The magnitude of this optimal drag, as well as the associated forebody drag, is dependent on the ratio of base area to vehicle wetted area. Counter-intuitively, the flight-determined optimal minimum drag does not occur at the point of minimum forebody drag, but at a higher forebody drag value. It was also found that the chosen definition for reference area for lift parameters should include the projection of planform area ahead of the wing trailing edge (i.e., forebody plus wing). Results are assembled collectively to provide a greater understanding of this class of vehicles than would occur by considering them individually.
Author
Lifting Reentry Vehicles; Aerodynamic Drag; Lift; Drag Measurement; Lift Drag Ratio

20070017932 NASA Ames Research Center, Moffett Field, CA, USA

3-D Navier-Stokes Analysis of Blade Root Aerodynamics for a Tiltrotor Aircraft In Cruise

Romander, Ethan; Jan. 6, 2006; 8 pp.; In English; AHS Vertical Lift Aircraft Design Confererence, 18-20 Jan. 2006, San Francisco, CA, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

The blade root area of a tiltrotor aircraft's rotor is constrained by a great many factors, not the least of which is aerodynamic performance in cruise. For this study, Navier-Stokes CFD techniques are used to study the aerodynamic performance in cruise of a rotor design as a function of airfoil thickness along the blade and spinner shape. Reducing airfoil thickness along the entire blade will be shown to have the greatest effect followed by smaller but still significant improvements achieved by reducing the thickness of root airfoils only. Furthermore, altering the shape of the spinner will be illustrated as a tool to tune the aerodynamic performance very near the blade root.

Author

Tilt Rotor Aircraft; Aerodynamic Characteristics; Airfoil Profiles; Computational Fluid Dynamics; Propeller Blades; Aerodynamics; Airfoils

20070017947 NASA Ames Research Center, Moffett Field, CA, USA

Aerothermal Anchoring of CBAERO Using High Fidelity CFD

Kinney, David J.; Jan. 11, 2007; 28 pp.; In English; AIAA Reno Conference, 8-11 Jan. 2007, Reno, NV, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017947

The Configuration Based Aerodynamics (CBAERO) software package is used to predict the convective and radiative heating environments for the Crew Exploration Vehicle (CEV). A limited number of high fidelity CFD solutions are used to 'anchor' the engineering level estimates obtained using CBAERO.

Author

Aerodynamic Configurations; Computational Fluid Dynamics; Aerothermodynamics; Convective Heat Transfer; Aerodynamics

20070017952 NASA Ames Research Center, Moffett Field, CA, USA

Impact of Aerodynamics and Structures Technology on Heavy Lift Tiltrotors

Acree, C. W., Jr.; [2006]; 13 pp.; In English; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017952

Rotor performance and aeroelastic stability are presented for a 124,000-lb Large Civil Tilt Rotor (LCTR) design. It was designed to carry 120 passengers for 1200 nm, with performance of 350 knots at 30,000 ft altitude. Design features include a low-mounted wing and hingeless rotors, with a very low cruise tip speed of 350 ft/sec. The rotor and wing design processes are described, including rotor optimization methods and wing/rotor aeroelastic stability analyses. New rotor airfoils were designed specifically for the LCTR; the resulting performance improvements are compared to current technology airfoils. Twist, taper and precone optimization are presented, along with the effects of blade flexibility on performance. A new wing airfoil was designed and a composite structure was developed to meet the wing load requirements for certification. Predictions of aeroelastic stability are presented for the optimized rotor and wing, along with summaries of the effects of rotor design parameters on stability.

Author

Tilt Rotor Aircraft; Rigid Rotors; Aeroelasticity; Composite Structures; Design Analysis; Wing Loading; Structural Engineering; Aircraft Design

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.

20070016689 NASA Marshall Space Flight Center, Huntsville, AL, USA

Recovery of Space Shuttle Columbia and Return to Flight of Space Shuttle Discovery

Rudolphi, Michael U.; [2007]; 31 pp.; In English; Fourth Management Challenge Conference 2007, 6-7 Feb. 2007, Galveston, TX, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: C01, CD-ROM: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070016689

NASA has come a long way in our journey to reduce the risks of operating the Spse Shuttle system. The External Tank bipod Thermal Protection System has been redesigned to eliminate the proximate cause of the Columbia accident. In all areas, we have applied the collective knowledge and capabilities of our Nation to comply with the Columbia Accident Investigation Board recommendations and to raise the bar beyond that. We have taken prudent technical action on potential threats to review and verify the material condition of all critical areas where failure could result in catastrophic loss of the crew and vehicle. We are satisfied that critical systems and elements should operate as intended-safely and reliably. While we will never eliminate all the risks from our human space flight programs, we have eliminated those we can and reduced, controlled, and/or mitigated others. The remaining identified risks will be evaluated for acceptance. Our risk reduction approach has its roots in the system safety engineering hierarchy for hazard abatement long employed in aerospace systems engineering. The components of the hierarchy are, in order of precedence, to: design/redesign; eliminate the hazard/risk; reduce the hazard/risk; and control the hazard/risk and/or mitigate the consequence of the remaining hazard/risk through warning devices, special procedures/capabilities, and/or training. This proven approach to risk reduction has been applied to potential hazards and risks in all critical areas of the Space Shuttle and has guided us through the technical challenges, failures, and successes present in return to flight endeavors. This approach provides the structured deliberation process required to verify and form the foundation for accepting any residual risk across the entire Space Shuttle Program by NASA leadership.
Author

Space Shuttles; Aerospace Systems; Space Transportation System; Columbia (Orbiter); NASA Space Programs; Discovery (Orbiter)

20070016972 Air Force Research Lab., Tyndall AFB, FL USA

Exhaust Recirculation - A Technology to Minimize Energy Use in Aircraft Painting Operations

Wandar, Joe; Doddington, Gerald; Frere, Steve; Jun 2007; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F08637-98-C-6002; Proj-2103
Report No.(s): AD-A464911; AFRL-ML-TY-TP-2007-4511; No Copyright; Avail.: CASI: A03, Hardcopy

The mandate in DoDD 5000.1 to manage risk as an element of acquisition cost control enabled Robins AFB?s justification for incorporation of 80% exhaust recirculation into the design for construction of a corrosion control facility (CCF) for C-5 aircraft that will enter service in 2007. A key tool in developing their justification was the LaPuma model, a process model into which a user inputs facility and process parameters to calculate the steady-state background air concentration of process-derived contaminants as a function of percent exhaust recirculated. The assumption that isocyanates-the exposure risk driver in topcoats-are an inert, ideal gas rather than a reactive, sticky vapor causes their concentration to be overestimated, and exposure data from the C-5 CCF are expected to clarify the extent and moment of this overestimation. In 2005 Elmendorf AFB followed Robins? lead and precedents in designing a C-17 CCF at 80% recirculation to save several $M in construction costs and $0.5M annually in fuel costs to operate. Predicted isocyanate concentrations for a (smaller) F-22 component repair facility (CRF) required interpretation and Elmendorf specified a conventional design in their bid request. That the only proposal whose cost was within the project budget included 80% recirculation created a situation that was ultimately resolved by a meeting of the design team, users, bioenvironmental engineering and the successful bidder that ended in consensus that the proposed design as modified in the meeting constituted an acceptable risk?benefit trade. However, that the situation arose demonstrates the need for explicit guidance to ensure that future decisions about recirculating hangar designs be made early on as a consensus among key offices at base level.
DTIC

Circulation; Corrosion Prevention; Finishes; Paints; Protective Coatings; Technology Utilization

20070017043 Naval Research Lab., Washington, DC USA
Developing High Assurance Avionics Systems with the SCR Requirements Method
Bharadwaj, R; Heitmeyer, C; Oct 2000; 9 pp.; In English
Report No.(s): AD-A465144; No Copyright; Avail.: CASI: A02, Hardcopy

In high assurance avionics systems, such as systems for flight guidance, air traffic control, and collision avoidance, compelling evidence is required that the system behavior satisfies certain critical properties. Some critical properties are functional properties, properties of the services that the system delivers. For example, when another aircraft flies too close, a collision avoidance system must advise the pilot to move the aircraft up or down to avoid a collision. Besides functional properties, four other classes of critical system properties may be identified: security, safety, realtime, and fault-tolerance. In most cases, an avionics system must satisfy properties in more than a single class. For example, a collision avoidance system must satisfy not only functional properties, but real-time constraints, fault-tolerance properties, and safety properties.
DTIC
Avionics; Collision Avoidance; Computer Programming; Computer Systems Design; Consistency; Fault Tolerance; Specifications

20070017453 NASA Dryden Flight Research Center, Edwards, CA, USA
An Online Resource for Flight Test Safety Planning
Lewis, Greg; [2007]; 31 pp.; In English; 37th San Diego Symposium/Society of Experimental Test Pilots, 22-24 Mar. 2007, San Diego, CA, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS4-02021; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017453

A viewgraph presentation describing an online database for flight test safety techniques is shown. The topics include: 1) Goal; 2) Test Hazard Analyses; 3) Online Database Background; 4) Data Gathering; 5) NTPS Role; 6) Organizations; 7) Hazard Titles; 8) FAR Paragraphs; 9) Maneuver Name; 10) Identified Hazard; 11) Matured Hazard Titles; 12) Loss of Control Causes; 13) Mitigations; 14) Database Now Open to the Public; 15) FAR Reference Search; 16) Record Field Search; 17) Keyword Search; and 18) Results of FAR Reference Search.
CASI
Flight Tests; On-Line Systems; Flight Safety; Data Bases

20070017894 NASA Dryden Flight Research Center, Edwards, CA, USA
NASA Turbulence Technologies In-Service Evaluation: Delta Air Lines Report-Out
Amaral, Christian; Dickson, Steve; Watts, Bill; April 2007; 154 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NND06AE46P
Report No.(s): NASA/CR-2007-214616; H-2702; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017894

Concluding an in-service evaluation of two new turbulence detection technologies developed in the Turbulence Prediction and Warning Systems (TPAWS) element of the NASA Aviation Safety and Security Program's Weather Accident Prevention Project (WxAP), this report documents Delta's experience working with the technologies, feedback gained from pilots and dispatchers concerning current turbulence techniques and procedures, and Delta's recommendations regarding directions for further efforts by the research community. Technologies evaluated included an automatic airborne turbulence encounter reporting technology called the Turbulence Auto PIREP System (TAPS), and a significant enhancement to the ability of modern airborne weather radars to predict and display turbulence of operational significance, called E-Turb radar.
Author
Airborne Radar; Accident Prevention; Warning Systems; Turbulence; Flight Safety; Prediction Analysis Techniques; Aircraft Safety; Commercial Aircraft

20070017926 NASA Ames Research Center, Moffett Field, CA, USA
Enhanced Rescue Lift Capability
Young, Larry A.; May 3, 2007; 25 pp.; In English; 63rd Annual Forum of the AHS International, 1-3 May 2007, Virginia Beach, VA, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017926

The evolving and ever-increasing demands of emergency response and disaster relief support provided by rotorcraft dictate, among other things, the development of enhanced rescue lift capability for these platforms. This preliminary analysis

is first-order in nature but provides considerable insight into some of the challenges inherent in trying to effect rescue using a unique form of robotic rescue device deployed and operated from rotary-wing aerial platforms.
Author
Rescue Operations; Flying Platforms; Rotary Wing Aircraft; Robotics

20070017927 NASA Ames Research Center, Moffett Field, CA, USA
Future Roles for Autonomous Vertical Lift in Disaster Relief and Emergency Response
Young, Larry A.; Nov. 17, 2006; 30 pp.; In English; AHS International Specialists' Meeting on Advanced Rotorcraft Technology and Life Saving Activity, 15-17 Nov. 2006, Aichi, Japan; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017927

System analysis concepts are applied to the assessment of potential collaborative contributions of autonomous system and vertical lift (a.k.a. rotorcraft, VTOL, powered-lift, etc.) technologies to the important, and perhaps underemphasized, application domain of disaster relief and emergency response. In particular, an analytic framework is outlined whereby system design functional requirements for an application domain can be derived from defined societal good goals and objectives.
Author
Vertical Takeoff Aircraft; Rotary Wing Aircraft; Powered Lift Aircraft; Functional Design Specifications; Systems Analysis; Systems Engineering

20070017940 NASA Ames Research Center, Moffett Field, CA, USA
Simulation Assisted Risk Assessment: Blast Overpressure Modeling
Lawrence, Scott L.; Gee, Ken; Mathias, Donovan; Olsen, Michael; May 19, 2006; 10 pp.; In English; 8th International Conference on Probabilistic Safety Assessment and Management, 14-19 May 2006, New Orleans, LA, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS2-00062; NNA05BF35C; Copyright; Avail.: CASI: A02, Hardcopy

A probabilistic risk assessment (PRA) approach has been developed and applied to the risk analysis of capsule abort during ascent. The PRA is used to assist in the identification of modeling and simulation applications that can significantly impact the understanding of crew risk during this potentially dangerous maneuver. The PRA approach is also being used to identify the appropriate level of fidelity for the modeling of those critical failure modes. The Apollo launch escape system (LES) was chosen as a test problem for application of this approach. Failure modes that have been modeled and/or simulated to date include explosive overpressure-based failure, explosive fragment-based failure, land landing failures (range limits exceeded either near launch or Mode III trajectories ending on the African continent), capsule-booster re-contact during separation, and failure due to plume-induced instability. These failure modes have been investigated using analysis tools in a variety of technical disciplines at various levels of fidelity. The current paper focuses on the development and application of a blast overpressure model for the prediction of structural failure due to overpressure, including the application of high-fidelity analysis to predict near-field and headwinds effects.
Author
Risk; Assessments; Structural Failure; Overpressure; Mathematical Models; Launch Escape Systems; Ascent

20070017951 NASA Ames Research Center, Moffett Field, CA, USA
Cost Analysis for Large Civil Transport Rotorcraft
Coy, John J.; [2006]; 10 pp.; In English; Vertical Lift Aircraft Design Conference, 18-20 Jan. 2006, San Francisco, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

This paper presents cost analysis of purchase price and DOC+I (direct operating cost plus interest) that supports NASA s study of three advanced rotorcraft concepts that could enter commercial transport service within 10 to 15 years. The components of DOC+I are maintenance, flight crew, fuel, depreciation, insurance, and finance. The cost analysis aims at VTOL (vertical takeoff and landing) and CTOL (conventional takeoff and landing) aircraft suitable for regional transport service. The resulting spreadsheet-implemented cost models are semi-empirical and based on Department of Transportation and Army data from actual operations of such aircraft. This paper describes a rationale for selecting cost tech factors without which VTOL is more costly than CTOL by a factor of 10 for maintenance cost and a factor of two for purchase price. The three VTOL designs selected for cost comparisons meet the mission requirement to fly 1,200 nautical miles at 350 knots and 30,000 ft carrying 120 passengers. The lowest cost VTOL design is a large civil tilt rotor (LCTR) aircraft. With cost tech factors applied, the LCTR is reasonably competitive with the Boeing 737-700 when operated in economy regional service

following the business model of the selected baseline operation, that of Southwest Airlines.
Author
Civil Aviation; Vertical Takeoff Aircraft; Tilt Rotor Aircraft; Commercial Aircraft; Cost Analysis; Rotary Wing Aircraft; Operating Costs; Insurance (Contracts); Depreciation

20070017957 Civil Aerospace Medical Inst., Oklahoma City, OK, USA
Color Analysis in Air Traffic Control Displays, Part 2, Auxiliary Displays
Xing, Jing; March 2007; 20 pp.; In English
Contract(s)/Grant(s): AM-HRRD522
Report No.(s): DOT/FAA/AM-07/5; No Copyright; Avail.: CASI: A03, Hardcopy

This report presents the second part of our analysis of color use in Air Tr&c 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.
Author
Air Traffic Control; Color; Display Devices; Human Factors Engineering; Systems Engineering; Decision Support Systems

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.

20070016742 Air Force Research Lab., Wright-Patterson AFB, OH USA
Aging Aircraft NDE: Capabilities, Challenges, and Opportunities (Preprint)
Lindgren, E A; Knopp, J S; Aldrin, J C; Steffes, G J; Buynak, C F; Oct 2006; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-M04R
Report No.(s): AD-A464674; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464674

U.S. Air Force aircraft are managed by Damage Tolerance Assessment (DTA) and Nondestructive Evaluation (NDE) plays a critical role in insuring their flight safety. This paper provides an overview of current NDE capabilities for aircraft structures. The potential migration to Condition-Based Maintenance (CBM) will require NDE to evolve from detection of defects to characterization of their location and size. This represents multiple significant challenges as aircraft have many material and geometry factors that complicate this analysis. This paper provides a strategy to resolve these factors.
DTIC
Aircraft; Characterization; Damage; Detection; Nondestructive Tests; Signal Processing; Tolerances (Mechanics)

20070016744 Computational Tools, Inc., Gurnee, IL USA
Probabilistic Risk Assessment: Impact of Human Factors on Nondestructive Evaluation and Sensor Degradation on Structural Health Monitoring (Preprint)
Aldrin, John C; Medina, Enrique A; Allwine, Daniel A; Qadeer Ahmed, Mohammed; Fisher, Joseph; Knopp, Jeremy S; Lindgren, Eric A; Sep 2006; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-03-D-5204; F33615-03-C-5226; Proj-4349
Report No.(s): AD-A464678; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464678

Managing human factors in nondestructive evaluation is critical to maintain inspection reliability. Reliability of structural

health monitoring systems is particularly sensitive to sensor degradation over time. To investigate the impact of these issues, probabilistic models for risk assessment and cost-benefits analysis have been developed. Quantitative studies are presented evaluating the effects of variations in probability of detection associated with human factors, plus in-situ sensor degradation on life cycle measures such as cost and probability of failure.
DTIC
Assessments; Degradation; Detectors; Health; Human Factors Engineering; Nondestructive Tests; Risk

20070016757 Air Force Research Lab., Wright-Patterson AFB, OH USA
Investigation of a Model-Assisted Approach to Probability of Detection Evaluation (Preprint)
Knopp, J S; Aldrin, J C; Lindgren,, E; Annis, C; Sep 2006; 10 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464706; AFRL-ML-WP-TP-2006-494; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464706

This paper presents a model-assisted probability of detection (MAPOD) study for inspection of a two-layer airframe structure. Eddy current measurements for varying crack length around fastener holes in a two-layer aluminum structure are studied using both experimental and model-generated data. New statistical algorithms are used to calculate the probability of detection. Good agreement was achieved between empirical and model-assisted approaches.
DTIC
Airframes; Detection; Eddy Currents; Probability Theory

20070016758 Dayton Univ., OH USA
Estimating the Distribution of the Sizes Of Flaws Remaining After an Inspection (Preprint)
Hovey, Peter W; Berens, Alan P; Knopp, Jeremy; Sep 2006; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-03-D-5204; Proj-4349
Report No.(s): AD-A464707; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464707

The U.S. Air Force plans for maintenance and retirement of aircraft based in part on fatigue crack growth models. Periodic inspections are used to help assess airworthiness and plan for future inspections. Nondestructive inspections are not perfect so some cracks are missed and the likelihood that an individual crack is detected is a function of the size of the crack when inspected. Additionally, the crack size distribution is related to the number of flight hours the aircraft has experienced, so not all inspection results come from the same distribution. In a recent study several models were compared that utilize the capability of the inspection system and the variation between aircraft and times of inspections to estimate the distribution of sizes of cracks that were missed during the inspection. This white paper summarizes those results and identifies some methods for extending them.
DTIC
Aircraft Reliability; Airframes; Cracks; Defects; Estimating; Inspection

20070016772 California Inst. of Tech., Pasadena, CA USA
Vehicle Motion Planning Using Stream Functions
Waydo, Stephen; May 6, 2003; 16 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-01-2-0557
Report No.(s): AD-A464756; CDS-TR-2003-001; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464756

Borrowing a concept from hydrodynamic analysis, this paper presents stream functions which satisfy Laplace's equation as a local-minima free method for producing potential-field based navigation functions in two dimensions. These functions generate smoother paths (i.e. more suited to aircraft-like vehicles) than previous methods. A method is developed for constructing analytic stream functions to produce arbitrary vehicle behaviors while avoiding obstacles, and an exact solution for the case of a single uniformly moving obstacle is presented. The effects of introducing multiple obstacles are discussed and current work in this direction is detailed. Experimental results generated on the Cornell RoboFlag testbed are presented and discussed, as well as related work applying these methods to path planning for unmanned air vehicles.
DTIC
Analytic Functions; Motion; Planning; Remotely Piloted Vehicles; Trajectory Control

20070016788 Air Force Research Lab., Wright-Patterson AFB, OH USA

Micro UAV Path Planning for Reconnaissance in Wind (Preprint)

Ceccarelli, Nicola; Enright, John J; Frazzoli, Emilio; Rasmussen, Steven J; Schumacher, Corey J; Oct 2006; 11 pp.; In English

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

Report No.(s): AD-A464782; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464782

The problem addressed in this paper is the control of a Micro Unmanned Aerial Vehicle (MAV) for the purpose of obtaining video footage of a set of known ground targets with preferred azimuthal viewing angles, using fixed onboard cameras. Control is exercised only through the selection of waypoints, without modification of the MAV's pre-existing autopilot and waypoint following capability. Specifically, we investigate problems and potential solutions of performing this task in the presence of a known constant wind. Simulations are provided in presence of randomly perturbed wind, based on the Air Force Research Laboratory equipment and the high fidelity simulator MultiUAV2.

DTIC

Angle of Attack; Automatic Pilots; Planning; Reconnaissance; Software Development Tools; Targets; Trajectory Planning; Wind (Meteorology)

20070016799 Air Force Research Lab., Wright-Patterson AFB, OH USA

Combining Collision Avoidance and Operator Workload Reduction with Cooperative Task Assignment and Path Planning (Preprint)

Saunders, Jeffery B; Rasmussen, Steven J; Schumacher, Corey J; Oct 2006; 9 pp.; In English; Original contains color illustrations

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

Report No.(s): AD-A464797; AFRL-VA-WP-TP-2006-346; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464797

This paper develops a method of assignment and path allocation that incorporates a priori collision avoidance and operator workload reduction in assigning multiple tasks to cooperative unmanned aerial vehicles (UAV). The problem is posed as a combinatorial optimization problem. A branch and bound tree search algorithm is implemented for a satisfying solution using a cost function that integrates distance traveled, proximity to other UAVs, and target visitation times. The results demonstrate that the assigned path is near optimal with respect to distance traveled, significantly increases the expected proximity distance to other UAVs, and significantly increases the difference between visitation times of targets. The algorithm runs in less than a tenth of a second allowing on the fly replanning.

DTIC

Autonomous Navigation; Collision Avoidance; Drone Vehicles; Trajectory Planning; Workloads (Psychophysiology)

20070016809 Army Cold Regions Research and Engineering Lab., Hanover, NH USA

Benefits of Using Remotely Operated Vehicles to Inspect USACE Navigation Structures

Lever, James H; Phetteplace, Gary E; Weale, Jason C; Mar 2007; 28 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464975; ERDC/CRREL-TR-07-4; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464975

The U.S. Army Corps of Engineers operates numerous navigation locks and dams across the country. Age and lack of funds to maintain these structures has led to significant increases in unscheduled outages. Dewatering provides the best inspection opportunity but is costly and halts navigation traffic. Diver inspections are costly, and safety is an issue. Frequent underwater inspections using remotely operated vehicles (ROVs) would help reduce the number and severity of unscheduled outages at low cost, with little impact on navigation and few safety concerns. ROV use was documented at two Corps facilities and one public utility district and their costs were compared with inspections using divers or dewatering. In each case, benefits from reduced labor costs, shipping delays, and lost power production far exceed the amortized costs of the ROVs. The payback period for purchasing an ROV can be less than one year, and their easy deployment encourages more frequent inspections. ROV technology can immediately help to improve Corps asset management and public safety assurance through increased underwater inspections. Most Corps navigation facilities should own a small ROV, costing about $30K, to conduct visual inspections. Also, the Corps should partner with vendors to improve ROV internal navigation and to integrate real-time position, sensor data, and visual images within 3-D virtual representations of its structures.

DTIC

Dams; Navigation; Remotely Piloted Vehicles

20070016925 SAFT America, Inc., Cockeysville, MD USA

SAFT Li-ion Technology for High Rate Applications

Nechev, Kamen; Deveney, Bridget; Guseynov, Teymur; Erbacher, John; Vukson, Stephen; Nov 2006; 6 pp.; In English

Contract(s)/Grant(s): F33615-03-D-2350-0001; Proj-3145

Report No.(s): AD-A464838; TP-2006-01-3021; No Copyright; Avail.: CASI: A02, Hardcopy

SAFT will present an update of its state-of-the art Very High Power (VHP) Lithium-ion (Li-ion) technology. The VHP cells are currently being qualified for use in military aircraft applications as well as in future military hybrid vehicles. Additionally, their use in Directed Energy Weapon (DEW) systems is also being explored.

DTIC

Electric Batteries; Lithium Batteries; Technology Utilization; Weapon Systems

20070016926 Air Force Research Lab., Wright-Patterson AFB, OH USA

Aircraft Thermal Management Using Loop Heat Pipes: Experimental Simulation of High Acceleration Environments Using the Centrifuge Table Test Bed (Postprint)

Fleming, Andrew J; Leland, Quinn H; Yerkes, Kirk L; Elston, Levi J; Thomas, Scott K; Nov 2006; 12 pp.; In English

Contract(s)/Grant(s): Proj-3145

Report No.(s): AD-A464839; AFRL-PR-WP-TP-2007-208; No Copyright; Avail.: CASI: A03, Hardcopy

The objective of this paper is to describe the design of an experiment that will examine the effects of elevated acceleration environments on a high-temperature, titanium-water loop heat pipe for actuator cooling. An experimental test setup has been designed for mounting a loop heat pipe on an 8-ft-diameter centrifuge table, which is capable of radial accelerations of up to 12-g's. A high-temperature PAO loop will interface the condenser of the loop heat pipe to simulate the rejection of the transported heat to an elevated temperature. In addition to LHP experimentation, a mathematical model has been developed for aerodynamic heating of high-speed aircraft. A flat plate at zero-incidence, used to model an aircraft wing, was subjected to sub- and supersonic flow to examine whether heat will be rejected or absorbed. The results of this analysis will be used to determine the condenser conditions of the loop heat pipe during centrifuge testing.

DTIC

Aerodynamic Heating; Centrifuges; Environment Simulation; Heat Pipes; High Acceleration; Temperature Control; Test Stands; Titanium; Water

20070016938 Air Force Research Lab., Wright-Patterson AFB, OH USA

Centrifuge Testing of a Partially-Confined FC-72 Spray

Elston, Levi J; Yerkes, Kirk L; Fleming, Andrew J; Thomas, Scott K; Nov 2006; 7 pp.; In English

Contract(s)/Grant(s): Proj-3145

Report No.(s): AD-A464856; AFRL-PR-WP-TP-2007-209; No Copyright; Avail.: CASI: A02, Hardcopy

The effects of elevated acceleration fields on spray cooling heat transfer are discussed in this paper. Spray cooling has proven to be one of the most efficient methods of heat removal. This technology is being transitioned into more advanced applications, such as fighter aircraft that must withstand a wide range of variable acceleration-induced body forces. Heat transfer associated with closed-loop spray cooling will be affected by acceleration body forces, the extent of which is not yet known. To test these various effects, an eight-foot-diameter centrifuge table will be outfitted with a spray cooling system to test for the effects associated with elevated gravity.

DTIC

Centrifuges; Confinement; Cooling; Liquid Cooling; Sprayers

20070016951 Air Force Research Lab., Wright-Patterson AFB, OH USA

The Effects of Ejection Seat Cushion Design on Physical Fatigue and Cognitive Performance

Pellettiere, Joseph; Parakkat, Julia; Reynolds, David; Sasidharan, Manikandan; El-Zoghbi, Muhamed; Oudenhuijzen, Aernout; Nov 2006; 39 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): EOARD-043066; Proj-7184

Report No.(s): AD-A464871; No Copyright; Avail.: CASI: A03, Hardcopy

The detrimental effects of prolonged sitting during long-duration flights include deep vein thrombosis, pressure sores, and decreased awareness and performance. However, the cushion is often the only component of the ejection seat system that can be modified to mitigate these effects. This study investigated the long-duration effects of sitting in four ejection seat cushions over eight hours. Subjective comfort survey data and cognitive performance data were gathered along with comparative

objective data, including seated pressures, muscular fatigue levels, and lower extremity oxygen saturation. Peak seated pressures ranged from 1.22-3.22 psi. Oxygen saturation in the lower extremities decreased over the eight hours. Cognitive performance increased over time regardless of cushion with the exception of the dynamic cushion, which induced a decrease in performance for females. Muscular fatigue increased throughout the eight hours regardless of cushion, with the exception of the dynamic cushion which promoted muscular recovery. Subjective comfort levels declined over the eight hours. Subjective measurements correlated with objective parameters for the static cushions. Trade-offs in performance and fatigue mitigation were apparent in the dynamic cushion which also highlighted the differences between genders. These results will be used to develop cushion design guidelines, both to prevent deep vein thrombosis and to promote performance and comfort for long-duration use.
DTIC
Cognition; Comfort; Cushions; Ejection Seats; Mental Performance

20070016964 Naval War Coll., Newport, RI USA
Lethal Autonomous Weapons -- Ethical and Doctrinal Implications
Guetlein, Michael A; Feb 14, 2005; 35 pp.; In English
Report No.(s): AD-A464896; No Copyright; Avail.: CASI: A03, Hardcopy

The use of unmanned autonomous weapons (robots and other unmanned weapon systems) on the battlefield is rapidly expanding. Autonomous weapons will influence the way in which the USA wages battles in the future. They are the springboard for a transformation that will eventually result in a Revolution in Military Affairs (RMA). However, there is a reluctance to arm them, which would exploit their full potential. Critics often cite the legal and ethical dimensions of fighting battles and killing humans with machines. The USA should begin capitalizing on the benefits autonomous weapons bring to the fight and should be preemptive in establishing joint war fighting doctrine and shaping international policy. This paper explores some of the operational benefits of autonomous weapons in terms of Joint Vision 2020, precision engagement, information superiority, and command and control. The author also discusses barriers to the use of autonomous weapons, including legal barriers, ethical barriers, the Law of Armed Conflict, and social implications. The paper includes a 9-page bibliography of journal articles, books, government documents, internet resources, internet sites, published papers, and unpublished papers.
DTIC
Autonomy; Ethics; Military Operations; Robotics; Weapon Systems

20070016988 Naval Postgraduate School, Monterey, CA USA
Proposed Architecture for a Helicopter Information Awareness Module (I-AM)
Oros, Carl; Mar 19, 2004; 53 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464941; No Copyright; Avail.: CASI: A04, Hardcopy

This paper proposes an Information Awareness Module (I-AM) architecture that addresses the innate need for shared battle space awareness among aviation entities in real to near real time. Though this architecture will be described from a helicopter vantage it is not limited to this entity class. Rather the intent has been to adopt an architectural framework that supports a product line approach capable of addressing this basic battle space need of all entities (Air Ground Sea). This shared awareness is facilitated by the tailored exchange of information that by nature should be inherently valuable relevant and timely to any user or platform requiring it.
DTIC
Heaters; Helicopters; Management Systems

20070017061 General Accounting Office, Washington, DC USA
Tactical Aircraft. DOD Needs a Joint and Integrated Investment Strategy
Apr 2007; 88 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465184; GAO-07-415; No Copyright; Avail.: CASI: A05, Hardcopy

The Department of Defense (DOD) plans to invest $109 billion in its tactical air forces between 2007 and 2013. Long term, DOD plans to replace aging legacy aircraft with fewer, more expensive but more capable and stealthy aircraft. Recapitalizing and modernizing tactical air forces within today's constrained budget environment is a formidable challenge. DOD has already incurred substantial cost and schedule overruns in its acquisition of new systems, and further delays could require billions of dollars in additional investments to keep legacy aircraft capable and sustainable. Because of the large investments and risk, GAO was asked to review investment planning for tactical aircraft. This report describes the current

status of DOD's new tactical aircraft acquisition programs; identifies current impacts on legacy aircraft modernization programs and retirement schedules; and assesses DOD's overall investment plan for tactical aircraft. To achieve better outcomes in acquisition programs and investment planning, GAO recommends that DOD (1) take decisive actions to shorten cycle times in developing and delivering new weapon systems and (2) develop an integrated and affordable enterprise-level investment strategy for tactical air forces.
DTIC
Acquisition; Planning

20070017279 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
B-2 Systems Engineering Case Study
Griffin, John M; Kinnu, James K; Colombi, John M; Jan 2007; 118 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464771; No Copyright; Avail.: CASI: A06, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464771

The B-2 Systems Engineering Case Study describes the application of systems engineering during the concept exploration, design, and development of the USAF B-2 Spirit stealth bomber. The case examines and explores the systems engineering process as applied by the Air Force B-2 System Program Office, the prime contractor, Northrop, and the two major subcontractors, Boeing and Vought, from the program's genesis in the late 1970s to the first flight of the first aircraft on 17 July 1989 The systems engineering process is traced from a vision of a few planners in 1978 to the production of 21 operational aircraft that are currently serving our nation. Numerous interviews were conducted with the principals who managed and directed the program and a study of the systems engineering process emerged. The B-2 was conceived to profit from the advances in stealth technology that grew from a series of laboratory experiments and design studies during 1970 to 1976. The early work by both the government and industry during this timeframe resulted in feasible and practical stealth vehicles that exist throughout our military. The current operational fleets of fighters, bombers, UAVs, ships, and other stealth vehicles trace their heritage to the early technology maturation and engineering development programs. Stealth (or low observables, as it was called by the original practitioners) offered a new and revolutionary approach for penetrating the burgeoning growth of the Soviet defensive system of an integrated radar network. The fighter was the first type of weapon system to be studied for the benefits of stealth and the pay-off was assessed as substantial. The bomber was the next obvious candidate, and it too, showed great promise. Lockheed was in the lead for the technology application for fighters and was awarded the development contract for the F-117 stealth fighter.
DTIC
Fighter Aircraft; Jet Aircraft; Systems Engineering

20070017314 NASA Glenn Research Center, Cleveland, OH, USA
Effective Training for Flight in Icing Conditions
Barnhart, Billy P.; Ratvasky, Thomas P.; March 2007; 16 pp.; In English; Interservice/Industry Training, Simulation and Education Conference (I/ITSEC), 4-7 Dec. 2006, Orlando, FL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 609866.02.07.03.02
Report No.(s): NASA/TM-2007-214693; E-15882; I/ITSEC 2006 Paper No. 2973; Copyright; Avail.: CASI: A03, Hardcopy

The development of a piloted flight simulator called the Ice Contamination Effects Flight Training Device (ICEFTD) was recently completed. This device demonstrates the ability to accurately represent an iced airplane s flight characteristics and is utilized to train pilots in recognizing and recovering from aircraft handling anomalies that result from airframe ice formations. The ICEFTD was demonstrated at three recent short courses hosted by the University of Tennessee Space Institute. It was also demonstrated to a group of pilots at the National Test Pilot School. In total, eighty-four pilots and flight test engineers from industry and the regulatory community spent approximately one hour each in the ICEFTD to get a 'hands on' lesson of an iced airplane s reduced performance and handling qualities. Additionally, pilot cues of impending upsets and recovery techniques were demonstrated. The purpose of this training was to help pilots understand how ice contamination affects aircraft handling so they may apply that knowledge to the operations of other aircraft undergoing testing and development. Participant feedback on the ICEFTD was very positive. Pilots stated that the simulation was very valuable, applicable to their occupations, and provided a safe way to explore the flight envelope. Feedback collected at each demonstration was also helpful to define additional improvements to the ICEFTD; many of which were then implemented in subsequent demonstrations.
Author
Ice Formation; Flight Training; Flight Simulators; Flight Conditions; Test Pilots; Training Devices

20070017318 NASA Johnson Space Center, Houston, TX, USA

Numerical Strip-Yield Calculation of CTOD

Beek, Joachim; Forman, Royce; April 16, 2007; 29 pp.; In English; 10th Joint DOD/NASA/FAA Conference on Aging, 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/2060/20070017318

Many existing methods to calculate CTOD can be costly and complicated, or apply only to particular configurations. A new numerical method for calculating CTOD was investigated. NASGRO's Boundary Element module NASBEM was adapted to calculate displacements at any point on the crack. Demonstrated for a number of crack configurations: a) finite and infinite domains; b) center and edge cracks; and c) complex cases with several cracks and holes. Great accuracy at minimal computational cost.

Derived from text

Displacement; Holes (Mechanics); Boundaries; Cracks; Domains

20070017899 NASA Glenn Research Center, Cleveland, OH, USA

Modeling Creep-Induced Stress Relaxation at the Leading Edge of SiC/SiC Airfoils

Lang, Jerry; DiCarlo, James A.; [2007]; 16 pp.; In English; 31st Annual Conference Composites Materials and Structures, 22-25 Jan. 2007, Daytona Beach, FL, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 984754.02.07.01.16.03; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017899

Anticipating the implementation of advanced SiC/SiC composites into internally cooled airfoil components within the turbine section of future aero-propulsion engines, the primary objective of this study was to develop physics-based analytical and finite-element modeling tools to predict the effects of composite creep and stress relaxation at the airfoil leading edges, which will generally experience large thermal gradients at high temperatures. A second objective was to examine how some advanced NASA-developed SiC/SiC systems coated with typical EBC materials would behave as leading edge materials in terms of long-term steady-state operating temperatures. Because of the complexities introduced by mechanical stresses inherent in internally cooled airfoils, a simple cylindrical thin-walled tube model subjected to thermal stresses only is employed for the leading edge, thereby obtaining a best-case scenario for the material behavior. In addition, the SiC/SiC composite materials are assumed to behave as isotropic materials with temperature-dependent viscoelastic creep behavior as measured in-plane on thin-walled panels. Key findings include: (1) without mechanical stresses and for typical airfoil geometries, as heat flux is increased through the leading edge, life-limiting tensile crack formation will occur first in the hoop direction on the inside wall of the leading edge; (2) thermal gradients through all current SiC/SiC systems should be kept below approx.300 F at high temperatures to avoid this cracking; (3) at temperatures near the maximum operating temperatures of advanced SiC/SiC systems, thermal stresses induced by the thermal gradients will beneficially relax with time due to creep; (4) although stress relaxation occurs, the maximum gradient should still not exceed 300oF because of residual tensile stress buildup on the airfoil outer wall during cool-down; and (5) without film cooling and mechanical stresses, the NASA-developed N26 SiC/SiC system with thru-thickness Sylramic-iBN fiber reinforcement and a typical EBC coating has the potential of offering a maximum long-term steady-state operating temperature of approx.3100 F at the surface of the EBC.

Author

Silicon Carbides; Airfoils; Leading Edges; Creep Properties; Composite Materials; Turbines; Temperature Dependence; High Temperature; Heat Flux; Finite Element Method; Coatings

20070017928 NASA Ames Research Center, Moffett Field, CA, USA

Aeromechanics Analysis of a Compound Helicopter

Yeo, Hyeonsoo; Johnson, Wayne; May 11, 2006; 16 pp.; In English; 2006 American Helicopter Society Forum, 9-11 May 2006, Phoenix, Az, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017928

A design and aeromechanics investigation was conducted for a 100,000-lb compound helicopter with a single main rotor, which is to cruise at 250 knots at 4000 ft/95 deg F condition. Performance, stability, and control analyses were conducted with the comprehensive rotorcraft analysis CAMRAD II. Wind tunnel test measurements of the performance of the H-34 and UH-1D rotors at high advance ratio were compared with calculations to assess the accuracy of the analysis for the design of a high speed helicopter. In general, good correlation was obtained with the increase of drag coefficients in the reverse flow region. An assessment of various design parameters (disk loading, blade loading, wing loading) on the performance of the

compound helicopter was made. Performance optimization was conducted to find the optimum twist, collective, tip speed, and taper using the comprehensive analysis. Blade twist was an important parameter on the aircraft performance and most of the benefit of slowing the rotor occurred at the initial 20 to 30% reduction of rotor tip speed. No stability issues were observed with the current design and the control derivatives did not change much with speed, but did exhibit significant coupling.
Author
Compound Helicopters; Aerodynamic Coefficients; Design Analysis; Helicopter Design; Wind Tunnel Tests; Rotary Wing Aircraft; Fluid Mechanics; Aerodynamic Drag

20070017929 NASA Ames Research Center, Moffett Field, CA, USA
Optimum Design of a Compound Helicopter
Yeo, Hyeonsoo; Johnson, Wayne; Nov. 17, 2006; 18 pp.; In English; Heli Japan 2006 AHS International Meeting on Advanced Rotorcraft Technology and Lift Saving Activities, 15-17 Nov. 2006, Nagoya, Japan; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017929

A design and aeromechanics investigation was conducted for a 100,000-lb compound helicopter with a single main rotor, which is to cruise at 250 knots at 4000 ft/95 deg F condition. Performance, stability, and control analyses were conducted with the comprehensive rotorcraft analysis CAMRAD II. Wind tunnel test measurements of the performance of the H-34 and UH-1D rotors at high advance ratio were compared with calculations to assess the accuracy of the analysis for the design of a high speed helicopter. In general, good correlation was obtained when an increase of drag coefficients in the reverse flow region was implemented. An assessment of various design parameters (disk loading, blade loading, wing loading) on the performance of the compound helicopter was conducted. Lower wing loading (larger wing area) and higher blade loading (smaller blade chord) increased aircraft lift-to-drag ratio. However, disk loading has a small influence on aircraft lift-to-drag ratio. A rotor parametric study showed that most of the benefit of slowing the rotor occurred at the initial 20 to 30% reduction of the advancing blade tip Mach number. No stability issues were observed with the current design. Control derivatives did not change significantly with speed, but the did exhibit significant coupling.
Author
Helicopter Design; Design Analysis; Compound Helicopters; Wind Tunnel Tests; Rotary Wing Aircraft; Lift Drag Ratio; Wing Loading; Aerodynamic Coefficients; Aerodynamic Drag

20070017930 NASA Ames Research Center, Moffett Field, CA, USA
Performance and Design Investigation of Heavy Lift Tiltrotor with Aerodynamic Interference Effects
Yeo, Yyeonsoo; Johnson, Wayne; May 4, 2007; 19 pp.; In English; AHS Forum May 2007, 1-4 May 2007, Virginia Beach, VA, USA; Original contains color and black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017930

The aerodynamic interference effects on tiltrotor performance in cruise are investigated using comprehensive calculations, to better understand the physics and to quantify the effects on the aircraft design. Performance calculations were conducted for 146,600-lb conventional and quad tiltrotors, which are to cruise at 300 knots at 4000 ft/95 deg F condition. A parametric study was conducted to understand the effects of design parameters on the performance of the aircraft. Aerodynamic interference improves the aircraft lift-to-drag ratio of the baseline conventional tiltrotor. However, interference degrades the aircraft performance of the baseline quad tiltrotor, due mostly to the unfavorable effects from the front wing to the rear wing. A reduction of rotor tip speed increased the aircraft lift-to-drag ratio the most among the design parameters investigated.
Author
Design Analysis; Tilt Rotor Aircraft; Aerodynamic Interference; Performance Prediction; Lift Drag Ratio; Rotor Speed; Interference Lift

20070017931 NASA Ames Research Center, Moffett Field, CA, USA
Three-dimensional Computational Fluid Dynamics Investigation of a Spinning Helicopter Slung Load
Theorn, J. N.; Duque, E. P. N.; Cicolani, L.; Halsey, R.; Sep. 15, 2005; 25 pp.; In English; 31st European Rotorcraft Forum, 13-15 Sep. 2005, Florence, Italy; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNA04CK19G; NNA05CS80A; Copyright; Avail.: CASI: A03, Hardcopy

After performing steady-state Computational Fluid Dynamics (CFD) calculations using OVERFLOW to validate the CFD method against static wind-tunnel data of a box-shaped cargo container, the same setup was used to investigate unsteady flow

with a moving body. Results were compared to flight test data previously collected in which the container is spinning.
Author
Computational Fluid Dynamics; Helicopters; Loads (Forces); Wind Tunnel Tests; Flight Tests

20070017933 NASA Ames Research Center, Moffett Field, CA, USA
Investigating Tiltrotor Formation Flight via 1/48-Scale Wind Tunnel Experiment
Romander, Ethan; Betzina, Mark; Silva, Mark; Wadcock, Alan; Yamauchi, Gloria; May 11, 2007; 19 pp.; In English; AHS 62nd Annual Forum, 9-11 May 2006, Phoenix, AZ, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

This paper describes two small-scale wind tunnel tests conducted in the Army 7- by 10-Foot Wind Tunnel at NASA Ames Research Center. These tests featured two 1/48-scale V-22 models that were operated in a variety of simulated flight conditions including climb, descent, and level flight at various flight speeds and spatial separations. Forces and moments experienced by the trail aircraft were used to deduce the influence of the lead aircraft on the trail aircraft. Particle Image Velocimetry (PIV) data were collected to relate these forces and moments to features in the lead aircraft wake. In general, the roll moment on the trail aircraft is shown to be maximum when the aircraft are laterally offset by a full wingspan and the trail aircraft is vertically positioned so as to be in the wake of the lead aircraft. Furthermore, the roll moment is maximal when operating near 50 knots full-scale flight speed. Because the interaction persists far downstream and the vertical position of the wake is dependent on descent angle and flight speed, lateral separation has been determined to be the best means of avoiding adverse interactions between aircraft.
Author
Wind Tunnel Tests; V-22 Aircraft; Scale Models; Tilt Rotor Aircraft; Climbing Flight; Descent

20070017996 NASA Dryden Flight Research Center, Edwards, CA, USA
Build-up Approach to Updating the Mock Quiet Spike(TradeMark) Beam Model
Herrera, Claudia Y.; Pak, Chan-gi; 23 Apr. 2007; 11 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; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017996

A crucial part of aircraft design is ensuring that the required margin for flutter is satisfied. A trustworthy flutter analysis, which begins by possessing an accurate dynamics model, is necessary for this task. Traditionally, a model was updated manually by fine tuning specific stiffness parameters until the analytical results matched test data. This is a time consuming iterative process. NASA Dryden Flight Research Center has developed a mode matching code to execute this process in a more efficient manner. Recently, this code was implemented in the F-15B/Quiet Spike(TradeMark) (Gulfstream Aerospace Corporation, Savannah, Georgia) model update. A build-up approach requiring several ground vibration test configurations and a series of model updates was implemented in order to determine the connection stiffness between aircraft and test article. The mode matching code successfully updated various models for the F-15B/Quiet Spike(TradeMark) project to within 1 percent error in frequency and the modal assurance criteria values ranged from 88.51-99.42 percent.
Author
Flutter Analysis; Aircraft Models; Vibration Tests; Ground Tests; Flutter

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.

20070017863 NASA Langley Research Center, Hampton, VA USA
Method and Apparatus for Loss of Control Inhibitor Systems
Harrah, Ralph C. A., Inventor; October 20, 2005; 8 pp.; In English
Patent Info.: Filed 27 Oct. 2004; US-Patent-Appl-SN-975119; US-Patent-Appl-SN-515215
Report No.(s): PB2007-105980; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017863

Active and adaptive systems and methods to prevent loss of control incidents by providing tactile feedback to a vehicle

operator are disclosed. According to the present invention, an operator gives a control input to an inceptor. An inceptor sensor measures an inceptor input value of the control input. The inceptor input is used as an input to a Steady-State Inceptor Input/Effector Output Model that models the vehicle control system design. A desired effector output from the inceptor input is generated from the model. The desired effector output is compared to an actual effector output to get a distortion metric. A feedback force is generated as a function of the distortion metric. The feedback force is used as an input to a feedback force generator which generates a loss of control inhibitor system (LOCIS) force back to the inceptor. The LOCIS force is felt by the operator through the inceptor.
Author
Flight Control; Control Systems Design; Active Control; Adaptive Control

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.

20070017055 Air Force Research Lab., Wright-Patterson AFB, OH USA
Aviation Safety in the Rapid Onset, High-G Environment
Werchen, Paul; O'Connor, Robert; Albery, William; Makley, Leah; Jan 2006; 19 pp.; In English
Contract(s)/Grant(s): Proj-7757
Report No.(s): AD-A465176; No Copyright; Avail.: CASI: A03, Hardcopy

This is a summary of research conducted on the high-G onset Air Force Research Laboratory centrifuge at Brooks City-Base TX. G-LOC and A-LOC research on the centrifuge is summarized. It was found that the G-LOC episode lasts longer than the nominal 24 sec previously described. It was found that pilot performance can be impaired up to EO sec after a G-LOC. No adverse effect of sustained acceleration was observed in Subjects who had PRK-treated eyes. There has been a proposal to eliminate the counter-pressure vest in pilots flying high- performance aircraft. Subjects reported no adverse effects of using Positive Pressure Breathing without the counter-pressure vest. The Navy's Smart Aircrew Integrated Life Support System (SAILSS) was evaluated on the centrifuge. The SAILSS is an advanced development project for the Navy with the objective of developing the next-generation aircrew life Support system. The Human Information Processing under Dynamic Environment program was evaluated on both the Brooks and Wright-Patterson AFB centrifuges.
DTIC
Aircraft Safety; Data Processing; Flight Control; Flight Safety; Pilots; Pressure Breathing; Pressure Suits

20070017480 NASA Dryden Flight Research Center, Edwards, CA, USA
NASA Dryden Status
Bosworth, John; February 2007; 9 pp.; In English; SAE Aerospace Control and Guidance Sub-committee System Conference, 28 Feb. - 2 Mar. 2007, Williamsburg, VA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017480

A viewgraph presentation on the satus of NASA Dryden's aircraft guidance and control is shown. The topics include: 1) Autonomous Airborne Refueling Demonstration (AARD); 2) Ikhana Project Update; 3) Quiet Spike; 4) F-15 Intelligent Flight Control System; 5) C-20A Precision Autopilot Development; and 6) X-48 Blended Wing Body.
CASI
Aerospace Engineering; Aircraft Guidance; NASA Programs; Automatic Flight Control

20070017943 NASA Ames Research Center, Moffett Field, CA, USA
Calculation of Hub Loads at Low Airspeeds with Active Control
Kottapalli, Sesi; May 3, 2007; 23 pp.; In English; American Helicopter Society 63rd Annual Forum, 1-3 May 2007, Virginia Beach, VA, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 877868.02.07.01.03.02; Copyright; Avail.: Other Sources

The effect of individual blade control (IBC) on the full-scale, low airspeed, level flight UH-60A oscillatory fixed system 4P hub loads and the rotating system blade bending moments is studied. The effect of a single 3P IBC input has been considered in this analytical study. At the low speed under consideration, it has been found that convergence of the comprehensive analysis is important for obtaining good predictions. Good correlation has been obtained with the measured

full-scale wind tunnel data for the shapes of the fixed system 4P hub loads variations with the 3P IBC input phase, and also for the 'best' phase of the 3P input (for minimum hub loads). The blade bending moment comparison shows mixed results. The 3P lead lag and the 4P flap bending moment trends with the 3P IBC input phase are reasonably predicted, whereas the 5P lead lag bending moment trend is not predicted well. Finally, the prediction of the baseline (no IBC) bending moments needs further study.
Author
Active Control; Low Speed; Loads (Forces); Bending Moments; Wind Tunnel Tests; Airspeed; Helicopters

09
RESEARCH AND SUPPORT FACILITIES (AIR)

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

20070017915 NASA Dryden Flight Research Center, Edwards, CA, USA
Update on Piloted and Un-Piloted Aircraft at NASA Dryden
DelFrate, John H.; March 07, 2007; 18 pp.; In English; W-HALES 2007: NASA-NICT Joint Workshop on HALE UAV and Wireless Systems, 7 Mar. 2007, Palmdale, CA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017915

This viewgraph presentation reviews the NASA Dryden Flight Research Center's (DFRC) environment for testing of experimental aircraft. Included are a satellite view of the Dryden locale, and a summary of the capabilities at DFRC. It reviews the capabilites of High Altitude Platform (HAP) testing; Gulfstream III (1.)Unmanned Aerial Vehicle (UAV) synthetic aperture radar (SAR) (2) Precision Trajectory Capability Global Hawk (ACTD); ER-2; Ikhana (Predator B);
CASI
Research Aircraft; Test Vehicles; Test Ranges

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*.

20070016717 Exercise Control Squadron (505th), Papillion, NE USA
C2 Puzzle: Space Authority and the Operational Level of War
Reiss, Jr, Robert J; Jun 2006; 29 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464581; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464581

Who commands space? Who controls space? Who does space support? Who is the lucky warfighter that gains so much support from space? These pointed questions lie at the heart of space power advocates and operational commanders, as they try to decipher the conundrum known as 'space.' Commanders ask, 'What can space do for me?' and ideally the advocates can answer, 'Space can do this for you, and this and this.' However, as with most heavily debated topics, the answers clearly depend upon whom you ask. The national agency advocate (i.e. NRO or NSA) might say, 'I can provide you this, but only at certain times and under certain conditions.' The joint force advocate might say, 'I can provide you anything, unless they were previously requested by someone else.' The military service advocate might say, 'I can give you anything my satellites provide, but I need the request to come from my boss, not directly from you.' In-place C2 constructs and force development clearly shows USA space control and capabilities were originally intended and operated for strategic purposes. Space supported strategic nuclear forces, reconnaissance, National Command Authority (Presidential/Secretary of Defense) communications, and other high-level national needs. Satellites were not anticipated for operational/tactical applications, hence the creation of the programs such as Tactical Exploitation of National Capabilities (TENCAP).
DTIC
Command and Control; Warfare

20070016764 Army Training and Doctrine Command, Fort Monroe, VA USA
The USA Army's Concept Capability Plan (CCP), Space Operations, 2015-2024
Nov 15, 2006; 95 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464725; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464725

The future Modular Force battlefield extends vertically into the region of space and this concept capability plan (CCP) concentrates on the growing importance and dependence of Army operations on space-based systems and space-enabled functions, processes and information. The Army Space Operations CCP is intended to focus the Army's efforts to exploit the ultimate high ground of space and describe the required space-enabled capabilities needed to realize the objectives of our joint and Army concepts. The CCP presents capabilities that enable the effective application of space-based assets and capabilities across the full spectrum of conflict in an interdependent, joint, and multinational environment. It describes how Army forces integrate the power of national, civil, and commercial space-based assets. The CCP is not an end unto itself but rather the foundation for change and will likely result in one or more capability based assessment. The reference timeframe for this CCP is 2015 2024. U.S. space operations are inherently joint and interagency in nature. The CCP recognizes the fact that joint interdependence is essential for the conduct of all Army space operations. This interdependence and complexity extends beyond the traditional Department of Defense (DOD) capabilities to include national agencies such as: the National Aeronautics and Space Administration (NASA), the National Reconnaissance Office, the National Oceanic & Atmospheric Administration, National Geospatial Intelligence Agency, National Security Agency and others. It is critical that the subject matter expertise, roles and unique capabilities each Service and agency provides be leveraged in the conduct of future Modular Force operations.
DTIC
Military Operations; Space Missions; United States

20070016985 Northrop Grumman Space and Mission Systems Corp., Redondo Beach, CA USA
High Capacity Two-Stage Pulse Tube (PREPRINT)
Jaco, C; Nguyen, T; Harvey, D; Tward, E; Nov 2006; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F29601-01-C-0226; Proj-2402
Report No.(s): AD-A464937; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The High Capacity Cryocooler (HCC) provides large capacity cooling at both 35 K and 85 K for space applications in which focal planes and optics require cooling. The compressor is scaled from the High Energy Cryocooler (HEC) compressor and is capable of using input powers up to 700 W. The two linear pulse tube cold heads are integrated with the compressor into an integral cryocooler. A thermal strap between the cold heads improves efficiency and can be positioned to provide cooling for a wide range of applied loads. The cooler has undergone acceptance testing that includes thermal performance mapping over a range of reject temperatures and power levels and launch vibration testing. In addition to the acceptance testing, self induced vibration measurements were made over a range of reject temperatures and power levels.
DTIC
Aerospace Engineering; Aerospace Systems; Coolers; Cooling; Cryogenic Cooling

20070016987 Jackson and Tull, Inc., Albuquerque, NM USA
Overview of the AFRL's Demonstration and Science Experiments (DSX) Program
Adler, Aaron; Guarnieri, Jason; Spanjers, Gregory; Winter, James; Ginet, Gregory; Dichter, Bronislaw; Tolliver, Martin; Cohen, Dan; Sep 2006; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F29601-01-D-0078
Report No.(s): AD-A464940; No Copyright; Avail.: CASI: A03, Hardcopy

The Air Force Research Laboratory (AFRL) Space Vehicles Directorate has developed the Demonstration and Science Experiments (DSX) mission to research technologies needed to significantly advance Department of Defense (DoD) capability to operate spacecraft in the harsh radiation environment of medium-earth orbits (MEO). The ability to operate effectively in the MEO environment significantly increases the DoD's capability to field space systems that provide persistent global targeting-grade space surveillance, high-speed satellite-based communication, lower-cost GPS navigation, and protection from space weather on a responsive satellite platform. The three DSX physics-based research areas are: 1. Wave Particle Interaction Experiment (WPIx): Researching the physics of very-low-frequency (VLF) transmissions in the magnetosphere and characterizing the feasibility of natural and man-made VLF waves to reduce space radiation; 2. Space Weather Experiment (SWx): Characterizing and modeling the space radiation environment in MEO, an orbital regime attractive for future DoD and commercial missions; 3. Space Environmental Effects (SFx): Researching and characterizing the space weather effects on

spacecraft electronics and materials. DSX uses a modular design that allows for launch either as a primary satellite on a conventional launcher, such as a Minotaur, or as a secondary payload on a larger rocket, such as the Evolved Expendable Launch Vehicle (EELV). Another key feature is the use of a dedicated payload computer, which unburdens the avionics of the need to conform to custom payload data interfaces, enabling the rapid procurement of a standard spacecraft bus. An overview of the DSX science experiments, payload design, spacecraft subsystems, and engineering approach will be described.
DTIC
Aerospace Environments; Aerospace Systems; Earth Orbits; Extraterrestrial Radiation; Launch Vehicles; Payloads; Space Weather

13
ASTRODYNAMICS

Includes powered and free flight trajectories; orbital and launching dynamics.

20070017870 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Innovative Trajectory Designs to meet Exploration Challenges
Folta, David C.; August 18, 2006; 19 pp.; In English; Presentation to the New Trends in Astrodynamics, 15-18 Aug. 2006, Princeton, NJ, USA; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017870

This document is a viewgraph presentation of the conference paper. Missions incorporated into NASA's Vision for Space Exploration include many different destinations and regions; are challenging to plan; and need new and innovative trajectory design methods to enable them. By combining proven methods with chaos dynamics, exploration goals that require maximum payload mass or minimum duration can be achieved. The implementation of these innovative methods, such as weak stability boundaries, has altered NASA's approach to meet exploration challenges and is described to show how exploration goals may be met in the next decade. With knowledge that various perturbations play a significant role, the mission designer must rely on both traditional design strategies as well as these innovative methods. Over the past decades, improvements have been made that would at first glance seem dramatic. This paper provides a brief narrative on how a fundamental shift has occurred and how chaos dynamics improve the design of exploration missions with complex constraints.
Author
Chaos; Flight Optimization; Flight Mechanics; Space Flight; Spacecraft Trajectories; Orbital Mechanics; Trajectory Optimization

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*.

20070016763 Air Force Research Lab., Kirkland AFB, NM USA
Studies and Experiments in Structural Dynamics and Control
Pham, Khanh D; Dec 30, 2006; 32 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-2302
Report No.(s): AD-A464717; AFRL-VS-PS-TR-2006-1194; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464717

The objective of this task is to develop enabling structural technologies for future Air Force systems. Four areas of research are currently under investigation: thermal/mechanical to electrical energy conversion utilizing piezoelectrics that explore power augmentation schemes to maximize power available for DoD satellites and the use of piezoelectric power generation produced by thermal expansion proves 5% satellite power augmentations possible; lightweight, low frequency acoustic barrier using particle embedded foil that uses in-plane bending waves in a thin foil layer to improve the low frequency characteristics of melamine foam; cable effects on dynamics of large precision structures that develop a design approach to incorporate the effect of cable damping into models for future large deployable structures; and on-orbit deployment detection that explores the use of the existing attitude control subsystem with a newly proposed attitude control algorithm to detect the

angular orientation change due to space debris impacts and inspector satellite dock for purposes of structural health monitoring and self-awareness.
DTIC
Dynamic Control; Dynamic Response; Dynamic Structural Analysis; Energy Conversion; Military Spacecraft; Piezoelectricity; Structural Analysis

20070016826 Defence Science and Technology Organisation, Canberra, Australia
Reliable Multicast and Integrated Party Retransmission with Channel Estimation Considerations
Gossink, Don E; Macker, Joseph P; Jan 1998; 7 pp.; In English
Report No.(s): AD-A465027; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465027

This paper explores extensions to parity-based retransmission schemes applied to protocols for reliable multicast delivery. It considers a hybrid protocol scheme to potentially reduce the number of required data repair cycles through channel loss prediction. It is conjectured that such a scheme has potential benefit for particular network architectures, such as direct broadcast satellite, in improving protocol throughput delay and efficiency.
DTIC
Artificial Satellites; Broadcasting

20070017033 Air Force Research Lab., Hanscom AFB, MA USA
Midcourse Space Experiment: Off-Axis Rejection Performance of the Infrared Sensor
O'Neil, R R; Gibson, J; Richards, E; Nov 28, 2005; 14 pp.; In English
Contract(s)/Grant(s): Proj-1010
Report No.(s): AD-A465124; No Copyright; Avail.: CASI: A03, Hardcopy

The Spatial Infrared Imaging Telescope III (SPIRIT III) sensor on the Midcourse Space Experiment (MSX) satellite observed stray radiation from the lower atmosphere and terrestrial surface, nonrejected Earth radiance, at angles of approximately 2 to 14 deg from the optical axis in measurements of Earth limb radiance. Analysis indicates that direct scatter of terrestrial radiance from contaminants on the telescope primary mirror is the principal source of stray radiation and the bidirectional reflectance distribution function (BRDF) of the primary mirror for the 6.8-10.8 micrometer radiometer band is off axis. Similarly, the BRDF values for the three other LWIR radiometer bands. The BRDF values derived from the on-orbit data are significantly greater than prelaunch measurements, and the increase is attributed to particulate accumulation on the primary mirror during the prelaunch period, launch, and the on-orbit telescope aperture cover removal and ejection process.
DTIC
Infrared Detectors; Infrared Telescopes; Military Spacecraft; Spaceborne Experiments

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*.

20070016697 NASA Johnson Space Center, Houston, TX, USA
Revalidation of the Volatile Organic Analyzer Following a Major On-Orbit Maintenance Activity
Limero, Thomas; James, John T.; July 12, 2007; 1 pp.; In English; 37th ICES Conference, 9-12 Jul. 2007, Chicago, IL, USA; Copyright; Avail.: Other Sources; Abstract Only

The Volatile Organic Analyzer (VOA) contributes to the assessment of air quality aboard the International Space Station (ISS) by identifying and quantifying target airborne volatile organic contaminants in the module air. This on-orbit contaminant monitoring capability becomes particularly important during an air quality degradation event such as a system leak. During several ISS air quality degradations, the VOA has generated near real-time data that was used to make decisions or to better understand the contingency. The VOA was operational from January 2002 through June 2003, during which time it was validated by comparing VOA data to simultaneously acquired grab sample containers (GSCs). In January 2003, one of the two analytical channels of the VOA was shutdown because of a component failure, but a redundant channel continued to supply the necessary analytical data. In June 2003, the sole remaining channel was deactivated. Initial assessments of the channel shutdowns pointed to failed fuses or heaters, but neither was considered repairable on orbit. In 2005, it was determined that

failed fuses could be replaced on orbit and the crew conducted a diagnostic procedure to identify the failed component. The crew discovered that both channels incurred failed fuses, which lead to a subsequent on orbit maintenance activity and return of the VOA to operational status in December 2005. The VOA has been providing data on the ISS atmosphere since its reactivation in 2005 and this paper will present the VOA data collected during 2006. Special emphasis will be placed upon the revalidation of the repaired VOA using GSCs as well as a summary of the diagnostic and repair procedures.
Author
International Space Station; Volatility; Analyzers; Volatile Organic Compounds

20070017853 NASA Johnson Space Center, Houston, TX, USA
Inadvertent Earth Reentry Breakup Analysis for the New Horizons Mission
Ling, Lisa M.; Salama, Ahmed; Ivanov, Mark; McRonald, Angus; [2007]; 10 pp.; In English; 2nd IAASS Confeence Space Safety in a GLobal World, 14-16 May 2007, Netherlands; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

The New Horizons (NH) spacecraft was launched in January 2006 aboard an Atlas V launch vehicle, in a mission to explore Pluto, its moons, and other bodies in the Kuiper Belt. The NH spacecraft is powered by a Radioisotope Thermoelectric Generator (RTG) which encases multiple General Purpose Heat Source (GPHS) modules. Thus, a pre-launch vehicle breakup analysis for an inadvertent atmospheric reentry in the event of a launch failure was required to assess aerospace nuclear safety and for launch contingency planning. This paper addresses potential accidental Earth reentries analyzed at the Jet Propulsion Laboratory (JPL) which may arise during the ascent to parking orbit, resulting in a suborbital reentry, as well as a departure from parking orbit, resulting in an orbital reentry.
Author
New Horizons Mission; Atmospheric Entry; Atlas Launch Vehicles; Thermoelectric Generators; Radioisotope Heat Sources; Kuiper Belt; Aerospace Safety

20070017902 NASA Glenn Research Center, Cleveland, OH, USA
The Columbia Accident Investigation and The NASA Glenn Ballistic Impact Laboratory Contributions Supporting NASA's Return to Flight
Melis, Matthew E.; [2007]; 51 pp.; In English; Original contains color illustrations; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017902

On February 1, 2003, the Space Shuttle Columbia broke apart during reentry, resulting in loss of the vehicle and its seven crewmembers. For the next several months, an extensive investigation of the accident ensued involving a nationwide team of experts from NASA, industry, and academia, spanning dozens of technical disciplines. The Columbia Accident Investigation Board (CAIB), a group of experts assembled to conduct an investigation independent of NASA, concluded in August, 2003 that the most likely cause of the loss of Columbia and its crew was a breach in the left wing leading edge Reinforced Carbon-Carbon (RCC) thermal protection system initiated by the impact of thermal insulating foam that had separated from the orbiters external fuel tank 81 seconds into the mission's launch. During reentry, this breach allowed superheated air to penetrate behind the leading edge and erode the aluminum structure of left wing, which ultimately led to the breakup of the orbiter. The findings of the CAIB were supported by ballistic impact tests, which simulated the physics of External Tank Foam impact on the RCC wing leading edge material. These tests ranged from fundamental material characterization tests to full-scale Orbiter Wing Leading Edge tests. Following the accident investigation, NASA spent the next 18 months focused on returning the shuttle safely to flight. In order to fully evaluate all potential impact threats from the many debris sources on the Space Shuttle during ascent, NASA instituted a significant impact testing program. The results from these tests led to the validation of high-fidelity computer models, capable of predicting actual or potential Shuttle impact events, were used in the certification of STS-114, NASA s Return to Flight Mission, as safe to fly. This presentation will provide a look into the inner workings of the Space Shuttle and a behind the scenes perspective on the impact analysis and testing done for the Columbia Accident Investigation and NASA's Return to Flight programs. In addition, highlights from recent Shuttle missions are presented.
Author
Accident Investigation; Space Shuttle Missions; NASA Space Programs; Ballistics; Impact Tests; Columbia (Orbiter); Space Transportation System

20070017936 NASA Ames Research Center, Moffett Field, CA, USA
Technology Development Risk Assessment for Space Transportation Systems
Mathias, Donovan L.; Godsell, Aga M.; Go, Susie; May 19, 2006; 8 pp.; In English; 8th Probabalistic Safety Assessment and Management Conference, 14-19 May 2006, New Orleans, LA, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

A new approach for assessing development risk associated with technology development projects is presented. The method represents technology evolution in terms of sector-specific discrete development stages. A Monte Carlo simulation is used to generate development probability distributions based on statistical models of the discrete transitions. Development risk is derived from the resulting probability distributions and specific program requirements. Two sample cases are discussed to illustrate the approach, a single rocket engine development and a three-technology space transportation portfolio.
Author
Technology Assessment; Space Transportation System; Risk; Probability Distribution Functions; Monte Carlo Method; Mathematical Models; Engine Design

20070017937 NASA Ames Research Center, Moffett Field, CA, USA
Launch Architecture Impact on Ascent Abort and Crew Survival
Mathias, Donovan L.; Lawrence, Scott L.; May 19, 2006; 8 pp.; In English; 8th Probabalistic Safety Assessment and Management Conference, 14-19, May 2006, New Orleans, LA, USA; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A02, Hardcopy

A study was performed to assess the effect of booster configuration on the ascent abort process. A generic abort event sequence was created and booster related risk drivers were identified. Three model boosters were considered in light of the risk drivers: a solid rocket motor configuration, a side mount combination solid and liquid configuration, and a stacked liquid configuration. The primary risk drivers included explosive fireball, overpressure, and fragment effects and booster-crew module re-contact. Risk drivers that were not specifically booster dependent were not addressed. The solid rocket configuration had the most benign influence on an abort while the side mount architecture provided the most challenging abort environment.
Author
Ascent; Launching; Overpressure; Spacecraft Modules; Survival

20070017976 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Micro-Inspector Spacecraft: An Overview
Goldberg, Hannah; Mueller, Juergen; Alkalai, Leon; August 15, 2006; 9 pp.; In English; 20th Annual AIAA/USU Conference on Small Satellites, 15 Aug. 2006, Logan, UT, USA; Original contains color and black and white illustrations
Report No.(s): SSC06-II-6; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39857

JPL has developed a small(\h5 kg) spacecraft capable of visual inspection of a host vehicle with support from NASA's Exploration Systems Mission Directorate (ESMD). This paper describes the multi-mission utility of the Micro-Inspector and presents an overview of the spacecraft system and subsystem designs, description of a typical inspection mission scenario, and initial hardware demonstrations of key subsystems, partially integrated with each other in a Micro-Inspector testbed at JPL.
Author
Visual Observation; Microelectromechanical Systems; Field-Programmable Gate Arrays; Aerospace Environments; Inspection; Miniaturization; Real Time Operation

20070017992 NASA Johnson Space Center, Houston, TX, USA
Orbit Processing and Analysis of a GEO Class of High Area-to-Mass Debris Objects
Kelecy, Tom; Payne, Tim; Thurston, Robin; Stansbery, Gene; [2007]; 3 pp.; In English; AAS Astrodynamics Specialist Conference, 19 - 23 Aug. 2007, Mackinac Island, MI, USA; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

A population of recently discovered deep space objects is thought to be debris having origins from sources in the geosynchronous orbit (GEO) belt. Observations have been presented indicating that these objects have area-to-mass ratios (AMR's) of anywhere from 1's to 10's of m(exp 2)/kg, and thus would explain the observed migration of eccentricity (0.1-0.6) and inclination that distinguishes their orbital characteristics. The solar radiation perturbations on orbital period, inclination and eccentricity over a 20 year period for AMR's of 0.01, 1, 10 and 20 m(exp 2)/kg, are shown in the figures. There is a

heightened interest in the international community due to the large number and small size of these objects, as they pose a hazard to active satellites operating in the vicinity of the GEO belt.
Author
Geosynchronous Orbits; Space Debris; Micrometeoroids; Near Earth Objects; Earth Orbital Environments; Debris

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*.

20070017260 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Accurate State Estimation and Tracking of a Non-Cooperative Target Vehicle
Thienel, Julie K.; Sanner, Robert M.; [2006]; 12 pp.; In English; AIAA Guidance Navigation and Control Conference, 21-24 Aug. 2006, Keystone, CO, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Autonomous space rendezvous scenarios require knowledge of the target vehicle state in order to safely dock with the chaser vehicle. Ideally, the target vehicle state information is derived from telemetered data, or with the use of known tracking points on the target vehicle. However, if the target vehicle is non-cooperative and does not have the ability to maintain attitude control, or transmit attitude knowledge, the docking becomes more challenging. This work presents a nonlinear approach for estimating the body rates of a non-cooperative target vehicle, and coupling this estimation to a tracking control scheme. The approach is tested with the robotic servicing mission concept for the Hubble Space Telescope (HST). Such a mission would not only require estimates of the HST attitude and rates, but also precision control to achieve the desired rate and maintain the orientation to successfully dock with HST.
Author
Docking; Autonomy; Attitude Control; Targets; Telemetry; State Estimation; Space Rendezvous; Robotics; Nonlinearity

20070017310 NASA Glenn Research Center, Cleveland, OH, USA
RF and Optical Communications: A Comparison of High Data Rate Returns From Deep Space in the 2020 Timeframe
Williams, W. Dan; Collins, Michael; Boroson, Don M.; Lesh, James; Biswas, Abihijit; Orr, Richard; Schuchman, Leonard; Sands, O. Scott; March 2007; 16 pp.; In English; 12th Ka and Broadband Communications Conference, 27-29 Sep. 2006, Naples, Italy; Original contains color illustrations
Contract(s)/Grant(s): WBS 439432.07.04.03.01
Report No.(s): NASA/TM-2007-214459; E-15723; K000083; Copyright; Avail.: CASI: A03, Hardcopy

As NASA proceeds with plans for increased science data return and higher data transfer capacity for science missions, both RF and optical communications are viable candidates for significantly higher-rate communications from deep space to Earth. With the inherent advantages, smaller apertures and larger bandwidths, of optical communications, it is reasonable to expect that at some point in time and combination of increasing distance and data rate, the rapidly emerging optical capabilities would become more advantageous than the more mature and evolving RF techniques. This paper presents a comparison of the burden to a spacecraft by both RF and optical communications systems for data rates of 10, 100, and 1000 Mbps and large distances. Advanced technology for RF and optical communication systems have been considered for projecting capabilities in the 2020 timeframe. For the comparisons drawn, the optical and RF ground terminals were selected to be similar in cost. The RF system selected is composed of forty-five 12-meter antennas, whereas the selected optical system is equivalent to a 10-meter optical telescope. Potential differences in availability are disregarded since the focus of this study is on spacecraft mass and power burden for high-rate mission data, under the assumption that essential communications will be provided by low-rate, high availability RF. For both the RF and optical systems, the required EIRP, for a given data rate and a given distance, was achieved by a design that realized the lowest possible communications subsystem mass (power + aperture) consistent with achieving the lowest technology risk. A key conclusion of this paper is that optical communications has great potential for high data rates and distances of 2.67 AU and beyond, but requires R&D and flight demonstrations to prove out technologies.
Author
Telecommunication; Radio Communication; Spacecraft Communication; Radio Frequencies; Bandwidth; Transmission Efficiency

20070017371 NASA Glenn Research Center, Cleveland, OH, USA
Applying MDA to SDR for Space to Model Real-time Issues
Blaser, Tammy M.; [2007]; 28 pp.; In English; OMG's Third Annual Software-Based Communications Workshop, 5-8 Mar. 2007, Fairfax, VA, USA
Contract(s)/Grant(s): WBS 439432.04.07.01; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017371

NASA space communications systems have the challenge of designing SDRs with highly-constrained Size, Weight and Power (SWaP) resources. A study is being conducted to assess the effectiveness of applying the MDA Platform-Independent Model (PIM) and one or more Platform-Specific Models (PSM) specifically to address NASA space domain real-time issues. This paper will summarize our experiences with applying MDA to SDR for Space to model real-time issues. Real-time issues to be examined, measured, and analyzed are: meeting waveform timing requirements and efficiently applying Real-time Operating System (RTOS) scheduling algorithms, applying safety control measures, and SWaP verification. Real-time waveform algorithms benchmarked with the worst case environment conditions under the heaviest workload will drive the SDR for Space real-time PSM design.
Author
Real Time Operation; Space Communication; Safety Management; Workloads (Psychophysiology); Algorithms

20070017420 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Use of Very Long Baseline Array Interferometric Data for Spacecraft Navigation
Martin-Mur, Tomas J.; Antreasian, P.; Border, J.; Benson, J.; Dhawan, V.; Fomalont, E.; Graat, E.; Jacobson, R.; Lanyi, G.; McElrath, T.; Romney, J.; Walker, C.; June 4, 2006; 6 pp.; In English; 19th International Symposium on Space Flight Dynamics, 4-11 Jun. 2006, Kanazawa, Japan; Original contains black and white illustrations
Report No.(s): ISTS 2006-d-50; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39896

The main VLBI technique that is used at JPL is known as the Delta Differential One-way Ranging ((Delta)DOR). Two DSN antennas simultaneously track a source, and alternate between sources. The signals recorded at the antennas from each source are correlated to obtain the delay in arrival to the two antennas, and the delays are differenced to remove common-source errors. An alternative technique is to use carrier phase differences between antennas. This is routinely done by the Very Large Baseline Array (VLBA) as part of source imaging. The VLBA capabilities are used for scientific research, but also have the potential to be used for navigation. Two main experiments were performed with the VLBA and JPL spacecraft. This paper describes and analyzes these experiments and discusses the possible uses of VLBA tracking for spacecraft navigation.
Author
Very Long Base Interferometry; Very Long Baseline Array (VLBA); Spacecraft Tracking; Space Navigation

20070017422 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
CCSDS SLE Service Management: Real-World Use Cases
Barkley, Erik; Pechkam, Paul; Pietras, John; Quintela, Paula; June 19, 2006; 5 pp.; In English; AIAA SpaceOps Conference, 19-24 Jun. 2006, Rome, Italy; Original contains color illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39898

The purpose of this paper is to illustrate how the standard SLE-SM services can be applied to the operations of current TT&C providers. It begins with a brief overview of the scope and operating environment of the SLE-SM services, then describes several use cases in which SLE-SM services can be applied to existing operational situations. The paper also addresses how SLE-SM services can be adopted in an evolutionary fashion. The paper concludes with a brief identification of additions to SLE-SM that are under consideration to make SLE-SM applicable to an even broader range of network operations concepts, policies, and procedures.
Author
Data Systems; Data Management; Spacecraft Communication; Services; Space Missions

20070017436 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Asynchronous Message Service for Deep Space Mission Operations
Burleigh, Scott C.; June 23, 2006; 8 pp.; In English; AIAA 9th International Conference on Space Operations (SpaceOps, 19-24 Jun. 2006, Rome, Italy; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39833

While the CCSDS (Consultative Committee for Space Data Systems) File Delivery Protocol (CFDP) provides internationally standardized file transfer functionality that can offer significant benefits for deep space mission operations, not all spacecraft communication requirements are necessarily best met by file transfer. In particular, continuous event-driven asynchronous message exchange may also be useful for communications with, among, and aboard spacecraft. CCSDS has therefore undertaken the development of a new Asynchronous Message Service (AMS) standard, designed to provide common functionality over a wide variety of underlying transport services, ranging from shared memory message queues to CCSDS telemetry systems. The present paper discusses the design concepts of AMS, their applicability to deep space mission operations problems, and the results of preliminary performance testing obtained from exercise of a prototype implementation. Author

Data Systems; Deep Space; Messages; Spacecraft Communication; Space Missions; Architecture (Computers)

20070017906 NASA Glenn Research Center, Cleveland, OH, USA

Space Telecommunications Radio Architecture (STRS)

Reinhart, Richard C.; February 2006; 42 pp.; In English; IDGA 4th Software Defined Radio Conference, Feb. 2006, Tyson Corner, VA, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 439432.07.02.03.03; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017906

A software defined radio (SDR) architecture used in space-based platforms proposes to standardize certain aspects of radio development such as interface definitions, functional control and execution, and application software and firmware development. NASA has charted a team to develop an open software defined radio hardware and software architecture to support NASA missions and determine the viability of an Agency-wide Standard. A draft concept of the proposed standard has been released and discussed among organizations in the SDR community. Appropriate leveraging of the JTRS SCA, OMG's SWRadio Architecture and other aspects are considered. A standard radio architecture offers potential value by employing common waveform software instantiation, operation, testing and software maintenance. While software defined radios offer greater flexibility, they also poses challenges to the radio development for the space environment in terms of size, mass and power consumption and available technology. An SDR architecture for space must recognize and address the constraints of space flight hardware, and systems along with flight heritage and culture. NASA is actively participating in the development of technology and standards related to software defined radios. As NASA considers a standard radio architecture for space communications, input and coordination from government agencies, the industry, academia, and standards bodies is key to a successful architecture. The unique aspects of space require thorough investigation of relevant terrestrial technologies properly adapted to space. The talk will describe NASA s current effort to investigate SDR applications to space missions and a brief overview of a candidate architecture under consideration for space based platforms.
Author

Space Communication; Radio Communication; Radio Equipment; Telecommunication; Architecture (Computers); Computer Programs; NASA Programs; Program Verification (Computers); Software Engineering

20070017907 NASA Glenn Research Center, Cleveland, OH, USA

NASA's SDR Standard: Space Telecommunications Radio System

Reinhart, Richard C.; Johnson, Sandra K.; February 21, 2007; 30 pp.; In English; IDGA 5th Annual Software Radio Summit, 21 Feb. 2007, Vienna, VA, USA

Contract(s)/Grant(s): WBS 439432.04.16.01.02; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017907

A software defined radio (SDR) architecture used in space-based platforms proposes to standardize certain aspects of radio development such as interface definitions, functional control and execution, and application software and firmware development. NASA has charted a team to develop an open software defined radio hardware and software architecture to support NASA missions and determine the viability of an Agency-wide Standard. A draft concept of the proposed standard has been released and discussed among organizations in the SDR community. Appropriate leveraging of the JTRS SCA, OMG s SWRadio Architecture and other aspects are considered. A standard radio architecture offers potential value by employing common waveform software instantiation, operation, testing and software maintenance. While software defined radios offer greater flexibility, they also poses challenges to the radio development for the space environment in terms of size, mass and power consumption and available technology. An SDR architecture for space must recognize and address the constraints of space flight hardware, and systems along with flight heritage and culture. NASA is actively participating in the development of technology and standards related to software defined radios. As NASA considers a standard radio architecture for space communications, input and coordination from government agencies, the industry, academia, and standards bodies is key to a

successful architecture. The unique aspects of space require thorough investigation of relevant terrestrial technologies properly adapted to space. The talk will describe NASA s current effort to investigate SDR applications to space missions and a brief overview of a candidate architecture under consideration for space based platforms.
Author
Aerospace Environments; Telecommunication; Space Communication; Program Verification (Computers); Applications Programs (Computers); NASA Programs; Radio Communication; Flexibility

20070017977 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Lessons Learned from Daily Uplink Operations during the Deep Impact Mission
Stehly, Joseph S.; Bliss, David A.; June 19, 2006; 8 pp.; In English; AIAA 9th International Conference on Spacecraft Operations (SpaceOps), 19-24 Jun. 2006, Rome, Italy; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39932

The Deep Impact mission to comet Tempel-1 produced some of the more spectacular science results ever collected by a spacecraft. On July 4, 2005 the Deep Impact Flyby vehicle observed the Deep Impact Impactor vehicle's collision with the comet. 24 hours earlier the Flyby vehicle released the Impactor vehicle into the path of comet Tempel-1. The process to command the spacecraft was a challenge to the entire flight operations team. This paper presents an overview of the process used prepare command products for uplink and the lessons that were learned from this process.
Author
Flyby Missions; Flight Operations; Comets; Collisions; Uplinking

20070017994 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Development of a Radio Frequency Space Environment Path Emulator for Evaluating Spacecraft Ranging Hardware
Mitchell, Jason W.; Baldwin, Philip J.; Kurichh, Rishi; Naasz, Bo J.; Luquette, Richard J.; January 2007; 10 pp.; In English; AIAA Guidance, Navigation and Control Conference and Exhibit, 20 - 23 Aug. 2007, Hilton Head, South Carolina, USA; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

The Formation Flying Testbed (FFTB) at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) provides a hardware-in-the-loop test environment for formation navigation and control. The facility is evolving as a modular, hybrid, dynamic simulation facility for end-to-end guidance, navigation and. control (GN&C) design and analysis of formation flying spacecraft. The core capabilities of the FFTB, as a platform for testing critical hardware and software algorithms in-the-loop, have expanded to include S-band Radio Frequency (RF) modems for inter-spacecraft communication and ranging. To enable realistic simulations that require RF ranging sensors for relative navigation, a mechanism is needed to buffer the RF signals exchanged between spacecraft that accurately emulates the dynamic environment through which the RF signals travel, including the effects of medium, moving platforms, and radiated power. The Path Emulator for RF Signals (PERFS), currently under development at NASA GSFC, provides this capability. The function and performance of a prototype device are presented.
Author
Aerospace Environments; Formation Flying; Radio Frequencies; Spacecraft Communication; Spacecraft Control; Hardware-in-the-Loop Simulation

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*.

20070016688 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Towards the GEOSAT Follow-On Precise Orbit Determination Goals of High Accuracy and Near-Real-Time Processing
Lemoine, Frank G.; Zelensky, Nikita P.; Chinn, Douglas S.; Beckley, Brian D.; Lillibridge, John L.; August 24, 2006; 17 pp.; In English; AIAA/AAS Astrodynamics Conference, 21-24 Aug. 2006, Keystone, CO, USA
Report No.(s): AIAA Paper 2006-6402; Copyright; Avail.: CASI: A03, Hardcopy

The US Navy's GEOSAT Follow-On spacecraft (GFO) primary mission objective is to map the oceans using a radar

altimeter. Satellite laser ranging data, especially in combination with altimeter crossover data, offer the only means of determining high-quality precise orbits. Two tuned gravity models, PGS7727 and PGS7777b, were created at NASA GSFC for GFO that reduce the predicted radial orbit through degree 70 to 13.7 and 10.0 mm. A macromodel was developed to model the nonconservative forces and the SLR spacecraft measurement offset was adjusted to remove a mean bias. Using these improved models, satellite-ranging data, altimeter crossover data, and Doppler data are used to compute both daily medium precision orbits with a latency of less than 24 hours. Final precise orbits are also computed using these tracking data and exported with a latency of three to four weeks to NOAA for use on the GFO Geophysical Data Records (GDR s). The estimated orbit precision of the daily orbits is between 10 and 20 cm, whereas the precise orbits have a precision of 5 cm. Author

GEOSAT Satellites; Radio Altimeters; Oceans; Rangefinding; Orbit Determination; Real Time Operation; Estimating; Satellite Laser Ranging

20070016698 NASA Johnson Space Center, Houston, TX, USA

The Human as a System - Monitoring Spacecraft Net Habitable Volume throughout the Design Lifecycle

Szabo, Richard; Kallay, Anna; Twyford, Evan; Maida, Jim; October 5, 2007; 5 pp.; In English; Human Factors and Ergonomics Society 51st Annual Meeting, 1-5 Oct. 2007, Baltimore, MD, USA; Original contains color and black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

Spacecraft design has historically allocated specific volume and mass 'not to exceed' requirements upon individual systems and their accompanying hardware (e.g., life support, avionics) early in their conceptual design in an effort to align the spacecraft with propulsion capabilities. If the spacecraft is too heavy or too wide for the launch stack - it does not get off the ground. This approach has predictably ended with the crew being allocated whatever open, pressurized volume remains. With the recent inauguration of a new human-rated spacecraft - NASA human factors personnel have found themselves in the unique position to redefine the human as a system from the very foundation of design. They seek to develop and monitor a 'not to fall below' requirement for crew net habitable volume (NHV) - balanced against the 'not to exceed' system volume requirements, with the spacecraft fitting the crew versus the crew having to fit inside the spacecraft.
Author

Spacecraft Design; Human Factors Engineering; Habitability; Spacecrews; Life Support Systems; Avionics

20070017857 NASA Glenn Research Center, Cleveland, OH, USA

Drive System Research

Handschuh, Robert F.; [2007]; 27 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

An overview of the NASA Glenn Research Center Drive Systems Research will be presented. The primary purpose of this research is to improve performance, reliability, and integrity of aerospace drive systems and space mechanisms. The research is conducted through a combination of in-house, academia, and through contractors. Research is conducted through computer code development and validated through component and system testing. The drive system activity currently has four major thrust areas including: thermal behavior of high speed gearing, health and usage monitoring, advanced components, and space mechanisms.
Author

Mechanical Drives; Aerospace Engineering; High Speed; Temperature Effects; Reliability; Aerospace Systems

20070017908 NASA Glenn Research Center, Cleveland, OH, USA

Metallic Concepts for Repair of Reinforced Carbon-Carbon Space Shuttle Leading Edges

Ritzert, Frank; Nesbitt, James; [2007]; 5 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 23-26 Apr. 2007, Honolulu, HI, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 377816.06.03.02; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017908

The Columbia accident has focused attention on the critical need for on-orbit repair concepts for wing leading edges in the event that potentially catastrophic damage is incurred during Space Shuttle Orbiter flight. The leading edge of the space shuttle wings consists of a series of eleven panels on each side of the orbiter. These panels are fabricated from reinforced carbon-carbon (RCC) which is a light weight composite with attractive strength at very high temperatures. The damage that was responsible for the loss of the Colombia space shuttle was deemed due to formation of a large hole in one these RCC leading edge panels produced by the impact of a large piece of foam. However, even small cracks in the RCC are considered as potentially catastrophic because of the high temperature re-entry environment. After the Columbia accident, NASA has

explored various means to perform on-orbit repairs in the event that damage is sustained in future shuttle flights. Although large areas of damage, such as that which doomed Columbia, are not anticipated to re-occur due to various improvements to the shuttle, especially the foam attachment, NASA has also explored various options for both small and large area repair. This paper reports one large area repair concept referred to as the 'metallic over-wrap.' Environmental conditions during re-entry of the orbiter impose extreme requirements on the RCC leading edges as well as on any repair concepts. These requirements include temperatures up to 3000 F (1650 C) for up to 15 minutes in the presence of an extremely oxidizing plasma environment. Figure 1 shows the temperature profile across one panel (#9) which is subject to the highest temperatures during re-entry. Although the RCC possesses adequate mechanical strength at these temperatures, it lacks oxidation resistance. Oxidation protection is afforded by converting the outer layers of the RCC to SiC by chemical vapor deposition (CVD). At high temperatures in an oxidizing environment, the SiC layer forms a protective SiO2 scale. However, CVD processing to form the SiC layer can result in the formation of small cracks in the outer surface. Hence, as a final fabrication step, a sodium silicate glass, known as 'Type A,' is applied as a sealant to fill any surface porosity and/or cracks in the coating and the outer portions of the RCC[1]. At relatively low temperatures, the Type A glass melts and flows into the cracks providing oxidation protection at the higher temperatures. In addition, the Type A coating, provides a 'dark' coating with a high emissivity. This high emissivity allows the RCC to transfer heat by radiating outward to space as well as dispersing heat within the leading edge cavity. Lastly, the Type A possesses low catalycity which reduces surface temperatures by limiting oxygen recombination on the surface during re-entry.

Author

Carbon-Carbon Composites; Leading Edges; Space Shuttles; Surface Temperature; High Temperature Environments; Damage; Surface Cracks; Oxygen Recombination; Oxidation Resistance

20070017914 NASA Johnson Space Center, Houston, TX, USA

The Disposal of Spacecraft and Launch Vehicle Stages in Low Earth Orbit

Johnson, Nicholas L.; May 16, 2007; 19 pp.; In English; 2nd International Association Advancment of Space Safety Conference, 14-16 May 2007, Chicago, IL, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017914

This viewgraph presentation reviews the rationale for disposal of Low Earth Orbit (LEO) satelites and other spacecraft after the operational lifetime for the space craft and launch vehicle stages. It also reviews the National and International Space Debris Mitigation Guidelines, LEO Spacecraft Disposals, and the LEO Launch Vehicle Stage Disposals. Several examples of space craft disposals or passivation are given.

CASI

Disposal; Low Earth Orbits; Space Debris; Spacecraft Breakup; Destruction

20070017954 Eloret Corp., Sunnyvale, CA, USA, NASA Ames Research Center, Moffett Field, CA, USA

Rapid Geometry Creation for Computer-Aided Engineering Parametric Analyses: A Case Study Using ComGeom2 for Launch Abort System Design

Hawke, Veronica; Gage, Peter; Manning, Ted; Jan. 11, 2007; 18 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNA05BF35C

Report No.(s): AIAA 2007-0970; Copyright; Avail.: CASI: A03, Hardcopy

ComGeom2, a tool developed to generate Common Geometry representation for multidisciplinary analysis, has been used to create a large set of geometries for use in a design study requiring analysis by two computational codes. This paper describes the process used to generate the large number of configurations and suggests ways to further automate the process and make it more efficient for future studies. The design geometry for this study is the launch abort system of the NASA Crew Launch Vehicle.

Author

Systems Engineering; Software Development Tools; Launch Vehicles; Computer Programs; Launching

20070017979 NASA Johnson Space Center, Houston, TX, USA

Remote and Ground Truth Spectral Measurement Comparisons

Abercromby, Kira Jorgensen; Hamada, Kris; Guyote, Michael; Okada, Jennifer; Barker, Edwin; [2007]; 1 pp.; In English;

Advanced Maui Optical and Space Surveillance Technologies Conference, 12 - 15 Sept. 2007, Maui, HI, USA; Copyright; Avail.: Other Sources; Abstract Only

FORMOSAT III are a set of six research satellites from Taiwan that were launched in April 2006. The satellites are in 800 km, 71 degree inclination orbits and separated by 24 degrees in ascending node. Ground truth spectral measurements were taken of outer surface materials on FORMOSAT III. From those measurements, a computer model was built to predict the spectral reflectance, which included phase angle and orientation of the spacecraft relative to the observer. However, materials exposed to the space environment have exhibited spectral changes including a darkening and a reddening of the spectra. This reddening was seen as an increase in slope of the reflectance as the wavelength increases. Therefore, the model of pristine materials was augmented to include the space weathering effects. Remote data were collected on two of the six FORMOSAT satellites using the 1.6 meter telescope at AMOS (Air Force Maui Optical and Supercomputing) site with the Spica spectrometer. Due to the separation in ascending node, observations were made on whichever one of the six satellites was visible on that specific night. Three nights of data were collected using the red (6000 9500 angstroms) filter and two nights of data were collected using the blue (3200 -6600 angstroms) filter. A comparison of the data showed a good match to the pristine model for the blue filter region. The absorption feature near 5500 angstroms due to the copper colored Kapton multi-layer insulation (MLI) was very apparent in the remote samples and a good fit to the data was seen in both satellites observed. The features in the red filter regime agreed with the pristine model up through 7000 angstroms where the reddening begins and the slope of the remote sample increases. A comparison of the two satellites showed similar features in the red and blue filter regions, i.e. the satellites were aging at the same rate. A comparison of the pristine model to the first month of remote measurements showed the amount by which the satellite had reddened. This information was used in the space weathered model to predict the second month s reflectance measurement. The results showed that the reddening did not increase from the first month of observations to the second. A third month of data will be necessary to determine if the reddening occurs instantly and then stabilizes with time or if the effect continues to increase with time.

Author

Ground Truth; Spectrum Analysis; Satellite Design; Remote Sensing

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*.

20070016693 NASA Marshall Space Flight Center, Huntsville, AL, USA

Testing in Support of Fission Surface Power System Qualification

Houts, Mike; Bragg-Sitton, Shannon; Godfroy, Tom; Martin, Jim; Pearson, Boise; VanDyke, Melissa; [2007]; 17 pp.; In English; Space Technology and Applications International Forum, 11-15 Feb. 2007, Albuquerque, NM, USA; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070016693

The strategy for qualifying a FSP system could have a significant programmatic impact. The US has not qualified a space fission power system since launch of the SNAP-10A in 1965. This paper explores cost-effective options for obtaining data that would be needed for flight qualification of a fission system. Qualification data could be obtained from both nuclear and non-nuclear testing. The ability to perform highly realistic nonnuclear testing has advanced significantly throughout the past four decades. Instrumented thermal simulators were developed during the 1970s and 1980s to assist in the development, operation, and assessment of terrestrial fission systems. Instrumented thermal simulators optimized for assisting in the development, operation, and assessment of modern FSP systems have been under development (and utilized) since 1998. These thermal simulators enable heat from fission to be closely mimicked (axial power profile, radial power profile, temperature, heat flux, etc.) and extensive data to be taken from the core region. For transient testing, pin power during a transient is calculated based on the reactivity feedback that would occur given measured values of test article temperature and/or dimensional changes. The reactivity feedback coefficients needed for the test are either calculated or measured using cold/warm zero-power criticals. In this way non-nuclear testing can be used to provide very realistic information related to nuclear operation. Non-nuclear testing can be used at all levels, including component, subsystem, and integrated system testing. FSP fuels and materials are typically chosen to ensure very high confidence in operation at design burnups, fluences, and temperatures. However, facilities exist (e.g. ATR, HFIR) for affordably performing in-pile fuel and materials irradiations, if such testing is desired. Ex-core materials and components (such as alternator materials, control drum drives, etc.) could be

irradiated in university or DOE reactors to ensure adequate radiation resistance. Facilities also exist for performing warm and cold zero-power criticals.
Author
Fission; Planetary Surfaces; Space Missions; Qualifications; Space Power Reactors; Technology Utilization; Systems Engineering; Flight Tests

20070016916 Air Force Research Lab., Edwards AFB, CA USA
Preliminary Study of Arcjet Neutralization of Hall Thruster Clusters (Postprint)
Walker, Quentin E; Cappelli, Mark A; Hargus, William A; Jan 18, 2007; 22 pp.; In English
Contract(s)/Grant(s): Proj-1011
Report No.(s): AD-A464819; No Copyright; Avail.: CASI: A03, Hardcopy

Clustered Hall thrusters have emerged as a favored choice for extending Hall thruster options to very high powers (50 kW - 150 kW). This paper examines the possible use of an arcjet to neutralize clustered Hall thrusters, as the hybrid arcjet-Hall thruster concept can fill a performance niche amongst available propulsion options. We examine missions on which this hybrid concept would be a competitive or favored thruster option, report on fundamental experiments to understand how much electron current can be drawn to a surrogate anode from the plume of low power arcjets operating on hydrogen and helium, and then demonstrate the first successful operation of a low power Hall thruster-arcjet neutralizer package. In the surrogate anode studies, we find that the drawing of current from the arcjet plume has only a weak effect on overall arcjet performance (thrust), with a slight decrease in arc voltage with increased extracted current. A single Hall thruster - arcjet neutralizer package was constructed for the hybrid concept demonstration. The arcjet operated at very low powers (- 70-120W) on helium, at a mass flow rate of 4.5 mg/s, and was able to effectively neutralize the - 200 -900W xenon Hall thruster causing little measurable departure from the hollow-cathode neutralized Hall thruster VI characteristics up to 250V. At higher helium mass flow rates, the Hall discharge current is slightly perturbed from its expected values, due most likely to the ingestion of helium. Further developments of the hybrid concept to clustered configurations and higher powers will require a vacuum facility that can pump tens of milligrams of helium while maintaining the low pressures needed for normal xenon Hall thruster operation.
DTIC
Arc Jet Engines; Electric Rocket Engines; Hall Thrusters; Specific Impulse

20070017311 NASA Glenn Research Center, Cleveland, OH, USA
Comparison of GRCop-84 to Other High Thermal Conductive Cu Alloys
deGroh, Henry C., III; Ellis, David L.; Loewenthal, William S.; February 2007; 54 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 599489.02.07.03.02.04.01
Report No.(s): NASA/TM-2007-214663; E-15798; Copyright; Avail.: CASI: A04, Hardcopy

The mechanical properties of five copper alloys (GRCop-84, AMZIRC, GlidCop Al-15, Cu-1Cr-0.1Zr, Cu-0.9Cr) competing in high temperature, high heat flux applications such as rocket nozzles, were compared. Tensile, creep, thermal expansion, and compression tests are presented. Tests were done on as-received material, and on material which received a simulated brazing heat treatment at 935 C. The 935 C heat treatment weakened AMZIRC, Cu-1Cr-0.1Zr, and Cu-0.9Cr, and the strength of as-received AMZIRC dropped precipitously as test temperatures exceeded 500 C. The properties of GlidCop Al-15 and GRCop-84 were not significantly affected by the 935 C heat treatment. Thus GRCop-84 is better than AMZIRC, Cu-1Cr-0.1Zr, and Cu-0.9Cr at temperatures greater than 500 C. Ductility was lowest in GlidCop Al-15 and Cu-0.9Cr. The creep properties of GRCop-84 were superior to those of brazed AMZIRC, Cu-1Cr-0.1Zr, and Cu-0.9Cr. At equivalent rupture life and stress, GRCop-84 had a 150 C temperature advantage over brazed AMZIRC; for equivalent rupture life and temperature GRCop-84 was two times stronger. The advantages of GRCop-84 over GlidCop Al-15 associated with ease of processing were confirmed by GlidCop s marginal ductility. In the post brazed condition, GRCop-84 was found to be superior to the other alloys due to its greater strength and creep resistance (compared to AMZIRC, Cu-1Cr-0.1Zr, and Cu-0.9Cr) and ductility (compared to GlidCop Al-15)
Author
Copper Alloys; Compression Tests; Heat Treatment; Tensile Creep; Thermal Expansion; Creep Strength; Mechanical Properties

20070017854 Toledo Univ., OH, USA
A Symmetrical, Planar SOFC Design for NASA's High Specific Power Density Requirements
Cable, Thomas L.; Sofie, Stephen W.; [2007]; 11 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-00145; WBS 561581.02.08.03.06.03; Copyright; Avail.: CASI: A03, Hardcopy

Solid oxide fuel cell (SOFC) systems for aircraft applications require an order of magnitude increase in specific power density (1.0 kW/kg) and long life. While significant research is underway to develop anode supported cells which operate at temperatures in the range of 650-800 C, concerns about Cr-contamination from the metal interconnect may drive the operating temperature down further, to 750 C and lower. Higher temperatures, 900-1000 C, are more favorable for SOFC stacks to achieve specific power densities of 1.0 kW/kg. Since metal interconnects are not practical at these high temperatures and can account for up to 75% of the weight of the stack, NASA is pursuing a design that uses a thin, LaCrO3-based ceramic interconnect that incorporates gas channels into the electrodes. The bi-electrode supported cell (BSC) uses porous YSZ scaffolds, on either side of a 10-20 microns electrolyte. The porous support regions are fabricated with graded porosity using the freeze-tape casting process which can be tailored for fuel and air flow. Removing gas channels from the interconnect simplifies the stack design and allows the ceramic interconnect to be kept thin, on the order of 50 -100 microns. The YSZ electrode scaffolds are infiltrated with active electrode materials following the high temperature sintering step. The NASA-BSC is symmetrical and CTE matched, providing balanced stresses and favorable mechanical properties for vibration and thermal cycling.

Author

High Temperature; Thermal Cycling Tests; Solid Oxide Fuel Cells; Cell Anodes; Electrodes; Operating Temperature; Fuel Flow; Air Flow

20070017858 NASA Glenn Research Center, Cleveland, OH, USA

Microgravity Droplet Combustion in CO2 Enriched Environments at Elevated Pressures

Hicks, Michael C.; Nayagam, V.; Williams, F. A.; March 28, 2007; 13 pp.; In English; 5th U.S. Combustion Meeting, 25-28 Mar. 2007, San Diego, CA, USA

Contract(s)/Grant(s): WBS 732759.03.01.02.21

Report No.(s): Paper G18; Copyright; Avail.: CASI: A03, Hardcopy

Microgravity droplet combustion experiments were performed in elevated concentrations of CO2 at pressures of 1.0 atm, 3.0 atm, and 5.0 atm to examine the effects of a radiatively participating suppression agent in space applications. Methanol and n-heptane droplets, with an initial diameter of 2.0 mm supported on a quartz fiber, were used in these experiments. The ambient O2 concentration was held constant at 21% and the CO2 concentrations ranged from 0% to a maximum of 70%, by volume with the balance consisting of N2 . Results from the methanol tests showed slight decreases in burning rates with increased CO2 concentrations at all ambient pressures. The n-heptane tests show slight increases in burning rates with increasing CO2 concentrations at each pressure level. Instantaneous radiative heat flux was also measured using both a broadband radiometer (i.e., wavelengths from 0.6 microns to 40.0 microns) and a narrowband radiometer (i.e., centered at 5.6 microns with a filter width at half maximum of 1.5 microns). Radiative exchanges between the droplet and surrounding gases as well as the soot field produce departures from the classical quasisteady theory which would predict a decrease in burning rates with increasing CO2 concentrations in microgravity.

Author

Carbon Dioxide Concentration; Drops (Liquids); Microgravity; Gravitational Effects; Combustion; Heat Flux; Broadband; Methyl Alcohol

20070017897 NASA Glenn Research Center, Cleveland, OH, USA

NASA's First Year Progress with Fuel Cell Advanced Development in Support of the Exploration Vision

Hoberecht, Mark; [2007]; 18 pp.; In English; 2007 STAIF Conference: Advanced Power and Propulsion Technologies and Systems, 14 Feb. 2007, Albuquerque, NM, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 038957.04.14.01.01.05; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017897

NASA Glenn Research Center (GRC), in collaboration with Johnson Space Center (JSC), the Jet Propulsion Laboratory (JPL), Kennedy Space Center (KSC), and industry partners, is leading a proton-exchange-membrane fuel cell (PEMFC) advanced development effort to support the vision for Exploration. This effort encompasses the fuel cell portion of the Energy Storage Project under the Exploration Technology Development Program, and is directed at multiple power levels for both primary and regenerative fuel cell systems. The major emphasis is the replacement of active mechanical ancillary components with passive components in order to reduce mass and parasitic power requirements, and to improve system reliability. A dual approach directed at both flow-through and non flow-through PEMFC system technologies is underway. A brief overview of the overall PEMFC project and its constituent tasks will be presented, along with in-depth technical accomplishments for the

past year. Future potential technology development paths will also be discussed.
Author
Regenerative Fuel Cells; Energy Storage; Protons; Membranes; Fuel Cells

20070017900 NASA Glenn Research Center, Cleveland, OH, USA
A Computational Investigation of Sooting Limits of Spherical Diffusion Flames
Lecoustre, V. R.; Chao, B. H.; Sunderland, P. B.; Urban, D. L.; Stocker, D. P.; Axelbaum, R. L.; March 28, 2007; 8 pp.; In English; 5th U.S. Combustion Meeting, 25-28 Mar. 2007, San Diego, CA, USA
Contract(s)/Grant(s): NCC3-696; NAG3-1912; NNC05AA46A; NCC3-697; NAG3-1910; WBS 732759.03.01.02.21
Report No.(s): Paper F-23; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017900

Limiting conditions for soot particle inception in spherical diffusion flames were investigated numerically. The flames were modeled using a one-dimensional, time accurate diffusion flame code with detailed chemistry and transport and an optically thick radiation model. Seventeen normal and inverse flames were considered, covering a wide range of stoichiometric mixture fraction, adiabatic flame temperature, and residence time. These flames were previously observed to reach their sooting limits after 2 s of microgravity. Sooting-limit diffusion flames with residence times longer than 200 ms were found to have temperatures near 1190 K where C/O = 0.6, whereas flames with shorter residence times required increased temperatures. Acetylene was found to be a reasonable surrogate for soot precursor species in these flames, having peak mole fractions of about 0.01.
Author
Soot; Diffusion Flames; Particle Diffusion; Stoichiometry; Microgravity

20070017905 NASA Glenn Research Center, Cleveland, OH, USA
An Overview of Aerospace Propulsion Research at NASA Glenn Research Center
Reddy, D. R.; May 2007; 36 pp.; In English; ASME Turbo Expo 2007 Meeting, 11-17 May 2007, Montreal, Canada; Original contains color illustrations
Contract(s)/Grant(s): WBS 732759.03.01.03.09; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017905

NASA Glenn Research center is the recognized leader in aerospace propulsion research, advanced technology development and revolutionary system concepts committed to meeting the increasing demand for low noise, low emission, high performance, and light weight propulsion systems for affordable and safe aviation and space transportation needs. The technologies span a broad range of areas including air breathing, as well as rocket propulsion systems, for commercial and military aerospace applications and for space launch, as well as in-space propulsion applications. The scope of work includes fundamentals, components, processes, and system interactions. Technologies developed use both experimental and analytical approaches. The presentation provides an overview of the current research and technology development activities at NASA Glenn Research Center .
Author
Propulsion System Performance; Research and Development; Rocket Engines; Aerospace Engineering; Propulsion System Configurations; Spacecraft Launching; Spacecraft Propulsion

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*.

20070016726 Air Force Research Lab., Wright-Patterson AFB, OH USA
Life Prediction of Fretting Fatigue with Advanced Surface Treatments (Preprint)
Golden, Patrick J; Shepard, Michael J; May 2006; 25 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-M02R
Report No.(s): AD-A464649; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464649

Laboratory fretting results with diamond like carbon coating, low plasticity burnishing, and laser shock processing as well

as with no surface treatments are presented. A method of life prediction for a dovetail type specimen is demonstrated with the laboratory results. In general, the life prediction calculations agree with the laboratory results when the appropriate coefficient of friction and compressive residual stresses are accounted for in the analysis. Some of the assumptions made in the analysis are qualitatively confirmed with experimental observations.
DTIC
Coatings; Engine Parts; Fretting; Lasers; Life (Durability); Lubricants; Plastic Properties; Predictions; Surface Treatment

20070016750 New York Univ., New York, NY USA
Regulation of Normal and Malignant Prostate Growth by the Glucocorticoid Receptor
Garabedian, Michael; Aug 2005; 42 pp.; In English
Contract(s)/Grant(s): W81XWH-04-1-0024
Report No.(s): AD-A464692; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464692

The glucocorticoid receptor (GR) is a hormone-dependent transcription factor involved in the regulation of a wide range of metabolic and developmental processes by controlling the expression of target genes in a hormone- and cell-specific manner. However, the expression and activity of GR in normal and malignant prostate growth is unclear. We have recently developed a GR phosphorylation site specific antibody to serine 211 of human GR (GR-S211-P) and found a strict correlation between phosphorylation of GR at this site and receptor transcriptional activity. Thus, GR phosphorylation at S211 is a surrogate marker for the ligand-bound and transcriptionally active form of GR in vivo. Using this antibody to survey GR phosphorylation in human tissues by immuohistochemistry, we came across the remarkable finding that ligand bound and transcriptionally active phospho-GR is present in the stroma and epithelium of normal prostate tissue,including basal and luminal epithelial cells. This was not the case for other tissues examined and suggests that the prostate is be continually exposed to glucocorticoids, such that GR is actively signaling in the prostate. The experiments described in this proposal are designed to elucidate the role of GR in prostate cell growth.
DTIC
Cancer; Glucocorticoids; Hormone Metabolisms; Hormones; Prostate Gland

20070016778 Naval Research Lab., Washington, DC USA
Cryogenic Far-Infrared Laser Absorptivity Measurements of the Herschel Space Observatory Telescope Mirror Coatings
Fischer, Jacqueline; Klaassen, Tjeerd; Hovenier, Niels; Jakob, Gerd; Poglitsch, Albrecht; Sternberg, Oren; Jul 1, 2004; 8 pp.; In English
Report No.(s): AD-A464764; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464764

Far-infrared laser calorimetry was used to measure the absorptivity, and thus the emissivity, of aluminum-coated silicon carbide mirror samples produced during the coating qualification run of the Herschel Space Observatory telescope to be launched by the European Space Agency in 2007. The samples were measured at 77 K to simulate the operating temperature of the telescope in its planned orbit about the second Lagrangian point, L2, of the Earth Sun system. Together, the telescope's equilibrium temperature in space and the emissivity of the mirror surfaces will determine the far-infrared submillimeter background and thus the sensitivity of two of the three astronomical instruments aboard the observatory if stray-light levels can be kept low relative to the mirror emission. Absorptivities of both clean and dust-contaminated samples were measured at 70, 118, 184, and 496 micrometers. Theoretical fits to the data predict absorptivities of 0.2-0.4% for the clean sample and 0.2-0.8% for the dusty sample, over the spectral range of the Herschel Space Observatory instruments.
DTIC
Absorptivity; Coatings; Cryogenics; Laser Applications; Mirrors; Observatories; Spaceborne Telescopes; Telescopes

20070016804 Army Research Lab., Aberdeen Proving Ground, MD USA
Alternative Chromate-Free Wash Primers
Smith, Pauline; Chesonis, Kestutis; Miller, Christopher; Escarsega, John; Sep 2006; 78 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-AH84
Report No.(s): AD-A464961; ARL-TR-3932; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464961

The purpose of the DOD-P-15328D wash primer is to enhance corrosion resistance, through the passivity of the metal surface. In the U.S. Army's Chemical Agent Resistant Coating (CARC) System, the metal surface is coated with a wash primer, over-coated with an epoxy primer, and followed by a camouflage urethane topcoat. Several coating procedures specify the use of wash primer DOD-P-15328D as a surface treatment prior to the application of an epoxy primer/polyurethane topcoat CARC system. The current wash primer is low-solids, solvent-based polyvinyl butyral that contains phosphoric acid and zinc chromate to promote adhesion and minimize corrosion. This coating contains large amounts of volatile organic compounds (VOCs) and hazardous air pollutants (HAPs) that impact coating operations due to air pollution regulations that may require the use of control devices to reduce the total VOC/HAP emissions to the atmosphere. The U.S. Army Research Laboratory has evaluated new, water-reducible wash primers that do not contain hexavalent chromium and significantly minimize potential VOC and HAP emissions during coating operations. Coatings have been extensively tested for accelerated corrosion and adhesion and have completed 3 years of outdoor exposure testing. Tests are now required on military equipment to validate the lab and controlled testing previously completed. The ultimate objective of the process is to demonstrate that the low-VOC wash primers can provide a 'drop-in' solution to the environmental issues associated with the solvent-based primer currently in use, providing equal or better performance, involving no significant changes to the application and stripping procedures currently used. The field demonstration of this coating was conducted at Letterkenny Army Depot facility, prepared on an Engagement Control Station Patriot truck unit.
DTIC
Chromates; Corrosion Tests; Evaluation; Protective Coatings; System Effectiveness

20070016915 Stollar (R. L.) and Associates, Inc., Denver, CO USA
Asbestos Survey Results for Fort Douglas, Utah. Fort Douglas Environmental Investigation/Alternatives Analysis. Volume 1
Dec 1991; 163 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAA15-90-D-0018-0005
Report No.(s): AD-A464817; No Copyright; Avail.: CASI: A08, Hardcopy

R.L. Stollar and Associates, Inc. (RLSA) conducted an asbestos survey and bulk sampling of materials in the excessed area at Fort Douglas, Utah. Fort Douglas is located near Salt Lake City, Utah. The excessed area of the facility consists of 51 acres and includes 51 structures which were evaluated for asbestos. The purpose of the survey was to identify all areas that may have asbestos-containing material (ACM), assess the extent and condition of friable versus nonfriable ACM, assess the potential for disturbance, and provide recommendations for corrective actions when necessary. The program was designed in accordance with the Asbestos Hazard Emergency Response Act (AHERA) and Army methods and procedures.
DTIC
Alternatives; Asbestos; Contamination; Surveys; Thermal Insulation

20070016943 Army Research Lab., Aberdeen Proving Ground, MD USA
Externally Activated Surface Modification Using Diels-Alder Ligand Chemistry and Selective Immiscibility
Beyer, Frederick L; Costanzo, Philip J; Demaree, John D; Mar 2007; 18 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-AH42
Report No.(s): AD-A464862; ARL-TN-271; No Copyright; Avail.: CASI: A03, Hardcopy

Gold particles 10 nm in diameter have been uniformly dispersed using a new dispersing agent (ligand) that is a diblock copolymer containing a Diels-Alder linkage between the blocks. Heating the sample to a specified temperature causes the particles to migrate to the surface of the film. This new strategy could be used to create coatings that can be deliberately activated or modified using an external trigger.
DTIC
Coatings; Diels-Alder Reactions; Gold; Ligands; Polyethylenes; Solubility

20070016956 Army Cold Regions Research and Engineering Lab., Hanover, NH USA
Blast Absorber Feasibility Test - Short Range Measurements Aberdeen Test Center, MD
Perron Jr , Frank E; Decato, Stephen N; Albert, Donald G; Carbee, David L; Mar 2007; 98 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464882; ERDC/CRREL TR-07-3; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Complaints about Army training noise, especially artillery noise, are increasing and are impacting soldier training

opportunities. One suggested mitigation method is to use a gravel pad near the noise source to reduce blast noise. Measurements were conducted to assess this method by detonating C4 charges located over a 15- x 15- x 1.5-m-thick gravel pad or over undisturbed ground and recording the acoustic and seismic waveforms at various distances from the source. The measurements recorded by ERDC-CRREL personnel at propagation distances from 10 to 400 m are documented in this report. Additional reports documenting the longer distance measurements and analyzing the measurements are planned.
DTIC
Education; Feasibility; Measurement; Military Personnel; Rangefinding; Sound Waves; Test Ranges

20070016958 Army Research Lab., Aberdeen Proving Ground, MD USA
Performance of Chromate-Free Pretreatment Options for CARC Systems
Smith, Pauline; Miller, Christopher; Feb 2007; 22 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-AH84
Report No.(s): AD-A464887; ARL-TR-4049; No Copyright; Avail.: CASI: A03, Hardcopy

Chemical agent resistant coatings (CARC) are required on all tactical and support equipment. These camouflage coatings meet the survivability criteria by resisting penetration of the paint film by chemical agents and make decontamination easier. Research efforts are primarily aimed at prevention and early detection of corrosion to maintain readiness and minimize life cycle cost. Another aspect associated with environmentally friendly coatings that are hazardous air pollutant (HAP)-free and low volatile organic compounds (VOC) is the high cost of solvents that meet the EPA criteria. Recently, the U.S. Army Research Laboratory developed a water-reducible two-component polyurethane CARC topcoat, MIL-DTL-64159, that will replace the U.S. Army's standard two-component, solvent-based CARC, MIL-C-46168. The water dispersible coating reduces VOCs by 50% and eliminates HAPs. The alternative, MIL-DTL-53039, is a solvent-borne aliphatic polyurethane that is HAP-free and low VOC. The development of these new and improved coatings have multifunctional performance requirements and need to withstand the most severe environments. Therefore, the need for effective corrosion control and detection lies at the center of our coatings research. The resistance of the coatings to corrosion was assessed using continuous exposure to salt fog per ASTM B117 and cyclic exposure per GM 9540P. Critical coating assessments including impact resistance and wet and dry adhesion were used as a basis to characterize and predict the performance of the coating. This report documents metal substrate selection, application techniques, and laboratory testing procedure.
DTIC
Chemical Attack; Chromates; Coatings; Corrosion Resistance; Pretreatment

20070017054 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Characterization of Chlorinated Ethene Degradation in a Vertical Flow Constructed Wetland
Waldron, James M; Mar 2007; 131 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465174; AFIT/GEM/ENV/07-M17; No Copyright; Avail.: CASI: A07, Hardcopy

Chlorinated solvents, including perchloroethene (PCE) and trichlorethene (TCE), are among the most common groundwater contaminants found in the USA. The use of constructed wetlands has shown promise as an effective and less costly alternative for the treatment of chlorinated solvent contaminated groundwater. This study characterized and evaluated the concentration of chlorinated ethenes within a vertical flow constructed wetland, fed with PCE contaminated groundwater, at Wright-Patterson Air Force Base (WPAFB), Ohio. Chlorinated ethene concentrations were characterized within three distinct layers of the wetland cell, as well as within the influent, and effluent. In addition, a pore-water sampler prototype was designed and developed for this research effort in order to obtain a more detailed contaminant profile. PCE concentrations declined from an average of 46.5 mug/L in the influent to an average of 0.5 mug/L in the upper layer, a 98.9% decrease. The chlorinated ethene concentration profiles indicate that the lower half of the wetland provides favorable conditions for the complete anaerobic reductive dechlorination of the PCE. Within the upper half of the wetland, contaminant profiles indicate dominant degradation processes other than anaerobic reductive dechlorination, possibly including aerobic or anaerobic oxidation or direct volatization.
DTIC
Chlorination; Degradation; Wetlands

20070017057 Virginia Univ., Charlottesville, VA USA
A Study of Performance of Corrosion Prevention Compounds on AA2024-T3 with Electrochemical Impedance Spectroscopy
Gui, F; Kelly, R G; Aug 25, 2005; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F09650-03-D-0001
Report No.(s): AD-A465179; No Copyright; Avail.: CASI: A02, Hardcopy

The performance of corrosion prevention compounds (CPC) on AA2024-T3 was assessed with electrochemical impedance spectroscopy (EIS). The good correlation between the protection performance of CPC and both the interfacial impedance and double layer capacitance allowed two assessment criteria to be defined; as found for AA7075-T6, excellent protection was exhibited by CPC-coated surfaces with interfacial impedances above 0.1M cm2 or double layer capacitances below 7.6 10 8 F/sq cm. A correlation between double layer capacitance (Cdl) and corroded area was also obtained. This latter correlation offers an alternative to evaluation of CPC performance via the corroded area calculated from Cdl. In addition, a prediction method was demonstrated based on impedance parameters that showed the feasibility of using data from 30 days to predict the performance of CPC after 180 days exposure. It was found that the CPC failure can be greatly accelerated without changing the relative ranking among the CPC used by introducing intentional scratches on CPC-coated specimens. In particular, the minimum time needed to rank various CPC was reduced to 8 days for scratched specimens from several months for unscratched ones.
DTIC
Corrosion Prevention; Electrochemistry; Impedance; Protective Coatings; Spectroscopy

20070017063 Virginia Univ., Charlottesville, VA USA
Effect of Surface Pretreatment on the Underpaint Corrosion of AA2024-T3 at Various Temperatures
Little, D A; Jakab, M A; Scully, J R; Apr 2006; 17 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F49620-02-1-0301
Report No.(s): AD-A465190; No Copyright; Avail.: CASI: A03, Hardcopy

The effects of surface pretreatment on the rate of scribe-creep caused by underpaint corrosion on coated AA2024-T3 (UNS A92024) were investigated. Scribe-creep experiments were conducted on epoxy polyamide-coated (average coating thickness: ~10 micrometers) AA2024-T3 in 80% relative humidity at 25 deg C, 40 deg C, and 50 deg C. Scribe-creep was observed to be enhanced by exposure test temperature regardless of surface pretreatment with an activation energy of 30 kJ/mol to 40 kJ/mol. The scribe-creep rate was accelerated at all temperatures especially by pretreatments that increased the concentration of surface Cu or left a high capacity for Cu-replating. Sodium hydroxide (NaOH) etching particularly increased the amount of replated Cu at the coated metal interface compared with an as-received condition and a NaOH etch followed by a nitric acid (HNO3) deoxidation. The effect of each surface pretreatment to enhance or retard scribe-creep is traced either to the initial level of Cu replating prior to coating or to its ability to supply Cu for replating in the scribe-creep filament wake. This Cu replating enhances the rate of cathodic electron transfer reactions, which supports the galvanic corrosion process between scribe-creep head and tail. When Cu was eliminated as an alloying element, or when surface Cu was minimized at the coating-metal interface by HNO3 deoxidation pretreatment, scribe-creep corrosion rates were lowered. This was rationalized to occur as a result of a decrease in the cathodic oxygen reduction reaction rate, which supports anodic undercutting at the head of the corrosion front.
DTIC
Aluminum Alloys; Copper; Corrosion; Creep Properties; Pretreatment

20070017886 NASA Langley Research Center, Hampton, VA USA
Laser-Induced Fabrication of Metallic Interlayers and Patterns in Polyimide Films
Milner, Gilda A., Inventor; Stoakley, Diane M., Inventor; Gaddy, Gregory A., Inventor; Koplitz, Brent D., Inventor; Simpson, Steven M., Inventor; Lynch, Michael F., Inventor; Ruffner, Samuel C., Inventor; October 20, 2005; 12 pp.; In English
Patent Info.: Filed 30 Sep. 2004; US-Patent-Appl-956704; US-Patent-Appl-564845
Report No.(s): PB2007-105985; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017886

Self-metallizing polyimide films are created by doping polyamic acid solutions with metallic ions and solubilizing agents. Upon creating a film, the film is exposed to coherent light for a specific time and then cured. The resulting film has been found to have a metallic surface layer and a metallic subsurface layer (interlayer). The layer separating the metallic layer has a uniform dispersion of small metal particulates within the polymer. The layer below the interlayer has larger metal particulates uniformly distributed within the polymer. By varying the intensity or time of exposure to the coherent light, three-dimensional control of metal formation within the film is provided.
Author
Metal Films; Polyimides; Metallizing; Surface Layers; Interlayers

20070017987 NASA Johnson Space Center, Houston, TX, USA
Sampling and Chemical Analysis of Potable Water for ISS Expeditions 12 and 13
Straub, John E. II; Plumlee, Deborah K.; Schultz, John R.; January 2007; 22 pp.; In English; 37th International Conference on Environmental Systems, 9 - 12 July 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): NAS9-02078
Report No.(s): 07ICES-242; Copyright; Avail.: Other Sources

The crews of Expeditions 12 and 13 aboard the International Space Station (ISS) continued to rely on potable water from two different sources, regenerated humidity condensate and Russian ground-supplied water. The Space Shuttle launched twice during the 12- months spanning both expeditions and docked with the ISS for delivery of hardware and supplies. However, no Shuttle potable water was transferred to the station during either of these missions. The chemical quality of the ISS onboard potable water supplies was verified by performing ground analyses of archival water samples at the Johnson Space Center (JSC) Water and Food Analytical Laboratory (WAFAL). Since no Shuttle flights launched during Expedition 12 and there was restricted return volume on the Russian Soyuz vehicle, only one chemical archive potable water sample was collected with U.S. hardware and returned during Expedition 12. This sample was collected in March 2006 and returned on Soyuz 11. The number and sensitivity of the chemical analyses performed on this sample were limited due to low sample volume. Shuttle flights STS-121 (ULF1.1) and STS-115 (12A) docked with the ISS in July and September of 2006, respectively. These flights returned to Earth with eight chemical archive potable water samples that were collected with U.S. hardware during Expedition 13. The average collected volume increased for these samples, allowing full chemical characterization to be performed. This paper presents a discussion of the results from chemical analyses performed on Expeditions 12 and 13 archive potable water samples. In addition to the results from the U.S. samples analyzed, results from pre-flight samples of Russian potable water delivered to the ISS on Progress vehicles and in-flight samples collected with Russian hardware during Expeditions 12 and 13 and analyzed at JSC are also discussed.
Author
Chemical Analysis; International Space Station; Potable Water; Sampling; Ground Water; Humidity; Sensitivity Analysis

20070018005 NASA Johnson Space Center, Houston, TX, USA
Safe Use of Hydrogen and Hydrogen Systems
Maes, Miguel; September 2006; 298 pp.; In English; Original contains color illustrations; No Copyright; Avail.: CASI: A13, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018005

This is a viewgraph presentation that is a course for teaching the safe use of hydrogen. The objectives of the course are 1. To familiarize the student with H2 safety properties 2. To enable the identification, evaluations and addressing of H2 system hazards 3. To teach: a. Safe practices for, b. Design, c. Materials selection, d. H2 system operation, e. Physical principles and empirical observations on which these safe practices are based, f. How to respond to emergency situations involving H2, g How to visualize safety concepts through in-class exercises, h. Identify numerous parameters important to H2 safety.
CASI
Education; Hazards; Hydrogen; Procedures; Safety; Avoidance; Hazardous Materials; Safety Management

24
COMPOSITE MATERIALS

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

20070017013 Delaware Univ., Newark, DE USA
Nanoparticle Control of Void Formation and Expansion in Polymeric and Composite Systems
Seferis, James C; Feb 2007; 9 pp.; In English
Contract(s)/Grant(s): FA9550-06-1-0124
Report No.(s): AD-A464995; No Copyright; Avail.: CASI: A02, Hardcopy

This research focused on a nanoscale modification of traditional polymeric matrix morphology through particle introduction and subsequent void formation. The main areas of research have been a study of interlayer modification and analyses of continued carbon fiber reinforced polymeric matrix composites at the nanoscale. The results showed improvements in toughness up to a critical threshold, after which, an increase in the concentration and size of nanoparticulate matter and corresponding foams in the matrix deteriorated the fracture toughness properties significantly. Furthermore, nanoscale particles and foams could be used to alter the response of composite materials to a hydrothermal environment. Collectively,

we are now establishing, in a reproducible manner, the placement of nanoparticles and foams in interlayer regions.
DTIC
Composite Materials; Nanoparticles; Nanotechnology; Polymers; Voids

20070017316 NASA Glenn Research Center, Cleveland, OH, USA
Probabilistic Dynamic Buckling of Smart Composite Shells
Chamis, Christos C.; Abumeri, Galib H.; [2007]; 12 pp.; In English; Canadian International Composite Conference (CANCOM 2007), 14-17 Aug. 2007, Winnipeg, Manitoba, Canada; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 561581.02.08.03.15.03; Copyright; Avail.: CASI: A03, Hardcopy

A computational simulation method is presented to evaluate the deterministic and nondeterministic dynamic buckling of smart composite shells. The combined use of intraply hybrid composite mechanics, finite element computer codes, and probabilistic analysis enable the effective assessment of the dynamic buckling load of smart composite shells. A universal plot is generated to estimate the dynamic buckling load of composite shells at various load rates and probabilities. The shell structure is also evaluated with smart fibers embedded in the plies right next to the outer plies. The results show that, on the average, the use of smart fibers improved the shell buckling resistance by about 10% at different probabilities and delayed the buckling occurrence time. The probabilistic sensitivities results indicate that uncertainties in the fiber volume ratio and ply thickness have major effects on the buckling load while uncertainties in the electric field strength and smart material volume fraction have moderate effects. For the specific shell considered in this evaluation, the use of smart composite material is not recommended because the shell buckling resistance can be improved by simply re-arranging the orientation of the outer plies, as shown in the dynamic buckling analysis results presented in this report.
Author
Buckling; Composite Structures; Shells (Structural Forms); Smart Materials; Composite Materials; Dynamic Loads

20070017329 NASA Glenn Research Center, Cleveland, OH, USA
Polymer-Layered Silicate Nanocomposites for Cryotank Applications
Miller, Sandi G.; Meador, Michael A.; Apr. 23, 2007; 9 pp.; In English; 48th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 23-26 Apr. 2007, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 561581.02.08.03.05.03; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017329

Previous composite cryotank designs have relied on the use of conventional composite materials to reduce microcracking and permeability. However, revolutionary advances in nanotechnology derived materials may enable the production of ultra-lightweight cryotanks with significantly enhanced durability and damage tolerance, as well as reduced propellant permeability. Layered silicate nanocomposites are especially attractive in cryogenic storage tanks based on results that have been reported for epoxy nanocomposite systems. These materials often exhibit an order of magnitude reduction in gas permeability when compared to the base resin. In addition, polymer-silicate nanocomposites have been shown to yield improved dimensional stability, strength, and toughness. The enhancement in material performance of these systems occurs without property trade-offs which are often observed in conventionally filled polymer composites. Research efforts at NASA Glenn Research Center have led to the development of epoxy-clay nanocomposites with 70% lower hydrogen permeability than the base epoxy resin. Filament wound carbon fiber reinforced tanks made with this nanocomposite had a five-fold lower helium leak rate than the corresponding tanks made without clay. The pronounced reduction observed with the tank may be due to flow induced alignment of the clay layers during processing. Additionally, the nanocomposites showed CTE reductions of up to 30%, as well as a 100% increase in toughness.
Author
Composite Materials; Fiber Composites; Nanocomposites; Nanotechnology; Storage Tanks; Epoxy Resins; Dimensional Stability

20070017880 Jacobs Sverdrup Technology, Inc., USA
NASA Shuttle Orbiter Reinforced Carbon Carbon (RCC) Crack Repair Arc-Jet Testing
Clark, ShawnDella; Larin, Max; Rochelle, Bill; April 13, 2007; 20 pp.; In English; ASME District E Student Professional Development, 12-14 Apr,. 2007, Edinburg, TX, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNJ05HI05C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017880

This NASA study demonstrates the capability for testing NOAX-repaired RCC crack models in high temperature

environments representative of Shuttle Orbiter during reentry. Analysis methods have provided correlation of test data with flight predictions. NOAX repair material for RCC is flown on every STS flight in the event such a repair is needed. Two final test reports are being generated on arc-jet results (both calibration model runs and repaired models runs).
Derived from text
Space Shuttle Orbiters; Arc Jet Engines; NASA Space Programs; Carbon-Carbon Composites; Cracks; Spacecraft Maintenance; Test Facilities

20070017980 NASA Johnson Space Center, Houston, TX, USA
Optical Properties of Multi-Layered Insulation
Rodriguez, Heather M.; Abercromby, Kira J.; Barker, Edwin; [2007]; 1 pp.; In English; Advanced Maui Optical and Space Surviellance Technologies Conference, 12 - 15 Sept. 2007, Maui, HI, USA; Copyright; Avail.: Other Sources; Abstract Only

Multi-layer insulation, MLI, is a material used on rocket bodies and satellites mainly for thermal insulation. MLI can be comprised of a variety of materials, layer numbers, and dimensions based on its purpose. A common composition of MLI consists of outer facing copper-colored Kapton with an aluminized backing for the top and bottom layers and the middle consisting of alternating layers of DARCON or Nomex netting with aluminized Mylar. If this material became separated from the spacecraft or rocket body its orbit would vary greatly in eccentricity due to its high area to mass (A/m) and susceptibility to solar radiation pressure perturbations. Recently a debris population was found with high A/m, which could be MLI. Laboratory photometric measurements of one intact piece and three different layers of MLI is presented in an effort to predict the characteristics of a MLI light curve and aid in identifying the source of the new population. For this paper, the layers used will be consistent with the common MLI mentioned in the above paragraph. Using a robotic arm, the piece was rotated from 0-360 degrees in one degree increments along the object s longest axis. Laboratory photometric data was recorded with a CCD camera using various filters (Johnson B, Johnson V and Bessell R). The measurements were taken at an 18 degree (light-object-camera) phase angle. As expected, the MLI pieces showed characteristics similar to a bimodal magnitude plot of a flat plate, but with more photometric features, dependant upon the layer of MLI. Time exposures varied from piece to piece such that the amount of pixels saturated would be minimal. In addition to photometric laboratory measurements, laboratory spectral measurements are shown for the same MLI samples. Spectral data will be combined to match the wavelength region of photometric data so a measure of truth can be established for the photometric measurements. Spectral data shows a strong absorption feature near 4800 angstroms, which is due to the copper color of Kapton. If the debris is MLI and the outer layer of copper coloring of Kapton is present, evidence would be seen spectrally by the specific absorption feature as well as using R-B (red-blue) light curves. Using laboratory photometric measurements and the results from spectral laboratory measurements, an optical property database is provided for an object with a high A/m. The benefits of this database for remote optical measurements of orbital debris are shown by illustrating the optical properties expected for a high A/m object, specifically common satellite and rocket body MLI.
Author
Multilayer Insulation; Optical Properties; Thermal Insulation; Rocket Vehicles; Satellite Design

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INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use of inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see category *34 Fluid Dynamics and Thermodynamics*. For astrochemistry see category *90\fAstrophysics*.

20070016699 NASA Johnson Space Center, Houston, TX, USA
Biogeochemical Activity of Siderophilic Cyanobacteria: Implications for Paleobiogeochemistry
Brown, Igor I.; Sarkisova, Svetlana A.; Auyeung, Weng S.; Garrison, Dan; Allen, Carlton C.; McKay, David S.; Nov. 16, 2007; 1 pp.; In English; ISEB 18 'Environmental Biogeochem at Extremes, 11-16 Nov. 2007, Taupo, New Zealand; No Copyright; Avail.: Other Sources; Abstract Only

Understanding the patterns of iron oxidation by cyanobacteria (CB) has tremendous importance for paleobiogeochemistry, since cyanobacteria are presumed to have been involved in the global oxidation of ferrous iron during the Precambrian (Cloud, 1973). B.K. Pierson (1999, 2000) first proposed to study iron deposition in iron-depositing hot springs (ID HS) as a model for Precambrian Fe(2+) oxidation. However, neither the iron-dependent physiology of individual species of CB inhabiting iron-depositing hot springs nor their interactions with minerals enriched with iron have been examined thoroughly. Such study

could shed light on ancient iron turnover. Cyanobacterial species isolated from ID HS demonstrate elevated tolerance to colloidal Fe(3+) (= 1 mM), while a concentration of 0.4 mM proved toxic for mesophilic Synechocystis PCC 6803. Isolates from ID HS require 0.4-0.6 mM Fe3+ for maximal growth while the iron requirement for Synechocystis is approximately one order of magnitude lower. We have also demonstrated that thick polysaccharide sheaths around cells of CB isolated from ID HS serve as repositories for precipitated iron. The growth of the mesophilic cyanobacteria Phromidium aa in iron-saturated (0.6 mM) DH medium did not lead to iron precipitation on its filament surfaces. However, a 14.3 fil.2 culture, isolated from an ID HS and incubated under the same conditions, was covered with dense layer of precipitated iron. Our results, taken together with Pierson s data concerning the ability of Fe2+ to stimulate photosynthesis in natural CB mats in ID HS, suggest that CB inhabiting ID HS may constitute a new group of the extremophiles - siderophilic CB. Our recent experiments have revealed for the first time that CB isolates from ID HS are also capable of biodeterioration - the etching of minerals, in particular glasses enriched with Fe, Al, Ti, O, and Si. Thus, Precambrian siderophilic cyanobacteria and their predecessors could have been involved not only in iron deposition but also in the global release of elements. The ability of siderophilic CB to participate in iron turnover make them appropriate candidates for biotechnological processes.
Author
Biogeochemistry; Siderophile Elements; Bacteria; Iron; Oxidation; Precambrian Period; Minerals

20070016729 Naval Research Lab., Washington, DC USA
Efficient Finite-Difference Time-Domain Scheme for Light Scattering by Dielectric Particles: Application to Aerosols
Yang, Ping; Liou, K N; Mishchenko, Michael I; Gao, Bo-Cai; Apr 24, 2000; 12 pp.; In English
Contract(s)/Grant(s): ATM-97-96277; NASA 5-7738
Report No.(s): AD-A464652; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464652

We have examined the Maxwell-Garnett, inverted Maxwell-Garnett, and Bruggeman rules for evaluation of the mean permittivity involving partially empty cells at particle surface in conjunction with the finite-difference time-domain (FDTD) computation. Sensitivity studies show that the inverted Maxwell-Garnett rule is the most effective in reducing the staircasing effect. The discontinuity of permittivity at the interface of free space and the particle medium can be minimized by use of an effective permittivity at the cell edges determined by the average of the permittivity values associated with adjacent cells. The efficiency of the FDTD computational program is further improved by use of a perfectly matched layer absorbing boundary condition and the appropriate coding technique. The accuracy of the FDTD method is assessed on the basis of a comparison of the FDTD and the Mie calculations for ice spheres. This program is then applied to light scattering by convex and concave aerosol particles. Comparisons of the scattering phase function for these types of aerosol with those for spheres and spheroids show substantial differences in backscattering directions. Finally, we illustrate that the FDTD method is robust and flexible in computing the scattering properties of particles with complex morphological configurations.
DTIC
Aerosols; Dielectric Properties; Dielectrics; Finite Difference Theory; Light Scattering

20070016774 Miami Univ., FL USA
Derivative Analysis of Absorption Features in Hyperspectral Remote Sensing Data of Carbonate Sediments
Louchard, Eric M; Reid, R P; Stephens, Carol F; Davis, Curtiss O; Leathers, Robert A; Downes, T V; Maffione, Robert; Dec 30, 2002; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-97-1-0010; N0014-99-1-0130
Report No.(s): AD-A464758; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464758

This study uses derivative spectroscopy to assess qualitative and quantitative information regarding seafloor types that can be extracted from hyperspectral remote sensing reflectance signals. Carbonate sediments with variable concentrations of microbial pigments were used as a model system. Reflectance signals measured directly over sediment bottoms were compared with remotely sensed data from the same sites collected using an airborne sensor. Absorption features associated with accessory pigments in the sediments were lost to the water column. However major sediment pigments, chlorophyll a and fucoxanthin, were identified in the remote sensing spectra and showed quantitative correlation with sediment pigment concentrations. Derivative spectra were also used to create a simple bathymetric algorithm.
DTIC
Carbonates; Derivation; Detection; Remote Sensing; Sediments

20070016782 State Univ. of New York, Stony Brook, NY USA

Experimental Micromechanics Study of Lamellar TiA1

Chiang, Fu-Pen; Feb 15, 2007; 25 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-03-1-0282

Report No.(s): AD-A464768; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464768

A unique micro-scale full field deformation measurement technique called electron speckle photography is exploited to investigate the deformation mechanism of lamellar TiAl. We find the size of the specimen used and the area of strain measurement affect the mechanical properties thus obtained. The strain distribution inside a grain is highly heterogeneous. The grain boundary is much stiffer than the interior of the grain. We also observe several interesting phenomena of the material when a crack is present. Crack speed tends to slow down when the crack approaches a grain boundary. Within a grain the slowest propagation speed is when the lamellar layers are perpendicular to the crack. Crack may jump across a grain boundary and its propagation direction may be predicted by the strain concentration congregated near the grain boundary. By mapping the deformation field surrounding the crack tip, we can evaluate the mode mixity from the speckle results at different stages of crack propagation.

DTIC

Crack Propagation; Grain Boundaries; Mapping; Mechanical Properties; Micromechanics

20070016783 Ohio State Univ., Columbus, OH USA

Partial Discharge Measurements for a Twisted Pair of Insulated Conductors at Low Pressures in Air, Argon and Helium (Postprint)

Liu, X; Kasten, D G; Sebo, S A; Grosjean, D F; Schweickart, D L; May 2006; 6 pp.; In English

Contract(s)/Grant(s): FA8650-04-C-2485; Proj-3005

Report No.(s): AD-A464772; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464772

This report was developed under a SBIR contract. Partial discharge (PD) measurements in air, argon and helium, under pressures from 101.3 kPa (760 Torr) down to 0.27 kPa (2 Torr), have been performed for both 60 Hz ac and dc energization. The electrode arrangement is a twisted pair of insulated conductors taken from a standard aircraft wiring harness. The paper describes the physical PD test setup, the electrical connections for ac energization, and specifies the twisted pair arrangement of the insulated conductors. The results are presented in terms of PD current pulse waveforms and their analysis reflecting the effects of pressure and voltage.

DTIC

Argon; Conductors; Electric Conductors; Harnesses; Helium; Insulation; Low Pressure; Wiring

20070016784 Southwestern Ohio Council for Higher Education, Dayton, OH USA

Corrosion Properties of Ca Based Bulk Metallic Glasses (Preprint)

Dahlman, James; Senkov, O N; Scott, J M; Miracle, D B; Oct 2006; 24 pp.; In English

Contract(s)/Grant(s): FA8650-04-D-5233; Proj-2311

Report No.(s): AD-A464773; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464773

Bulk amorphous metals are attractive materials for several reasons. An absence of microstructural features such as crystal plains, dislocations, grain and phase boundaries contribute to appealing mechanical properties such as high hardness and high specific strength. The amorphous structure also results in attractive magnetic properties such as high magnetic permeability. Corrosion studies have also established amorphous metals as a group of materials with corrosion properties much more desirable than their crystalline counterparts. As a result, metallic glasses have found their way into common applications including golf club heads, magnetic security strips, step-down transformers and cell phone cases. Within the last 15 years, many successful steps have been made in both understanding the properties of amorphous metals and in processing bulk quantities efficiently. Calcium based bulk metallic glasses constitute a new class of amorphous materials.

DTIC

Amorphous Materials; Corrosion; Glass; Hardness; High Strength; Metallic Glasses

20070016800 Massachusetts Univ., Amherst, MA USA
Drawing Nylon 6,6 Fibers in High Pressure CO2
Lesser, Alan J; Dec 7, 2005; 27 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-01-1-0580
Report No.(s): AD-A464955; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464955

Research studies have been performed on various fibers using supercritical carbon dioxide treatments. In these studies, Nylon6,6, PBO (Zylon) and other polyester fibers are treated under various conditions and post -treated fiber properties are measured and reported. In this research, supercritical CO2 is used as a plasticizing medium, a transport medium, and as a pressurizing medium to enhance the mechanical performance of selected high performance fibers. In a variety of cases, moderate enhancements in mechanical behavior are observed.
DTIC
Carbon Dioxide; High Pressure; Mechanical Properties; Nylon (Trademark); Polyesters

20070016824 Naval Research Lab., Washington, DC USA
Superlow Friction Behavior of Diamond-Like Carbon Coatings: Time and Speed Effects
Heimberg, J A; Wahl, K J; Singer, I L; Erdemir, A; Apr 23, 2001; 4 pp.; In English
Report No.(s): AD-A465025; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465025

The friction behavior of a diamond-like carbon coating was studied in reciprocating sliding contact at speeds from 0.01 to 5 mm/s, in dry nitrogen. 'Superlow' friction coefficients of 0.003 0.008 were obtained in continuous sliding at the higher speeds (\g1 mm/s). However, friction coefficients rose to values typical of diamond-like carbon in dry and ambient air (0.01-0.1) at lower speeds (\h0.5 mm/s) as well as in time-delayed, higher speed tests. The rise of the friction coefficients in both speed and time-delay tests was in good quantitative agreement with gas adsorption kinetics predicted by the Elovich equation for adsorption onto carbon. More generally, superlow friction could be sustained, suppressed, and recovered as a function of exposure time, demonstrating that duty cycle cannot be ignored when predicting performance of superlow friction coatings in devices.
DTIC
Adsorption; Carbon; Coatings; Diamonds; Friction; Time Dependence

20070016828 Naval Research Lab., Washington, DC USA
A Triboscopic Investigation of the Wear and Friction of MoS2 in a Reciprocating Sliding Contact
Wahl, K J; Belin, M; Singer, I L; Oct 8, 1997; 26 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465030; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465030

Reciprocating sliding tests with ball-on-flat geometry were performed on a duplex coating at low speeds in moist air (RH=60%). The coating, 55 nm MoS2 on 35 nm of TiN, was deposited by ion-beam assisted deposition onto a steel substrate. Friction coefficient (micro) and electrical contact resistance (Rc) measurements were recorded at ~2micrometers intervals along the track; these spatially resolved measurements were compared to the more commonly presented cycle-averaged values. The last-cycle tracks of several runs were also analyzed by a variety of microscopies and spectroscopies to identify compositions and determine thicknesses of films on the tracks and balls. Rc measurements, both averaged and spatially resolved, were more sensitive to coating damage and loss than mu measurements. In the averaged data, fluctuations in Rc were observed before fluctuations in mu. Spatially resolved data showed that local drops in Rc could be detected as early as 20% of life. Additionally, recovery of both high mu and low Rc regions, interpreted as healing of damage in the contact, occurs. Friction coefficient data were insensitive to changes in MoS2 coating thickness; conversely, Rc followed wear track thickness and consequently may provide an in situ method of monitoring coating wear.
DTIC
Contact Resistance; Deposition; Electrical Resistance; Friction; Microscopy; Molybdenum Compounds; Molybdenum Disulfides; Reciprocation; Spectroscopy; Wear

20070016829 Naval Research Lab., Washington, DC USA
Quantification of a Lubricant Transfer Process that Enhances the Sliding Life of a MoS2 Coating
Wahl, K J; Singer, I L; Apr 28, 1995; 8 pp.; In English
Report No.(s): AD-A465031; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465031

A lubricant transfer process that enhanced the wear life of a MoS2 coating has been identified and quantified. A steel ball sliding against a coated steel flat in reciprocating motion produced reservoirs at the turnaround part of the track ends, then emptied them, to provide replenishment similar to what is expected of liquid lubricants. The dynamics of the process were inferred from measurements of material loss and/or buildup in the track and on the ball; measurements were performed with Michelson interferometry and energy dispersive x-ray spectroscopy.
DTIC
Coating; Coatings; Lubricants; Lubrication; Molybdenum Compounds; Molybdenum Disulfides; Sliding

20070016859 Imperial Coll. of Science and Technology, London, UK
Oxygen Ion Conduction in Pyrochlores
Grimes, Robin W; Pirzada, Mohsin T; Minervini, Licia; LeClair, Steve R; May 29, 2001; 2 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F61775-00-W-E016
Report No.(s): AD-A465081; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465081

This report results from a contract tasking Imperial College London as follows: The contractor will investigate use of cellular automata (CA) algorithms to predict the growth of surface structures and the effects of the underlying substrate on the surface morphology. Structure/property maps will be generated using atomistic simulation calculations. Three systems will be investigated First the activation energy for oxygen ion conduction in pyrochlore oxides. Second the stability of the perovskite structure with particular reference to stoichiometry Third the structure type exhibited by AB2O4 compounds. The results of the research will be presented at the 102nd American Ceramic Society meeting at a Materials Directorate organized meeting and will be a published in the open literature.
DTIC
Ions; Oxygen; Oxygen Ions

20070016910 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Optical Parametric Oscillation in Orientation-Patterned Gallium Arsenide
Shell, Scott A; Mar 2007; 43 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464811; AFIT/GMS/ENP/07-01; No Copyright; Avail.: CASI: A03, Hardcopy

Tunable laser sources in the mid-infrared (MIR) spectral range are required for several Air Force applications. Existing lasers with output in the near-infrared can be converted to more desirable MIR by using nonlinear effects. Orientation patterned gallium arsenide (OPGaAs) is a promising nonlinear conversion material because it has broad transparency and can be engineered for specific pump laser and output wavelengths using quasi-phase matching techniques. This research examines optical parametric oscillation (OPO) of several OPGaAs samples using a 2.052 micrometers wavelength Tm, Ho:YLF pump laser. Of the seven samples available the five that were capable of getting OPO output with this pump were tested and OPO was successfully demonstrated on 4 of the 5. The highest slope efficiency of 10% was seen in sample 5. The highest pump power of incident 190 mW without causing damage to the AR coatings was applied to sample 4. Finally spectroscopic data of input and output was obtained and compared to calculated values.
DTIC
Gallium Arsenides; Oscillations; Tunable Lasers

20070016945 Army Research Lab., Aberdeen Proving Ground, MD USA
Interactions of Organic Surfactants With Oxide Nanoparticles Grown in Aqueous Environments
Synowczynski, Jennifer; Feb 2007; 28 pp.; In English
Contract(s)/Grant(s): Proj-AH84
Report No.(s): AD-A464864; ARL-TR-4047; No Copyright; Avail.: CASI: A03, Hardcopy

The goal of this report is to provide a fundamental understanding of how organic surfactants with different functional endgroups and branching structures affect the surface chemistry, organization, and growth of oxide nanoparticles (e.g., TiO2, ZnO) in aqueous solutions. It is generally known that particles grow from solution into shapes that minimize their surface free energy . The surface free energy is a complex function of the surface area, crystal anisotropy and defect structure, degree of coordination unsaturation, surface polarity, reconstruction barriers, and stoichiometry gradients. In solution, the situation is further complicated by changes in pH as well as interactions with ions and surfactants. Whether an ion or surfactant adsorbs to a specific facet depends on the competition between electrostatic and hydrophobic forces as well as their ability to form

chemical complexes with the surface. By engineering these surface interactions, one can either promote or prevent particle growth along specific crystallographic planes. Using this approach, researchers have succeeded in precipitating particles with atypical shapes such as nanotubes, rods, cubes, and monodispersed spheres. A firm understanding of the relationship between solution chemistry and the complexes that form at the aqueous/TiO2 surface will greatly enhance our ability to control the morphology of TiO2 nanoparticles and assemble these particles into more complicated structures. This work is critical to demonstrating many devices that rely on quantum confinement effects, including photonic bandgap devices and self-cleaning photocatalytically active surfaces.
DTIC
Aqueous Solutions; Chemical Reactions; Crystallography; Nanoparticles; Oxides; Photonics; Surface Reactions; Surfactants

20070016948 Army Engineer Research and Development Center, Vicksburg, MS USA
Effect of Residence Time on Net Nitrate Retention in Flow-Regulated Backwaters of the Upper Mississippi River
James, William F; Richardson, William B; Soballe, David M; Barko, John W; Eakin, Harry L; Feb 2006; 14 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464867; ERDC-TN-SWWRP=-6=1; No Copyright; Avail.: CASI: A03, Hardcopy

This research investigated relationships between water residence time and net nitrate retention (i.e., loading minus discharge) in flow-controlled backwater systems of the Upper Mississippi River (UMR). Goals were to gain a better understanding of the management potential for removing nitrogen in large river systems by increasing connectivity between nitrogen-rich main channel areas and backwater habitats. Nitrogen (N) runoff to receiving streams and rivers, particularly in the form of nitrate-nitrite (NO3NO2-N), has increased several-fold in recent decades (Justic et al. 1995, Vitousek et al. 1997, Goolsby and Battaglin 2001). A consequence of accelerated N mobilization and transport has been water quality degradation of coastal areas and estuaries which are sensitive to N inputs (Nixon 1995). For instance, increased N loading from the Mississippi River basin has been associated with the development of extensive areas of anoxia and hypoxia (Rabalais et al. 1994) and declines in fish and invertebrate abundance (Pavela et al. 1983) in the Gulf of Mexico. Continued unchecked N loading to coastal systems could lead to significant declines in the diversity and abundance of higher trophic levels and increased bloom frequency of noxious and toxic algae (Vitousek et al. 1997). In addition to managing NO3NO2-N runoff input to large river systems (i.e., watershed N source and transport control, wetland detention, riparian buffers, restored bottomland hardwood floodplains), there is a need to promote in-stream removal of NO3NO2-N by biological uptake, bacterial denitrification, and burial in order to reduce N transport to coastal systems (Mitsch et al. 2001). In-stream N transformation and removal do occur in large rivers, but are typically low and represent a small percentage of the overall load (5 to 20 percent, Seitzinger 1988).
DTIC
Mississippi River (US); Nitrates; Nitration; Nitrogen; Time Dependence; Watersheds

20070016980 Army Engineer Research and Development Center, Vicksburg, MS USA
Water and Sediment Data for Chemical Indicators of Contamination
Bowley, Tyler; Larson, Steven; Bednar, Anthony; Dec 2006; 25 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464921; ERDC/EL-TN-06-5; No Copyright; Avail.: CASI: A03, Hardcopy

INTRODUCTION: This subtask of the Interagency Performance Evaluation Team (IPET) Task 9 project focuses on data mining and compilation for chemical results in four Louisiana parishes affected by flooding from Hurricanes Katrina and Rita Orleans, Plaquemines, St. Bernard, and St. Charles. The compounds of interest are arsenic, lead, benzo[a]pyrene (BaP) and 1,1-dichloro-2,2- bis(p-chlorophenyl)ethylene (DDE), selected by consensus as likely candidates because of availability of data following the flooding events (Hurricanes Katrina and Rita) and the chemical variability between them. Arsenic and lead, although both inorganic analytes, would behave differently based on soil:solution chemistry. Lead sorbs to soil as a traditional cation, whereas arsenic speciation [As(III) or (V)] would yield little sorption in reduced environments as As(III), compared to increased sorption in the case of As(V) being favored in oxidizing environments. As(V) being favored in oxidizing environments. BaP is an organic polycyclic aromatic hydrocarbon which could be used to trace petroleum-impacted floodwaters. The pesticide DDE was selected because of its presence at superfund sites in the New Orleans area and historical production and usage in the area.
DTIC
Chemical Indicators; Contamination; Environmental Surveys; Hurricanes; Information Retrieval; Sediments; Water; Water Pollution

20070016989 Army Research Lab., Adelphi, MD USA
Carbon/PTFE Electrode for Lithium/Air-Water Batteries
Margulies, Benjamin; Read, Jeffrey; Mar 2007; 18 pp.; In English
Report No.(s): AD-A464942; ARL-TR-4066; No Copyright; Avail.: CASI: A03, Hardcopy

For this project we constructed an inexpensive air cathode free of catalyst, capable of functioning in both acidic and neutral electrolytes, for use in a lithium/air-water battery. The use of acidic electrolyte is necessitated by the formation of the discharge product LiOH from the lithium/air-water reaction. We present a procedure for the construction of a carbon/PTFE air cathode for use with both acidic and neutral electrolytes. We evaluated the performance of the cathode in electrolytes ranging from pH=0 to pH=8 by applying voltage to a half cell, in reference to a Ag/AgCl reference electrode, and then measuring the steady state current. Current densities were found to be the highest in 1M H(sub2)SO(sub4), the most acidic electrolyte tested, and decreased as the pH of the electrolyte increased. The cathode performed well enough over the entire pH range to be useful for the lithium/air-water battery.
DTIC
Air Water Interactions; Carbon; Current Density; Electrodes; Lithium; Lithium Batteries; Polytetrafluoroethylene; Steady State; Water

20070017006 Pennsylvania State Univ., University Park, PA USA
Condensed-Phase Reactions of Energetic Ionic Liquids Under Different Ignition Stimuli
Litzinger, Thomas A; Thynell, Stefan T; Mar 20, 2007; 17 pp.; In English
Contract(s)/Grant(s): F49620-03-1-0211
Report No.(s): AD-A464980; No Copyright; Avail.: CASI: A03, Hardcopy

The experimental work conducted under this program was designed to provide new insight into condensed-phase reactions leading to ignition of ionic liquids. The objectives of the work were: (1) to identify the initiation and secondary reactions in the condensed phase that lead to ignition and combustion, (2) to understand the effects of the structure of the cation on these reactions, and (3) to determine the effects of the type of ignition stimulus used. Two primary experimental approaches were applied: laser heating coupled with tandem mass spectrometry and rapid thermolysis coupled with FTIR and time-of-flight mass spectrometry. The compounds studied included: l-Ethyl-3-Methyl-Imidazolium Nitrate, 4-Amino-l,2,4-Triazolium Nitrate, i-Methyl, 4-Amino-l,2,4-Triazolium Nitrate, 2-Amino-4,5-Dimethyl Tetrazolium Nitrate and 1-Amino-4,5-Dimethyl Tetrazolium Nitrate.
DTIC
Condensing; Ignition; Liquid Phases; Liquids; Reaction Kinetics

20070017030 Naval Research Lab., Washington, DC USA
Optimization of Buffer Layers for InGaAs/AlGaAs PIN Optical Modulators Grown on GaAs Substrates by Molecular Beam Epitaxy
Katzer, D S; Rabinovich, W S; Ikossi-Anastasiou, K; Gilbreath, G C; Jun 2000; 6 pp.; In English
Report No.(s): AD-A465117; No Copyright; Avail.: CASI: A02, Hardcopy

In this work we compare the effect of the buffer layer on the device quality and surface morphology of strained InGaAs/AlGaAs PIN multiple quantum well (MQW) modulators. We examine GaAs buffer layers and linearly graded InGaAs buffer layers. Our results indicate that for lower indium concentrations in the quantum wells (less than about 23%) better device performance and surface morphology are obtained by growing directly on GaAs. PIN MQWs with indium mole fractions higher than about 24% have better properties when a linearly graded buffer layer is used.
DTIC
Aluminum Gallium Arsenides; Gallium Arsenides; Indium Gallium Arsenides; Light Modulators; Modulators; Molecular Beam Epitaxy; Pins; Quantum Wells; Substrates

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METALS AND METALLIC MATERIALS

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

20070016718 Naval Research Lab., Bay Saint Louis, MS USA
UNS N06625: A Current Review of the Literature
Lee, Jason S; Ray, Richard I; Little, Brenda J; Sep 2006; 8 pp.; In English
Report No.(s): AD-A464623; NRL/JA/7303-06-6217; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464623

The mechanical and electrochemical characteristics of nickel-based alloys have been extensively examined for their potential application in high- and elevated-temperature and marine environments. This article presents a literature review concerning the behavior of alloy UNS N06625 and other nickel-based alloys in these environments.
DTIC
Corrosion; High Temperature; Nickel Alloys; Sea Water

20070016738 Universal Technology Corp., Dayton, OH USA
A New Paradigm of Fatigue Variability Behavior and Implications for Life Prediction (Preprint)
Jha, S K; Caton, M J; Larsen, J M; Jun 2006; 23 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-M02R
Report No.(s): AD-A464665; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464665

The treatment of the fatigue variability behavior has traditionally been based on the understanding of the mean-lifetime behavior. With reference to two turbine engine materials, an alpha + Beta titanium alloy and a nickel-based superalloy, it is shown that the traditional approach may not accurately describe the fatigue variability behavior of these materials. Decreases in stress level, or microstructural change directed at increasing the mean lifetime, were found to affect mean and worst-case (life-limiting) fatigue behavior differently, and these differences could not be accounted for in the traditional understanding. A new paradigm of fatigue variability was therefore suggested, in which the total uncertainty in lifetime breaks down into the variability in (1) the worst-case mechanism and that in (2) the classical, mean-lifetime governing response. The effects of microstructure and temperature on the fatigue variability behavior were studied with respect to the new paradigm and found to have a very systematic effect on the worst-case and the mean behavior, depending on the degree of influence of these variables on the crack initiation and the growth regime.
DTIC
Fatigue Life; Heat Resistant Alloys; Microstructure; Nickel; Predictions; Titanium Alloys; Variability

20070017038 Dayton Univ. Research Inst., OH USA
Corrosion Rate Evaluation Procedure (CREP): A Convenient Reliable Method for Determining Corrosion Inhibition Ability of Lubricants (Preprint)
Roberts, Marcie B; Fultz, George; Gschwender, Lois J; Snyder, Carl E; Oct 2004; 17 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-00-D-5021-0001; Proj-4347
Report No.(s): AD-A465133; No Copyright; Avail.: CASI: A03, Hardcopy

The Corrosion Rate Evaluation Procedure (CREP) was first designed as a screening test for corrosion inhibited aerospace gas turbine engine oils as a substitute for the Humidity Cabinet corrosion Test (ASTM D1748) in order to screen large numbers of oils in a short period of time for their ability to prevent rust. The CREP was later adapted for hydraulic fluids and greases because of its simplicity, low cost, and speed. For greases it is an alternate method to ASTM D1743 and can evaluate corrosion protection in 1.5 to 2 hours using only 2-4 milligrams of grease. The metal coupons, used in the CREP test, are low cost and available in a variety of metallurgies. The CREP is convenient, reliable, adaptable, cost effective, and usable with greases, liquid lubricants, or hydraulic fluids and various metals as desired.
DTIC
Corrosion; Corrosion Prevention; Lubricants

20070017372 NASA Glenn Research Center, Cleveland, OH, USA
Correlation between Mechanical Behavior and Actuator-type Performance of Ni-Ti-Pd High-temperature Shape Memory Alloys
Bigelow, Glen S.; Padula, Santo A., II; Garg, Anita; Noebe, Ronald D.; [2007]; 12 pp.; In English; 14th International Symposium on Smart Structures and Materials and Nondestructive Evaluation and Health Monitoring, 18-22 Mar. 2007, San Diego, CA, USA
Contract(s)/Grant(s): WBS 561581.02.08.03.15.02
Report No.(s): Paper-6526-79; Copyright; Avail.: CASI: A03, Hardcopy

High-temperature shape memory alloys in the NiTiPd system are being investigated as lower cost alternatives to NiTiPt alloys for use in compact solid-state actuators for the aerospace, automotive, and power generation industries. A range of ternary NiTiPd alloys containing 15 to 46 at.% Pd has been processed and actuator mimicking tests (thermal cycling under

load) were used to measure transformation temperatures, work behavior, and dimensional stability. With increasing Pd content, the work output of the material decreased, while the amount of permanent strain resulting from each load-biased thermal cycle increased. Monotonic isothermal tension testing of the high-temperature austenite and low temperature martensite phases was used to partially explain these behaviors, where a mismatch in yield strength between the austenite and martensite phases was observed at high Pd levels. Moreover, to further understand the source of the permanent strain at lower Pd levels, strain recovery tests were conducted to determine the onset of plastic deformation in the martensite phase. Consequently, the work behavior and dimensional stability during thermal cycling under load of the various NiTiPd alloys is discussed in relation to the deformation behavior of the materials as revealed by the strain recovery and monotonic tension tests.
Author
Actuators; Heat Resistant Alloys; Shape Memory Alloys; Thermal Cycling Tests; Cost Reduction; Deformation

20070017374 NASA Glenn Research Center, Cleveland, OH, USA
Effects of Exposures on Superalloys for Space Applications
Gabb, Tim; Garg, Anita; Gayda, John; Feb. 26, 2007; 21 pp.; In English; TMS Annual Meeting, 26 Feb. - 1 Mar. 2007, Orlando, FL, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 850661.04.01.03; Copyright; Avail.: CASI: A03, Hardcopy

The industry is demanding longer term service at high temperatures for nickel-base superalloys in gas turbine engine as well as potential space applications. However, longer term service can severely tax alloy phase stability, to the potential detriment of mechanical properties. Cast Mar-M247LC and wrought Haynes 230 superalloys were exposed and creep tested for extended times at elevated temperature. Microstructure and phase evaluations were then undertaken for comparisons.
Author
Heat Resistant Alloys; Exposure; Nickel Alloys; Mechanical Properties; Creep Properties

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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*.

20070016728 Air Force Research Lab., Wright-Patterson AFB, OH USA
An Experimental Investigation of Low-Pressure Turbine Blade Suction Surface Stresses Using S3F (Preprint)
McQuilling, Mark; Wolff, Mitch; Fonov, Sergey; Crafton, Jim; Sondergaard, Rolf; Oct 2006; 14 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-2307
Report No.(s): AD-A464651; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464651

A shear and stress sensitive film (S3F) is employed on the suction surface of an industry standard low-pressure turbine blade. These tests address the optimization of S3F for low-speed air investigations on a curved surface, and are the first measurements of its kind. S3F provides all three stress components on a surface in a single measurement, and is based on 3D elastic deformations of a polymeric film. New composition films have been developed, and results over a range of Re respective of LPT flow conditions illustrate the need for separate films tailored for the local stress levels in each area.
DTIC
Computational Fluid Dynamics; Deformation; Displacement; Low Pressure; Skin Friction; Strain Distribution; Suction; Turbine Blades

20070016957 Army Research Lab., Aberdeen Proving Ground, MD USA
Porous Thin Films Based on Photo-Cross-Linked Star-Shaped Poly(D,L-lactide)s
Karikari, Afia S; Williams, Sharlene R; Heisey, Cheryl L; Rawlett, Adam M; Long, Timothy E; Mar 2007; 12 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-AH84
Report No.(s): AD-A464886; ARL-RP-165; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Self-assembly processes and subsequent photo-cross-linking were used to generate cross-linked, ordered microporous structures on the surfaces of well-defined four-arm star-shaped poly(D,L-lactide) (PDLLA) thin films. The four-arm star-shaped PDLLAs were synthesized using an ethoxylated pentaerythritol initiator. Solutions of the PDLLAs were cast in

a humid environment, and upon solvent evaporation, ordered honeycomb structures (or breath figures) were obtained. Correlations between molar mass, polymer solution viscosity, and pore dimensions were established. The average pore dimension decreased with increasing polymer solution concentration, and a linear relationship was observed between relative humidity and average pore dimensions. Highly ordered microporous structures were also developed on four-arm star-shaped methacrylate-modified PDLLA (PDLLA-UM) thin films. Subsequent photo-cross-linking resulted in more stable PDLLA porous films. The photo-cross-linked films were insoluble, and the honeycomb structures were retained despite solvent exposure. Free-standing, structured PDLLA-UM thin films were obtained upon drying for 24 h. Ordered microporous films based on biocompatible and biodegradable polymers, such as PDLLA, offer potential applications in biosensing and biomedical applications.
DTIC
Polymeric Films; Porosity; Porous Materials; Thin Films

20070016968 Air Force Research Lab., Wright-Patterson AFB, OH USA
Influence of Surface Roughness on The Specular Reflectance of Low Gloss Coatings Using Bidirectional Reflectance Measurements
Farrier, Lisa M; Oct 2006; 70 pp.; In English
Contract(s)/Grant(s): Proj-M06R
Report No.(s): AD-A464906; AFRL-ML-WP-TM-2007-4019; No Copyright; Avail.: CASI: A04, Hardcopy

The objective of this study was to determine the effects of surface roughness and incident angle on the reflectance of low gloss coatings at grazing incidence. A specular peak has been identified from the forward scatter at longer wavelengths, 3.39 μm and 10.6 μm, for various painted surfaces. Depending on the surface roughness and wavelength, this specular component occurs at different angles. However, this effect has not been observed in the visible region. Material surfaces with well characterized surface roughness have been measured at a wavelength of 0.633 μm in an attempt to observe this effect in the visible region. The angle at which it was observed for various roughnesses has been obtained using bidirectional reflectance distribution function (BRDF) measurements.
DTIC
Antireflection Coatings; Bidirectional Reflectance; Coatings; Reflectance; Surface Roughness

20070017904 NASA Glenn Research Center, Cleveland, OH, USA
Piloted Ignition to Flaming in Smoldering Fire-Retarded Polyurethane Foam
Putzeys, O.; Fernandez-Pello, A. C.; Urban, D. L.; March 28, 2007; 15 pp.; In English; 5th U.S. Combustion Meeting, 25-28 Mar. 2006, San Diego, CA, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 732759.03.01.02.21
Report No.(s): Paper H38; Copyright; Avail.: CASI: A03, Hardcopy

Experimental results are presented on the piloted transition from smoldering to flaming in the fire-retarded polyurethane foam Pyrell . The samples are small rectangular blocks with a square cross section, vertically placed in the wall of a vertical wind tunnel. Three of the vertical sample sides are insulated and the fourth side is exposed to an upward oxidizer flow of variable oxygen concentration and to a variable radiant heat flux. The gases emitted from the smoldering reaction pass upwards through a pilot, which consists of a coiled resistance heating wire. In order to compensate for the solid-phase and gas-phase effects of the fire retardants on the piloted transition from smoldering to flaming in Pyrell, it was necessary to assist the process by increasing the power supplied to the smolder igniter and the pilot (compared to that used for non-fire retarded foam). The experiments indicate that the piloted transition from smoldering to flaming occurs when the gaseous mixture at the pilot passes the lean flammability limit. It was found that increasing the oxygen concentration or the external heat flux increases the likelihood of a piloted transition from smoldering to flaming, and generally decreases the time delay to transition. The piloted transition to flaming is observed in oxygen concentrations of 23% and above in both low-density and high-density Pyrell. Comparisons with previous experiments show that the piloted transition from smoldering to flaming is possible under a wider range of external conditions (i.e. lower oxygen concentration) than the spontaneous transition from smoldering to flaming. The results show that the fire retardants in Pyrell are very effective in preventing the piloted transition to flaming in normal air, but Pyrell is susceptible to smoldering and the piloted transition to flaming in oxygen-enriched environments. Therefore, precautions should be taken in the design of applications of Pyrell in oxygen-enriched environments to reduce to the risk of a piloted transition to flaming.
Author
Smoldering; Polyurethane Foam; Ignition; Gas Mixtures; Flame Retardants; Resistance Heating; Heat Flux; Flammability

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*.

20070016961 Army War Coll., Carlisle Barracks, PA USA
Chinese Perceptions of Traditional and Nontraditional Security Threats
Craig, Susan L; Mar 2007; 169 pp.; In English
Report No.(s): AD-A464893; No Copyright; Avail.: CASI: A08, Hardcopy

This research is an attempt to understand the motivations and decisions of China's leadership by examining the writings and opinions of China's scholars, journalists, and leaders -- its influential elite. It will show that China has a comprehensive concept of national security that includes not only defending its sovereignty and territorial integrity, but continuing its economic and social development and maintaining its international stature. There are two main types of threats to China's national security: traditional and nontraditional. Traditional threats can be characterized loosely as threats to a nation emanating from other nations and involving a military component. While the most talked-about threat to China's territory is a declaration of independence by Taiwan, the influential elite actually find this possibility unlikely. The focus is therefore on the few countries considered both capable of and willing to endanger all three of China's components of national security: sovereignty, economic development, and international stature. The USA, Japan, and India have significant ideological, historical, or territorial disagreements with China and possess the military, economic, and/or international diplomatic means to go to battle over such differences. While China's influential elite are concerned about a direct military confrontation with the USA, Japan, and India, they are far more concerned about the possibility of containment efforts by any, or all, of these countries. Even more troublesome to China's security environment are nontraditional threats. This monograph also focuses on three nontraditional threats to China: economic and social disparities within China, environmental degradation, and energy insecurity. China's nontraditional threats are more menacing than traditional ones because they require China's leadership to not only look outward to foster cooperation, but also to look inward and make serious internal reforms.
DTIC
China; Perception; Petroleum Products; Pollution; Security

20070016999 Army Tank-Automotive Research and Development Command, Warren, MI USA
OSD Clean Fuel Initiative
Muzzell, Patsy A; May 10, 2005; 27 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464964; TARDEC-14912; No Copyright; Avail.: CASI: A03, Hardcopy

The vision of the OSD(Office of the Secretary of Defense) Clean Fuel Initiative is that DoD intends to catalyze the commercial industry to produce clean fuels for the military from secure domestic resources using environmentally sensitive processes that create jobs and wealth in the USA.
DTIC
Clean Fuels; Fuels

20070017960 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA, Illinois Univ., Urbana-Champaign, IL, USA, NPL Associates, Champaign, IL, USA
Regenerative Fuel Cells for Space Power and Energy Conversion (NaBH4/H2O2 Fuel Cell Development)
Valdez, Thomas I.; Miley, George H.; Luo, Nie; Burton, Rodney; Mather, Joseph; Hawkins, Glenn; Byrd, Ethan; Gu, Lifeng; Shrestha, Prajakti Joshi; April 25, 2006; 16 pp.; In English; Space Power Workshop, 25-27 Apr. 2006, Manhattan Beach, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39874

A viewgraph presentation describing hydrogen peroxide and sodium borohydride development is shown. The topics include: 1) Motivation; 2) The Sodium Borohydride Fuel Cell; 3) Fuel Cell Comparisons; 4) MEA Optimization; 5) 500-Watt Stack Testing; 6) System Modeling: Fuel Cell Power Source for Lunar Rovers; and 7) Conclusions
CASI
Energy Conversion; Hydrogen Peroxide; Regenerative Fuel Cells; Sodium; Borohydrides; Fabrication

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*.

20070016760 Stanford Univ., Stanford, CA USA
Diode Laser Sensor for Gas Temperature and H2O Concentration in a Scramjet Combustor Using Wavelength Modulation Spectroscopy (Postprint)
Rieker, Gregory B; Li, Jonathan T; Jeffries, Jay B; Mathur, Tarun; Gruber, Mark R; Carter, Campbell D; Jul 2005; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-3012
Report No.(s): AD-A464709; AIAA-2005-3710; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464709

A diode laser absorption sensor which probes three spectral features of water vapor in the near infrared region to infer gas temperature and water vapor concentration near the exit of a scramjet combustor is presented. Optical engineering is used to overcome beam steering and fiber mode noise sources. A method to make absolute measurements using wavelength modulation spectroscopy (WMS) with second harmonic detection (2f) is described, along with the advantages of the technique over direct absorption spectroscopy. Measurements using both techniques in the scramjet combustor are compared to show superior noise rejection and overall signal to noise ratios with WMS-2f. Results of temperature and water vapor partial pressure under various scramjet operating conditions show the utility of the sensor for scramjet engine design and optimization.
DTIC
Combustion Chambers; Diodes; Gas Temperature; Lasers; Modulation; Semiconductor Lasers; Spectroscopy; Supersonic Combustion Ramjet Engines; Temperature Measuring Instruments; Tunable Lasers; Water

20070016761 Air Force Research Lab., Wright-Patterson AFB, OH USA
Simulating Inlet Distortion Effects In A Direct-Connect Scramjet Combustor (Postprint)
Gruber, Mark R; Hagenmaier, Mark A; Mathur, Tarun; Jul 2006; 14 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): Proj-3012
Report No.(s): AD-A464710; AFRL-PR-WP-TP-2006-274; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464710

Direct-connect simulations of scram jet combustors typically use facility nozzles designed to produce uniform flow entering the test article. Conversely, in free-jet and flight experiments, where air is ducted to the supersonic combustor through an inlet, flow entering the test article will be inherently distorted. These distortion effects can include non-uniform boundary layer thicknesses on the walls and relatively strong oblique shock waves. In this work, a special piece of hardware (called a distortion generator) was designed to mimic the effects of inlet distortion in a direct-connect test environment. The design methodology for this distortion generator will be described along with details of its fabrication and installation into the experimental research facility. Finally, the results of computational and experimental calibrations will be presented. These results confirm that distortion characteristics anticipated in freejet and flight experiments can be effectively simulated in the direct-connect test environment. This new hardware will enable future experimental investigations aimed at understanding the effects of inlet-induced distortion on combustor operability and performance.
DTIC
Combustion Chambers; Distortion; Simulation; Supersonic Combustion Ramjet Engines

20070016986 Edgewood Chemical Biological Center, Aberdeen Proving Ground, MD USA
Development of the 5-cm Agent Fate Wind Tunnel
Weber, Daniel J; Scudder, Mary K; Moury, Clayton S; Shuely, Wendel J; Molnar, John W; Miller, Miles C; Dec 2006; 181 pp.; In English
Report No.(s): AD-A464938; ECBC-TR-327; No Copyright; Avail.: CASI: A09, Hardcopy

This report describes development of a 5-cm wind tunnel designed to measure the release and retention of chemical warfare agents (CWA) from various materials under simulated environmental conditions. The wind tunnel, sized to fit within a standard chemical fume hood, provides a specified vertical velocity profile, temperature, and relative humidity (simulating the natural environment) for a sustained time period ranging from hours to weeks. The associated data acquisition instrumentation measures the time history of the vapor released during evaporation of the CWA from the material substrate

whether the chemical is a sessile drop on the surface or a sorbed liquid within the substrate. The wind tunnel creates the full-scale, lower portion of the velocity profile produced by a wind-induced, atmospheric boundary layer, which passes over a full-scale drop of agent and a full-scale sample of the material substrate. This feature differentiates it from environmental type wind tunnels where scaling is required for the airflow and items being tested. The 5-cm wind tunnel has the capability to test single and multiple drops of agent. This report summarizes the design evolution, component details and operational functions. Representative data obtained in the tunnel are compared with results from other experimental sources.
DTIC
Chemical Warfare; Environmental Tests; Evaporation; Wind Tunnels

20070017254 NASA Glenn Research Center, Cleveland, OH, USA
Comparison of the Atomic Oxygen Erosion Depth and Cone Height of Various Materials at Hyperthermal Energy
Waters, Deborah L.; Banks, Bruce A.; Thorson, Stephen D.; deGroh, Kim, K.; Miller, Sharon K.; March 2007; 13 pp.; In English; 10th International Symposium on 'Materials in a Space Environment', 19-23 Jun. 2006, Collioure, France; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 843515.01.15.03
Report No.(s): NASA/TM-2007-214374; E-15655; Copyright; Avail.: CASI: A03, Hardcopy

Atomic oxygen readily reacts with most spacecraft polymer materials exposed to the low Earth orbital (LEO) environment. If the atomic oxygen arrival comes from a fixed angle of impact, the resulting erosion will foster the development of a change in surface morphology as material thickness decreases. Hydrocarbon and halopolymer materials, as well as graphite, are easily oxidized and textured by directed atomic oxygen in LEO at energies of approx.4.5 eV. What has been curious is that the ratio of cone height to erosion depth is quite different for different materials. The formation of cones under fixed direction atomic oxygen attack may contribute to a reduction in material tensile strength in excess of that which would occur if the cone height to erosion depth ratio was very low because of greater opportunities for crack initiation. In an effort to understand how material composition affects the ratio of cone height to erosion depth, an experimental investigation was conducted on 18 different materials exposed to a hyperthermal energy directed atomic oxygen source (approx.70 eV). The materials were first salt-sprayed to provide microscopic local areas that would be protected from atomic oxygen. This allowed erosion depth measurements to be made by scanning microscopy inspection. The polymers were then exposed to atomic oxygen produced by an end Hall ion source that was operated on pure oxygen. Samples were exposed to an atomic oxygen effective fluence of 1.0x10(exp 20) atoms/sq cm based on Kapton H polyimide erosion. The average erosion depth and average cone height were determined using field emission scanning electron microscopy (FESEM). The experimental ratio of average cone height to erosion depth is compared to polymer composition and other properties.
Author
Low Earth Orbits; Oxygen Atoms; Field Emission; Tensile Strength; Scanning Electron Microscopy; Depth Measurement; Crack Initiation; Hydrocarbons; Ion Sources

20070017912 QSS Group, Inc., Cleveland, OH, USA
Robust Joining and Integration Technologies for Advanced Metallic, Ceramic, and Composite Systems
Singh, M.; Shpargel, Tarah; Morscher, Gregory N.; Halbig, Michael H.; Asthana, Rajiv; January 27, 2006; 44 pp.; In English; Invited Talk at 30th International Conference on Advanced Ceramics and Composites, 22-27 Jan. 2007, Cocoa Beach, FL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-00145; WBS 22-973-80-50; Copyright; Avail.: CASI: A03, Hardcopy

Robust integration and assembly technologies are critical for the successful implementation of advanced metallic, ceramic, carbon-carbon, and ceramic matrix composite components in a wide variety of aerospace, space exploration, and ground based systems. Typically, the operating temperature of these components varies from few hundred to few thousand Kelvin with different working times (few minutes to years). The wide ranging system performance requirements necessitate the use of different integration technologies which includes adhesive bonding, low temperature soldering, active metal brazing, diffusion bonding, ARCJoinT, and ultra high temperature joining technologies. In this presentation, a number of joining examples and test results will be provided related to the adhesive bonding and active metal brazing of titanium to C/C composites, diffusion bonding of silicon carbide to silicon carbide using titanium interlayer, titanium and hastelloy brazing to silicon carbide matrix composites, and ARCJoinT joining of SiC ceramics and SiC matrix composites. Various issues in the joining of metal-ceramic systems including thermal expansion mismatch and resulting residual stresses generated during joining will be discussed. In addition, joint design and testing issues for a wide variety of joints will be presented.
Author
Ceramic Matrix Composites; Thermal Expansion; Adhesive Bonding; Composite Materials; Metal Bonding; Operating Temperature; Diffusion Welding

20070017949 Ohio Aerospace Inst., Cleveland, OH, USA

Effect of Composite Substrates on the Mechanical Behavior of Brazed Joints in Metal-Composite System

Singh, M.; Morscher, Gregory N.; Shpargel, Tarah; Asthana, Rajiv; April 23, 2006; 19 pp.; In English; 3rd International Brazing and Soldering Conference, 23-26 Apr. 2006, San Antonio, TX, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): NNC06ZA12A; WBS 22-973-80-50; Copyright; Avail.: CASI: A03, Hardcopy

Advanced composite components are being considered for a wide variety of demanding applications in aerospace, space exploration, and ground based systems. A number of these applications require robust integration technologies to join dissimilar materials (metalcomposites) into complex structural components. In this study, three types of composites (C-C, C-SiC, and SiC-SiC) were vacuum brazed to commercially pure Ti using the active metal braze alloy Cusil-ABA (63Ag-35.3Cu-1.75Ti). Composite substrates with as fabricated and polished surfaces were used for brazing. The microstructure and composition of the joint, examined using scanning electron microscopy (SEM) coupled with energy dispersive spectroscopy (EDS), showed sound metallurgical bonding in all systems. The butt strap tensile (BST) test was performed on bonded specimens at room and elevated temperatures. Effect of substrate composition, interlaminar properties, and surface roughness on the mechanical properties and failure behavior of joints will be discussed.

Author

Composite Materials; Brazing; Mechanical Properties; Structural Design; Tensile Tests; Microstructure; Soldered Joints; Bonding

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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*.

20070016713 Defence Science and Technology Agency, Singapore

The Harbour Defence IKC2 Experience

Choon Kiat, Tan; Lu Yun, Tan; Jiang Pern, Goh; Teck Hwee, Wong; Lock Pin, Chew; Jun 2005; 30 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464466; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464466

In the past, conventional design of command and control systems has been adopting a client-server approach or the stovepipe structural design, which means that system components are tightly integrated and all system software components have to be completed before the system can be fully operational. Such tightly coupled system architecture imposes rigid limitations on system flexibility for expansion. More crucially, in the rapidly changing environment, it is more important than ever to embrace the evolutionary development process, whereby system components are developed as building blocks, that can facilitate ease of introducing new features within short time cycles. The Harbor Defense Integrated Knowledge-based Command and Control (IKC2) Experiment was conceived against the backdrop of increasing waves of terror threats. In particular, with the tight coupling of Singapore's prosperity with international trade, protection of our local waters is paramount. This experiment seeks to leverage upon advances in the commercial world to rapidly and cost effectively deploy solutions to address homeland security, through the Enterprise Architecture approach. In essence, the experiment seeks to utilize the enterprise architecture approach as a means to achieve the operational vision of IKC2 in the Harbor Defense context. From the integration of sensors to achieve superior situation awareness, to the networking of forces to share a common operational picture, enhanced operationally with the assistance of decision support system. In the experiment, the services provided broadly demonstrate the potential of such a systems approach where additional operational capabilities can be introduced progressively, giving the players heightened clarity and an increased situation awareness, thus enabling faster reaction to the situation.

DTIC

Command and Control; Harbors; Knowledge Based Systems; Security

20070016735 Naval War Coll., Newport, RI USA

Global Missile Defense: The Case for a New Operational Command Structure

Galazin, Jared J; Feb 14, 2005; 24 pp.; In English

Report No.(s): AD-A464660; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464660

With the very short timeline for a ballistic missile attack on the USA, unity of effort of all Ballistic Missile Defense System (BMDS) assets under one commander is essential for rapid decision-making and execution. Unfortunately, the current approach to executing the missile defense mission, as outlined in Unified Command Plan 2002 (UCP 02), violates the principle of unity of command. Placing components of the BMDS under the control of different combatant commanders creates unnecessary friction in a process where speed of execution is measured in seconds. This flaw is not significant enough to threaten the basic function of the system, but it does prevent it from operating as efficiently as possible. This paper proposes a single Joint Force Commander (JFC) that has operational control (OPCON) of all elements of the BMDS to mitigate risk by ensuring that all seams are removed from the ICBM kill chain.
DTIC
Antimissile Defense; Ballistic Missiles; Command and Control; Intercontinental Ballistic Missiles; Missile Bodies; Missile Defense

20070016767 Department of Defense, Washington, DC USA
Rapid Simulation Evaluation from Scenario Specifications for Command and Control Systems
Paul, Raymond A; Tsai, W T; Mikell, John S; Jun 2004; 42 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464749; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464749

This paper presents a technique to simulate and evaluate a system once the system scenarios are available without any simulation programming. This is different from traditional simulation where simulation code and the system specification are separately developed by human engineer and potential gaps between them might be introduced. Another significant advantage of this approach is that the scenarios specified do not need to be complete or consistent. Inconsistency and incompleteness, as well as safety, performance, and behavior problems, can be detected by the simulation via various dynamic analyses. This technique is a part of Scenario-Driven System Engineering (SDSE) that is being developed for Command-and-Control systems.
DTIC
Command and Control; Simulation

20070016779 Naval Research Lab., Washington, DC USA
Resource management in energy-limited, bandwidth-limited, transceiver-limited wireless networks for session-based multicasting
Wieselthier, Jeffrey E; Nguyen, Gam D; Ephremides, Anthony; Nov 12, 2001; 20 pp.; In English
Report No.(s): AD-A464765; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464765

In this paper we consider source-initiated multicast session traffic in an ad hoc wireless network, operating under hard constraints on the available transmission energy as well as on bandwidth and transceiver resources. We describe the similarities and differences between energy-limited and energy-efficient communications, and we illustrate the impact of these overlapping (and sometimes conflicting) considerations on network operation. In energy-limited applications, fundamental objectives include the maximization of a network's useful lifetime and the maximization of traffic that is delivered during this lifetime. We demonstrate how the incorporation of residual energy into the cost metric used for tree construction can provide improved performance based on these criteria.
DTIC
Bandwidth; Communication Networks; Resources Management; Transmitter Receivers

20070016802 Sandia National Labs., Albuquerque, NM USA
A Modified Perspective of Decision Support in C2
Senglaub, Michael; Harris, Dave; Feb 2002; 49 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DE-AC04-94AL85000
Report No.(s): AD-A464958; SAND2005-1701C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464958

Information processing and transformation in support of operations in combat environments have evolved well beyond the capabilities of classic deductive inductive/information systems. Unconventional warfare, and modern terrorism operate under conditions that do not lend themselves to pattern recognition techniques. The effort at Sandia National Laboratories is approaching the problem from an adaptive decision aid perspective in which new technologies are being hybridized to provide

new and unique capabilities to deal with this new threat. These technologies are founded in Peircean reasoning and provide support for the various components needed to formulate a solution. The supporting technologies include formal concept analysis for knowledge representation, modal logic to provide guidelines for the movement and transformation of data and information, and a unique neural construct based on Hawkins concept of the neocortex. When integrated into a co-evolutionary game theoretic environment we believe we can provide capabilities of predicting the trends that will emerge in insurgency use of IEDs against combatants and non-combatants in theater.
DTIC
Command and Control; Decision Support Systems

20070016811 Naval Research Lab., Washington, DC USA
Progress in High-Speed Communication at the NRL Chesapeake Bay Lasercomm Testbed
Vilcheck, M J; Burris, H R; Moore, C I; Stell, M F; Suite, M R; Davis, M A; Mahon, R; Oh, E; Scharpf, W J; Rabinovich, W S; Reed, A E; Jan 2004; 9 pp.; In English
Report No.(s): AD-A464984; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464984

The Naval Center for Space Technology at the Naval Research Laboratory has been operating a long-range, maritime, free-space optical communications facility located between Chesapeake Beach, MD and Tilghman, Island, MD. The two sections of the facility are separated by 16.2 km of the Chesapeake Bay. The facility permits one-way communications with the transmitter and receiver at opposite ends as well as double pass communications using a retroreflector array on Tilghman Island and the transmitter and receiver located together at Chesapeake Beach. Over the past year, a ball lens has been incorporated to couple the returned free-space light into an optical fiber. This ball lens makes the coupling much less sensitive to angle. With the lens, averaged coupled power into the receive fiber increased from 50 microwatts to 130 microwatts. Link statistics including fade rate and bit error rate are included for a typical summer afternoon for the double pass configuration.
DTIC
Chesapeake Bay (US); High Speed; Optical Communication; Progress

20070016934 California Inst. of Tech., Pasadena, CA USA
Verification of an Autonomous Reliable Wingman Using CCL
Waydo, Stephen; Klavins, Eric; Jan 2004; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F49620-01-1-0361
Report No.(s): AD-A464849; No Copyright; Avail.: CASI: A02, Hardcopy

We present a system of two aircraft, one human piloted and one autonomous, that must coordinate to achieve tasks. The vehicles communicate over two data channels, one high rate link for state data transfer and one low rate link for command messages. We analyze the operation of the system when the high rate link fails and the aircraft must use the low rate link to execute a safe lost wingman procedure to increase separation and re-acquire contact. In particular, the protocol is encoded in CCL, the Computation and Control Language, and analyzed using temporal logic. A portion of the verified code is then used to command the unmanned aircraft, while on the human-piloted craft the protocol takes the form of detailed flight procedures. An overview of the implementation for a June, 2004 flight test is also presented.
DTIC
Aircraft Pilots; Autonomy; Command and Control; Data Transmission

20070016965 Naval War Coll., Newport, RI USA
Operation Anaconda: Command and Control through VTC
McPherson, James A; Feb 14, 2005; 24 pp.; In English
Report No.(s): AD-A464899; No Copyright; Avail.: CASI: A03, Hardcopy

Before the video-teleconference came into use, operational level commanders often relied on personal observations to make decisions. Commanders personally observed their subordinates' actions and were able to gain a 'feel' for the battlefield. Advanced information technology has changed the way operational commanders communicate with subordinates. Face-to-face meetings and personal observations have largely been replaced by video-teleconferences (VTC). While in use for many years, Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) ushered in the first widespread use of the VTC as a Command and Control (C2) system. Many strategic and operational commanders have come to rely heavily on VTCs, almost to the exclusion of other forms of communication. Operation Anaconda conducted in OEF provides a good illustration of a breakdown in communication between two critical components due to an over-reliance on VTCs. VTCs, while offering

significant capabilities, have inherent limitations as a C2 system that must be appreciated by operational commanders to ensure success. The over-reliance on VTCs in Operation Anaconda at the expense of personal face-to-face interaction degraded General Tommy Franks' ability to gage his subordinates' level of understanding. Component staffs came to rely solely on VTCs for coordination to the exclusion of message traffic. As a result, components developed different perspectives concerning Anaconda. Additionally, component commanders relied heavily on their staffs for coordination and did not communicate personally with each other. These communication breakdowns contributed to many of the problems in the operation. The enemy in Operation Anaconda lacked the ability to exploit mistakes resulting from poor coordination. Nonetheless, these types of mistakes may prove to be disastrous against a formidable opponent in the future.
DTIC
Command and Control; Telephony; Video Communication

20070016969 Naval Research Lab., Washington, DC USA
Applicability of the Temporally-Ordered Routing Algorithm for Use in Mobile Tactical Networks
Park, Vincent D; Macker, Joseph P; Corson, M S; Jan 1998; 6 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464908; No Copyright; Avail.: CASI: A02, Hardcopy

In this paper we present a conceptual overview of the Temporally-Ordered Routing Algorithm (TORA), discuss the philosophy that shaped its design and consider its applicability for use in forward-deployed mobile tactical networks. The salient characteristics of mobile, multihop, wireless networks differ significantly from those of traditional hardwired networks. Consequently, the routing protocols that have been designed for operation in the Internet are not particularly well-suited for use in mobile tactical environments. TORA, which has been tailored for operation in this highly-dynamic networking environment, represents a significant departure from the traditional 'shortest-path' routing paradigm. We also highlight recent simulation results of a performance comparison with Ideal Link-State (ILS) routing. The results show that the relative performance of TORA and ILS is critically dependent on the network size and average rate of topological changes. The results further indicate that the performance of TORA exceeds that of ILS for the conditions expected in relatively large mobile networks, lending credence to the philosophy behind the TORA design.
DTIC
Algorithms; Communication Networks

20070016971 Naval Research Lab., Washington, DC USA
A Study of Link State Flooding Optimizations for Scalable Wireless Networks
Macker, Joseph P; Dean, Justin W; Jan 2003; 7 pp.; In English
Report No.(s): AD-A464910; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A02, Hardcopy

Several methods have recently been proposed to improve link state protocol efficiency within wireless ad hoc networks. One class of approaches targets the reduction of link state control overhead that contributes to network wide broadcast storms, therefore enhancing protocol scalability. We have implemented and studied two such methods and demonstrate and discuss their relative performance characteristics. We present early simulation analysis over a number of scalability factors, including average nodal density and network diameter (maximum path length). Based upon initial results, we demonstrate that the two approaches to link state overhead reduction are somewhat complementary and that they provide additional benefit when applied together in many topologies studied. While both approaches are valid scalable flooding techniques, we discuss further the relative merits and potential disadvantages of each technique.
DTIC
Communication Networks; Optimization

20070016975 Naval Research Lab., Washington, DC USA
Application of Network Voice to Navy and DOD Telecommunications
McBeth, Michael S; Adamson, R B\g; Cole Jr , Raymond; Jan 1998; 5 pp.; In English
Report No.(s): AD-A464915; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A01, Hardcopy

The application of network voice technology~ to Navy and DoD telecommunications offers possibilities for highly integrated communications services including voice, data, and video while maintaining interoperability with legacy communication systems. The need for network voice technology can be understood by considering the level of voice integration being achieved in contemporary shipboard backbone networks. Voice transport across shipboard Asynchronous Transfer Mode (ATM networks being installed under the Navy's Information Technology for the 21st Century (IT-21) initiative is limited to using the ATM Forum's Circuit Emulation standard. Using Internet Protocol (IP) and Application

Programming Interfaces (APO for conducting H.323 multimedia conferencing sessions to handle shipboard voice traffic is an attractive option for overcoming this limitation. In this paper, we identify options available for developing network voice applications for military communication systems. A specific example of applying network voice technology for developing a solution for interoperating with legacy shipboard communications is discussed.
DTIC
Communication Networks; Navy; Telecommunication; Voice Communication

20070017002 Naval Research Lab., Washington, DC USA
Optical Communication and Navigation for Spacecraft Docking using Modulating Retroreflectors
Wasiczko, Linda M; Burris, Harris R; Creamer, N G; Mahon, Rita; Moore, Christopher; Swingen, Lee; Murphy, James; Stell, Mena; Pinney, Brad E; Goetz, Peter; Jan 2005; 10 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464970; No Copyright; Avail.: CASI: A02, Hardcopy

An optical communications link is used to transmit important navigation and range information between two spacecraft platforms to aid in the spacecraft docking process. This experiment uses NRL's multiple quantum well modulating retroreflector (MRR) array as the light payload optical communications transmitter on the target spacecraft. Spacecraft navigation information is determined by using the MRR array to impose five distinct modulation frequencies on the optical transmit beam, and analyzing the received signal on the pursuer spacecraft to extract target attitude and range information. Design, architecture, and status of the experiment at NRL are discussed.
DTIC
Modulation; Navigation; Optical Communication; Retroreflectors; Spacecraft Docking

20070017042 Naval Research Lab., Washington, DC USA
Progress in Development of Mulitple-Quantum-Well Retromodulators for Free-Space Data links
Gilbreath, G C; Rabinovich, William S; Meehan, Timothy J; Vilcheck, Michael J; Stell, Mena; Mahon, Rita; Goetz, Peter G; Cochrell, Kerry; Lucke, Robert L; Mozersky, Sharon; Jun 2003; 8 pp.; In English
Report No.(s): AD-A465143; No Copyright; Avail.: CASI: A02, Hardcopy

We present an update on the progress of the development of the Naval Research Laboratory's (NRL's) multiple-quantum-well retromodulators for compact, low-power communications. We report results for data-in-flight on a small, unmanned aerial vehicle at up to 5 Mbps, in preparation for real-time video transfer using an array of devices. This data was taken at Chesapeake Bay Detachment. We also report transference of color video using wavelet compression at 15 and 30 frames/s, at 4 to 6 Mbps in the lab, at eye-safe intensity levels. The unit is a corner cube modulator using a 980-nm shutter. A five-element array was used for the data-in-flight. First results of our 1550-nm devices are also presented as progress in a cat's eye retromodulator.
DTIC
Cats; Data Links; Eye (Anatomy); Modulation; Modulators; Optical Communication; Progress; Quantum Wells; Retroreflectors

20070017282 Army Command and Control Directorate, Fort Monmouth, NJ USA
Positioning, Navigation and Timing: The Foundation of Command and Control
Filler, Raymond; Ganop, Steven; Olson, Paul; Sokolowski, Stanley; Fischer, William; Jun 2004; 30 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465175; No Copyright; Avail.: CASI: A03, Hardcopy

A major tenet of Network Centric Warfare is Information Dominance. The accuracy and availability of position information directly affects operational effectiveness. The traditional role of positioning was for own ship pilotage. That is, can I get from Point A to Point B? The evolving role of positioning is as a shared resource to establish nearperfect Situation Awareness (SA) to enhance Command and Control (C2). C2 systems such as the Army Battle Command Systems (ABCS) rely on digitized position reports from all platforms on the battlefield. The predominate source of that position data is the NAVSTAR Global Positioning System (GPS). GPS provides a common consistent coordinate reference. GPS accuracy does not degrade with time or distance traveled as self-contained navigation units, e.g. Inertial Navigation Units (INU) or Doppler Radar Navigation Sets. In addition, GPS receivers are significantly less expensive to integrate, operate and maintain than INU's or Doppler's. GPS has vulnerabilities to Electro-Magnetic Interference (EMI) and satellite signal blockage. Technology initiatives are concentrating on investigating sophisticated integration techniques for combining externally-aided and self-contained navigation systems. This paper addresses the relationship of navigation systems to command and control

systems and recent/new technology initiatives to improve the robustness of position information.
DTIC
Command and Control; Navigation; Navigation Aids; Position Sensing; Positioning

20070017320 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-A464939; No Copyright; Avail.: CASI: A02, Hardcopy

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
Protocol (Computers); Multimedia; Computer Networks; Military Technology

20070017442 Naval Research Lab., Washington, DC USA
Controlled Link Sharing and Quality of Service Data Transfer for Military Internetworking
Macker, Joseph P; Jan 1996; 9 pp.; In English
Report No.(s): AD-A464902; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy

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
Information Transfer; Data Transmission; Networks; Systems Engineering

20070017881 NASA Langley Research Center, Hampton, VA, USA, Honeywell Research and Technology Center, Columbia, MD, USA
An Analysis of the Effects of RFID Tags on Narrowband Navigation and Communication Receivers
LaBerge, E. F. Charles; March 2007; 38 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): DFTA03-96-X-90001; NNL06AC06P; WBS 23R-079-30
Report No.(s): NASA/CR-2007-214859; NCCSRTC-EFCL-0261B2; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017881

The simulated effects of the Radio Frequency Identification (RFID) tag emissions on ILS Localizer and ILS Glide Slope functions match the analytical models developed in support of DO-294B provided that the measured peak power levels are adjusted for 1) peak-to-average power ratio, 2) effective duty cycle, and 3) spectrum analyzer measurement bandwidth. When these adjustments are made, simulated and theoretical results are in extraordinarily good agreement. The relationships hold over a large range of potential interference-to-desired signal power ratios, provided that the adjusted interference power is

significantly higher than the sum of the receiver noise floor and the noise-like contributions of all other interference sources. When the duty-factor adjusted power spectral densities are applied in the evaluation process described in Section 6 of DO-294B, most narrowband guidance and communications radios performance parameters are unaffected by moderate levels of RFID interference. Specific conclusions and recommendations are provided.
Author
Radio Frequencies; Narrowband; Aircraft Communication; Navigation; Transmitter Receivers; Exhaust Emission; Mathematical Models

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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*.

20070016709 NASA Johnson Space Center, Houston, TX, USA
NASA Lunar Base Wireless System Propagation Analysis
Hwu, Shian U.; Upanavage, Matthew; Sham, Catherine C.; 8 May 2007; 19 pp.; In English; Symposium for Space Applications of Wireless, 8-9 May 2007, Houston, TX, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNJ05HT05C; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070016709

There have been many radio wave propagation studies using both experimental and theoretical techniques over the recent years. However, most of studies have been in support of commercial cellular phone wireless applications. The signal frequencies are mostly at the commercial cellular and Personal Communications Service bands. The antenna configurations are mostly one on a high tower and one near the ground to simulate communications between a cellular base station and a mobile unit. There are great interests in wireless communication and sensor systems for NASA lunar missions because of the emerging importance of establishing permanent lunar human exploration bases. Because of the specific lunar terrain geometries and RF frequencies of interest to the NASA missions, much of the published literature for the commercial cellular and PCS bands of 900 and 1800 MHz may not be directly applicable to the lunar base wireless system and environment. There are various communication and sensor configurations required to support all elements of a lunar base. For example, the communications between astronauts, between astronauts and the lunar vehicles, between lunar vehicles and satellites on the lunar orbits. There are also various wireless sensor systems among scientific, experimental sensors and data collection ground stations. This presentation illustrates the propagation analysis of the lunar wireless communication and sensor systems taking into account the three dimensional terrain multipath effects. It is observed that the propagation characteristics are significantly affected by the presence of the lunar terrain. The obtained results indicate the lunar surface material, terrain geometry and antenna location are the important factors affecting the propagation characteristics of the lunar wireless systems. The path loss can be much more severe than the free space propagation and is greatly affected by the antenna height, surface material and operating frequency. The results from this paper are important for the lunar wireless system link margin analysis in order to determine the limits on the reliable communication range, achievable data rate and RF coverage performance at planned lunar base work sites.
Author
Wave Propagation; Radio Waves; Wireless Communication; Radio Frequencies; NASA Programs; Multipath Transmission; Lunar Communication

20070016722 Naval Research Lab., Washington, DC USA
GaAs/AIGaAs Multiquantum Well Resonant Photorefractive Devices Fabricated Using Epitaxial Lift-Off
Kyono, C S; Ikossi-Anastasiou, K; Rabinovich, W S; Bowman, S R; Katzer, D S; Tsao, A J; Feb 1, 1994; 4 pp.; In English
Report No.(s): AD-A464640; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464640

This letter deals with resonant photorefractive devices fabricated from multi-quantum wells of GaAs/Al0.3Ga.07As and operated in a quantum-confined Stark effect geometry. Details of the processing are presented. Epitaxial lift-off was used to remove the active device from the substrate. Low-temperature Al0.3Ga.07 was used as an insulator to form metal-insulator-semiconductor structures on both sides of the multi-quantum wells. Proton implant damage was used to improve the fringe visibility. Photorefractive wave mixing with a diffraction efficiency of approx. 0.03% was demonstrated. The incorporation of

a nitride layer between the top electrode and the low-temperature AlGaAs increased the efficiency to 0.5%. The improvement is attributed to a reduction in the conduction of carriers across the low-temperature layer into the electrode.
DTIC
Electro-Optics; Epitaxy; Fabrication; Gallium Arsenides; Launching; Quantum Wells

20070016734 National Security Agency, Fort Meade, MD USA
Superconducting Technology Assessment
Aug 2005; 258 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464659; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464659

This Superconducting Technology Assessment (STA) has been conducted by the National Security Agency to address the fundamental question of a potential replacement for silicon complementary metal oxide semiconductor (CMOS) in very high-end computing (HEC) environments. Recent industry trends clearly establish that design tradeoffs between power, clock and metrology have brought CMOS to the limits of its scalability. All microprocessor firms have turned to multiple cores and reduced power in efforts to improve performance. Increased parallelism on a chip permits some architectural innovation, but it also increasingly shifts issues of performance gains into software application environments, where there are already many practical limits to scalability of performance. For many demanding applications in the U. S. national security, scientific, medical and industrial sectors, availability of higher-performance components in well-balanced HEC environments is essential. Alternatives to CMOS must therefore be found. The Semiconductor Industry Association (SIA) International Technology Roadmap for Semiconductors (ITRS) has identified Superconducting Rapid Single Flux Quantum (RSFQ) technology as the most promising technology in the continuing demand for faster processors. There has been steady progress in research in this technology, though with somewhat weaker efforts at development and industrialization. This assessment is an in-depth examination of RSFQ technologies with the singular objective of determining if a comprehensive roadmap for technology development is possible, aiming for industrial maturity in the 2010-2012 timeframe. The goal would be an RSFQ technology set sufficient to support development of true petaflop-scale computing at the end of this decade.
DTIC
Microprocessors; Semiconductors (Materials); Superconductivity; Superconductors (Materials); Technology Assessment

20070016755 Arizona State Univ., Tempe, AZ USA
Nano-Resonators for RF-Enabled Networked-Control
Wang, Lifeng; Phillips, Stephen M; Branicky, Michael S; Bayraktar, Bulent; Jan 2006; 6 pp.; In English
Contract(s)/Grant(s): CCR-0329910
Report No.(s): AD-A464704; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464704

Several types of microfabricated mechanical filters are analyzed for RF communications applications and their advantages over the traditional SAW or FBAR filters are described. GHz frequency operation requires sub-micron dimensions. This work focuses on the modeling of a filter with torsional mode vibration. Ansys finite element simulation has been performed to make comparison with the analytical modelling. These devices enable a networked approach to control along with a specific application to velocity estimation in servocontrol.
DTIC
Communication Networks; Microelectromechanical Systems; Radio Frequencies; Resonators

20070016812 State Univ. of New York, Stony Brook, NY USA
Crested Tunnel Barriers for Fast, Scalable, Nonvolatile Semiconductor Memories (Theme 3)
Likharev, Konstantin K; Ma, Tso-Ping; Dec 2006; 14 pp.; In English
Contract(s)/Grant(s): FA9550-04-1-0059; Proj-2305/TC
Report No.(s): AD-A464986; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464986

The main objective of this project was the experimental demonstration of the theoretically predicted enhanced quantum-mechanical tunneling through layered ('crested') barriers. If demonstrated in silicon-compatible materials with sufficient endurance under electric stress, this effect may enable high-density, high-speed nonvolatile memories that may potentially replace DRAM as the main random access memories of semiconductor electronics. With that objective, we have combined the expertise at Stony Brook University in crested barrier theory (Prof. Konstantin Likharev) and aluminum oxide

layer growth (Prof. James Lukens, Dr. Vijay Patel) with that of Yale University (Prof. T.P. Ma, Dr. X. Wang) in jet vapor deposition of silicon nitride and silicon dioxide films, as well as in nonvolatile memory technology.
DTIC
Computer Storage Devices; Semiconductors (Materials)

20070016822 Yale Univ., New Haven, CT USA
Student Support for Quantum Computing with Single Cooper-Pair Electronics
Schoelkopf, R J; Girvin, S M; Jan 2006; 21 pp.; In English
Contract(s)/Grant(s): DAAD19-01-1-0611
Report No.(s): AD-A465023; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465023

This project supplies support for an additional graduate student on experimental investigations on quantum coherence, entanglement, and quantum computation in a solid-state, electronic realization of quantum bits based on superconducting single-electron devices, namely the single Cooper-pair box. Since these qubits can be microfabricated in large numbers on a single chip, addressed and coherently manipulated electronically, and then entangled with each other, they represent one of the most scalable implementations for possible quantum computers. A radio-frequency single electron transistor (RF-SET) is used for readout of the charge state of the qubit. Of particular importance in this scheme is an understanding and the control of the backaction of the measurement system, which can affect the lifetime and coherence of the qubit. Therefore, this backaction is studied with the goal of optimizing the sensitivity and lifetime in order to attain single-shot readout of the qubit.
DTIC
Quantum Computation; Quantum Electronics; Students

20070016830 Naval Research Lab., Washington, DC USA
Viscoelastic Effects in Nanometer-Scale Contacts Under Shear
Wahl, K J; Stepnowski, S V; Unertl, W N; Jan 1998; 5 pp.; In English
Report No.(s): AD-A465036; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465036

We demonstrate the effects of shear modulation on the viscoelastic response of nanometer-scale single-asperity contacts under static and dynamic loading conditions. Contact stiffness and relaxation time are determined for contacts to poly(vinylethylene) using a scanning force microscope (SFM). Knowledge of the torsional stiffness kQ of the SFM cantilever is not required to determine the relaxation time. The relaxation time was several orders of magnitude slower than the bulk relaxation time but decreased slowly to the bulk value as the sample age increased. Contacts showed no evidence of microslip. We show that the shear response observed during the making and breaking of the contacts provides information about the time evolution of the contact area that is not available in force vs. distance curve measurements.
DTIC
Tribology; Viscoelasticity

20070016858 Naval Research Lab., Washington, DC USA
Multiple Quantum Well Retromodulators for Spacecraft-to-Spacecraft Laser Interrogation, Communication, and Navigation
Creamer, N G; Gilbreath, G C; Meehan, Timothy J; Stell, Mena F; Vilcheck, Michael J; Rabinovich, William S; Jan 2001; 16 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465076; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465076

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

board demonstrate the potential of the concept, and preliminary test results demonstrate reflector discrimination capability. DTIC

Interrogation; Modulators; Navigation; Optical Communication; Quantum Wells

20070016909 Air Force Research Lab., Wright-Patterson AFB, OH USA

Improved Electrical Properties of Epoxy Resin with Nanometer-Sized Inorganic Fillers (Preprint)

Horwath, John C; Schweickart, Daniel L; Garcia, Guido; Klosterman, Donald; Galaska, Mary; Schrand, Amanda; Walko, Lawrence C; May 2006; 5 pp.; In English

Contract(s)/Grant(s): Proj-3145

Report No.(s): AD-A464807; No Copyright; Avail.: CASI: A01, Hardcopy

In this study, the average dielectric breakdown voltage of POSS-filled epoxy was increased 34 percent compared to unloaded epoxy. Additionally, scanning electron microscopy showed uniform dispersion of the POSS filler down to a level of 10-100 nm. Dispersion uniformity appears to be a critical parameter in obtaining the desired property enhancements. DTIC

Dielectric Properties; Electric Potential; Electrical Properties; Epoxy Resins; Fillers

20070016917 Universal Energy Systems, Inc., Dayton, OH USA

200 deg C Operation of a DC-DC Converter with SiC Power Devices

Ray, Biswajit; Kosai, Hiroyuki; Scofield, James D; Jordan, Brett; Nov 2006; 7 pp.; In English

Contract(s)/Grant(s): FA8650-04-D-2404-0004; Proj-3145

Report No.(s): AD-A464822; No Copyright; Avail.: CASI: A02, Hardcopy

Design, operation, and performance evaluation of a 180 W, 100 kHz, 270 V/28 V two-transistor forward dc-dc power converter are reported for elevated temperatures up to 200 deg C. Use of SiC power semiconductor devices, and high temperature powdered ferrite (for magnetics design), and characterization of ceramic (X7R) capacitors' leakage current over temperature are presented as well. DTIC

High Temperature; Voltage Converters (DC to DC)

20070016918 Kohlberg Associates, Inc., Reston, VA USA

Classical Method for Deriving the Electromagnetic Propagation Equations for Double Negative Materials With Application for Antenna Design

Kohlberg, Ira; Feb 2007; 28 pp.; In English

Contract(s)/Grant(s): W911QX-06-P-0212

Report No.(s): AD-A464825; ARL-CR-591; No Copyright; Avail.: CASI: A03, Hardcopy

We derive a system of propagation equations in a Double Negative (DN) material in a way that appears to differ from previous derivations although the end result is the same. Our derivation assumes the Poynting vector theorem applies, real materials always have some loss, epsilon(omega) and mu(omega) are obtained from real materials, and wave energy traveling in a specified direction must always be accompanied by a loss of energy in that direction. Additional mathematics beyond Maxwell's equation is not required. Energy losses per unit length of travel are finite, and can be extremely small. Propagation in a lossless DN media is found as the mathematical limiting solution of an extremely small energy loss per unit length. When developed along these principles, the equations developed for designing leaky antennas are straightforward. DTIC

Antenna Design; Antennas; Electromagnetic Wave Transmission

20070016919 California Univ., Berkeley, CA USA

Chip-Scale Controlled Storage All-Optical Memory

Chang-Hasnain, Constance; Chuang, Shun Lien; Feb 2007; 28 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8750-02-2-0096; DARPA ORDER-V407-00; Proj-N584

Report No.(s): AD-A464826; No Copyright; Avail.: CASI: A03, Hardcopy

Goal of the project was to demonstrate a semiconductor waveguide device suitable for use as an all-optical buffer with a slow down factor of 1000 at room temperature. Theoretical and experimental research was performed to show the feasibility of slow light in semiconductor quantum wells. Prototype GaAs quantum well devices were fabricated, and characterized at both cryogenic and ambient laboratory temperatures. Mechanisms such as coherent population oscillation (CPO) and

electromagnetically induced transparency (EIT) were explored. The results included several of the first ever achieved experimental and theoretical results on slow light, including the demonstration of a factor of one million times reduced light speed in semiconductor quantum wells at low temperature, a reduction of approximately 600 at room temperature, and the first observation of EIT in semiconductor quantum wells. Wide-spread interest in the subject led to an international conference starting in 2006, and helped spur new research into all-optical buffers.
DTIC
Chips; Optical Memory (Data Storage); Quantum Wells

20070016927 Memtronics, Plano, TX USA
High-Cycle Life Testing of RF MEMS Switches
Goldsmith, C L; Forehand, D I; Peng, Z; Hwang, J C; Dec 2006; 7 pp.; In English
Contract(s)/Grant(s): F33615-03-C-7003; Proj-ARPS
Report No.(s): AD-A464840; No Copyright; Avail.: CASI: A02, Hardcopy

RF MEMS capacitive switches capable of order of-magnitude impedance changes have demonstrated operating lifetimes exceeding 100 billion switching cycles without failure. In situ monitoring of switch characteristics demonstrates no significant degradation in performance and quantifies the charging properties of the switch silicon dioxide film. This demonstration lends credence to the mechanical robustness of RF MEMS switches.
DTIC
Electric Potential; Life (Durability); Microelectromechanical Systems; Radio Frequencies; Switches

20070016930 Cree Research, Inc., Durham, NC USA
1.8 kV, 10 mOmega-square cm 4H-SiC JFETs (Preprint)
Scofield, James; Ryu, Sei-Hyung; Krishnaswami, Sumi; Fatima, Husna; Agarwal, Anant K; Jan 2006; 8 pp.; In English
Contract(s)/Grant(s): F33615-01-C-2188
Report No.(s): AD-A464844; No Copyright; Avail.: CASI: A02, Hardcopy

Fabrication and characteristics of high voltage, normally-on junction field effect transistors (JFETs) in 4H-silicon carbide (4H-SiC) are presented. The devices were built on 5x10(exp 15) cm(exp -3) doped, 12 micron thick n-type epilayer grown on a n+ 4H-SiC substrate. A specific on-resistance of 10 mOmega-square cm and a blocking voltage of 1.8 kV were measured. Device characteristics were measured for temperatures up to 300 deg C. An increase of specific on-resistance by a factor of 5 and a decrease in transconductance were observed at 300 deg C, when compared to the value at room temperature. This is due to a decrease in bulk electron mobility at elevated temperature. A slight negative shift in pinch-off voltage was also observed at 300 deg C. The devices demonstrated robust DC characteristics for temperatures up to 300 deg C, and stable high temperature inverter operation in a power DC-DC converter application, using these devices, is reported in this paper.
DTIC
Field Effect Transistors; Silicon Carbides

20070016959 Pennsylvania State Univ., University Park, PA USA
Application of Frequency Domain Substructure Synthesis Technique for Plates loaded with Complex Attachments
Campbell, R L; Hambric, S A; Apr 2004; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464888; TR-04-004; No Copyright; Avail.: CASI: A03, Hardcopy

The generalized frequency domain substructure synthesis technique proposed by Jetmundsen et al has been used to predict the combined response of a bare, edge-stiffened plate and two electronic components. This technique offers a substantial advantage over other coupling techniques because it is uniquely suited to handle data sets of varying origin. Of particular interest is the combination of numerically and experimentally derived frequency response data, which is useful for a structural model comprised of components too complex to model using the finite element method. Limitations of the frequency domain techniques are identified and discussed along with potential methods for avoiding these shortcomings. The synthesis results for the plate and equipment show similar shifts in resonance frequency locations and amplitudes relative to the experimental results for the combined structures.
DTIC
Electronic Equipment; Frequencies; Frequency Domain Analysis; Substructures

20070016966 Florida Univ., Gainesville, FL USA
A Power Efficient 26-GHz 32:1 Static Frequency Divider in 130-nm Bulk CMOS
Cao, Changhua; O, Kenneth K; Nov 2005; 4 pp.; In English
Contract(s)/Grant(s): N66001-03-1-8901; N66001-03-1-8911
Report No.(s): AD-A464900; No Copyright; Avail.: CASI: A01, Hardcopy

A 32:1 static frequency divider consisting of five stages of 2:1 dividers using current mode logic (CML) was fabricated in a 130-nm bulk complementary metal-oxide semiconductor (CMOS) logic process. By optimizing transistors size, high operating speed is achieved with limited power consumption. For an input power of 0 dBm, the 32:1 divider operates up to 26 GHz with a 1.5-V supply voltage. The whole 32:1 chain including buffers consumes 8.97 mW and the first stage consumes only 3.88 mW at a 26-GHz operation. The power consumption of the first 2:1 stage is less than 15% of other bulk CMOS static frequency dividers operating at the same frequency. Index Terms Complementary metal-oxide semiconductor (CMOS), current mode logic (CML), frequency divider.

DTIC

CMOS; Energy Consumption; Fiber Optics; Frequency Dividers; Metal Oxide Semiconductors; Radiotelephones

20070016973 New Mexico Univ., Albuquerque, NM USA
Dielectric and Infrared Properties of TiO2 Films Containing Anatase and Rutile
Busani, T; Devine, R A; Jul 18, 2005; 7 pp.; In English
Report No.(s): AD-A464913; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Electrical and optical properties of low-temperature, plasma enhanced chemical vapour deposited films of Ti02 have been studied; the source gases were TiCl4 and O2. The amorphous, as-deposited films had a dielectric constant ~33 consistent with their measured density of 3.2 0.2 g cm - . Films deposited using a -41 V substrate bias contained the anatase phase and some rutile as evidenced from infrared spectroscopy and x-ray scattering. Annealing of these films at 600 C resulted in a significant increase in the rutile content of the film.

DTIC

Anatase; Dielectric Properties; Dielectrics; Infrared Radiation; Optical Properties; Rutile; Thin Films; Titanium Oxides

20070016974 Air Force Research Lab., Hanscom AFB, MA USA
New Results Using Polyomino-Tiled Subarrays for Time-Delay Control of Wideband Arrays
Mailloux, R J; Santarelli, S G; Roberts, T M; Mar 7, 2007; 17 pp.; In English
Contract(s)/Grant(s): Proj-2304
Report No.(s): AD-A464914; No Copyright; Avail.: CASI: A03, Hardcopy

This paper presents recent results describing the use of polyomino subarrays to introduce time delays into phased-array systems. Results for arrays of 8-element subarrays show suppression of peak quantization lobes to levels below -14 dB, relative to the quantization lobes of 8-element rectangular subarrays. Since algorithms for producing arbitrarily large arrays that tile rectangular areas are not available, we have combined smaller arrays chosen to be statistically independent. These have allowed the evaluation of ensemble averages of array gain, average and peak sidelobe levels.

DTIC

Broadband; Phased Arrays; Steering; Time Lag

20070016994 Florida Univ., Gainesville, FL USA
192 GHz Push-Push VCO in 0.13-micrometer CMOS
Cao, C; Seok, E; O, K K; Feb 16, 2006; 3 pp.; In English
Contract(s)/Grant(s): N66001-03-1-8911
Report No.(s): AD-A464948; No Copyright; Avail.: CASI: A01, Hardcopy

A 192 GHz cross-coupled push push voltage controlled oscillator (VCO) is fabricated using the UMC 0.13-micrometer CMOS logic process. The VCO can be tuned from 191.4 to 192.7 GHz. The VCO provides output power of ~--20 dBm and phase noise of ~--100 dBc/Hz at 10 MHz offset, while consuming 11 mA from a 1.5 V supply.

DTIC

CMOS; Voltage Controlled Oscillators

20070016995 Florida Univ., Gainesville, FL USA

Millimeter-Wave Voltage-Controlled Oscillators in 0.13-micrometer CMOS Technology

Cao, Changhua; O, Kenneth K; Jun 2006; 9 pp.; In English

Contract(s)/Grant(s): N66001-03-1-8911

Report No.(s): AD-A464949; No Copyright; Avail.: CASI: A02, Hardcopy

This paper describes the design of CMOS millimeter-wave voltage controlled oscillators. Varactor, transistor, and inductor designs are optimized to reduce the parasitic capacitances. An investigation of tradeoff between quality factor and tuning range for MOS varactors at 24 GHz has shown that the polysilicon gate lengths between 0.18 and 0.24 micrometer result in both good quality factor (\g12) and Cmax/Cmin ratio (~3) in the 0.13-micrometer CMOS process used for the study. The components were utilized to realize a VCO operating around 60 GHz with a tuning range of 5.8 GHz. A 99-GHz VCO with a tuning range of 2.5 GHz, phase noise of --102.7 dBc/Hz at 10-MHz offset and power consumption of 7-15 mW from a 1.5-V supply and a 105-GHz VCO are also demonstrated. This is the CMOS circuit with the highest fundamental operating frequency. The lumped element approach can be used even for VCOs operating near 100-GHz and it results in a smaller circuit area.

DTIC

CMOS; Microwave Equipment; Microwave Oscillators; Millimeter Waves; Voltage Controlled Oscillators

20070016996 Florida Univ., Gainesville, FL USA

Progress Towards a Micromachined Thermoelectric Generator using PbTe and PbSnSeTe Thin Films

Boniche, I; Meyer, C D; Taylor, P J; Dhar, N K; Arnold, D P; Nov 2006; 5 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): W911NF-06-2-0004

Report No.(s): AD-A464950; No Copyright; Avail.: CASI: A01, Hardcopy

This paper presents etching techniques and metal contact resistance studies for vapor-deposited PbTe and PbSnSeTe films to enable micromachining of thermoelectric (TE) generators within integrated MEMS devices (e.g. micro heat engines, microcombustors). Films of up to 10 micrometers were achieved using (100) silicon substrates. Single-crystal films were achieved using CdTe or ZnTe buffer layers, while polycrystalline films were formed on thermally-oxidized silicon. Processes using a bromine-based wet etch and methane-based ICP plasma etch yielded etch rates of 3 micrometer/min and 0.65 micrometers/min, respectively, with high selectivities (\g10:1) to photoresist, silicon and SiO2. Electrical resistivity (van der Pauw) and metal contact resistance (transfer length method) test structures were used to characterize patterned PbTe and PbSnSeTe films and the contact resistance with a variety of metals (Au/Cr, Au, Pt, Ni, Cu, Pt). Film resistivities of 5-300 m(omega)-cm and ohmic contacts with specific contact resistivities of 0.4-40 m(omega)-sq cm were achieved.

DTIC

Lead Alloys; Lead Tellurides; Micromachining; Thermoelectric Generators; Thermoelectric Power Generation; Thin Films

20070017050 Laboratoire d'Electrostatique at Des Materiaux, Dielectriques, France

Structural Effects in the Dielectric Constant Rare-Earth Oxides: Nd2O3

Busani, T; Devine, R A; Gonon, P; Jan 2006; 11 pp.; In English

Contract(s)/Grant(s): F29601-01-C-0241; Proj-4846

Report No.(s): AD-A465166; No Copyright; Avail.: CASI: A03, Hardcopy

Thin films of Nd2O3 have been studied. For the amorphous phase the dielectric constant is ~ 11 whilst the refractive index is 1.76 0.02, in the cubic form these values are ~ 13.6 15.4 and 1.93 0.02. Hexagonal films have dielectric constants in the range 17 21 and estimates based upon the cubic values lead to k ~ 27, we were unable to determine a reliable refractive index value. The normally high temperature hexagonal phase could be nucleated on a Si substrate by deposition at relatively low temperature ~ 280 C.

DTIC

Amorphous Materials; Dielectrics; Oxides; Permittivity; Rare Earth Compounds; Rare Earth Elements; Thin Films

20070017056 Virginia Univ., Charlottesville, VA USA

Effects of Molecular Environments on the Electrical Switching with Memory of Nitro-Containing OPEs

Gegel-Hackett, N; Majumdar, N; Martin, Z; Swami, N; Harriott, L R; Bean, J C; Pattanaik, G; Zangari, G; Tour, Y Yao J M; Jun 22, 2006; 7 pp.; In English

Contract(s)/Grant(s): Proj-N00014-01-0706; Proj-00014-01-1-0657

Report No.(s): AD-A465178; No Copyright; Avail.: CASI: A02, Hardcopy

An oligo (phenylene ethynylene) (OPE) molecule with a nitro side group has exhibited electrical switching with memory and thus has potential for use in molecular electronic devices. However, different research groups have reported different electrical behaviors for this molecule. In addition to variations among test structures, differences in local molecular environments could be partially responsible for the differences in the reported results. Thus, we tested four variations of a nitro-OPE/ dodecanethiol monolayer in the same type of nanowell test device to study how the environment of the nitro-OPE affects the observed electrical behavior. We found that the density of the nitro-containing molecules in the device altered the observed electrical switching behavior. Further, we found a positive correlation between the disorder of the monolayer and the observed electrical switching behavior. This correlation is consistent with suggestions that nitro molecule switching may depend on a conformational change of the molecule, which may be possible only in a disordered monolayer.
DTIC
Electric Switches; Molecular Electronics; Switching

20070017064 Virginia Univ., Charlottesville, VA USA
Impact of Parameter Variations on Multi-Core Chips
Humenay, Eric; Tarjan, David; Skadron, Kevin; Jan 2006; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W911NF-04-1-0288
Report No.(s): AD-A465191; No Copyright; Avail.: CASI: A02, Hardcopy

Increasing variability during manufacturing and during runtime are projected for future generation microprocessors. This paper introduces a pre-RTL, architectural modeling methodology that incorporates the impact of manufacturing and runtime temperature variations on delay and power for both combinational logic and SRAM structures. The model is then used to show that frequency variations among microarchitectural functional units and among cores are relatively small in a high-performance microprocessor design. However, the impact of within-die systematic process variations on leakage power will result in major leakage variation across multiple cores on a single chip. WID leakage variation can cause core-to-core leakage to differ by as much as 45%.
DTIC
Chips; Electric Potential; Microprocessors

20070017266 Executive Office of the President, Washington, DC USA
The National Nanotechnology Initiative Strategic Plan
Dec 2004; 44 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464997; No Copyright; Avail.: CASI: A03, Hardcopy

The vision of the National Nanotechnology Initiative (NNI) is a future in which the ability to understand and control matter on the nanoscale leads to a revolution in technology and industry. Toward this vision, the NNI will expedite the discovery, development, and deployment of nanotechnology in order to achieve responsible and sustainable economic benefits, to enhance the quality of life, and to promote national security. The initiative is a multiagency, multidisciplinary program that supports research and development (R&D); develops infrastructure; and promotes education, knowledge diffusion, and commercialization in nanotechnology. Concurrent with development of new technology options, the NNI is addressing nanotechnology's various societal dimensions. With the goal of achieving the above vision, the National Nanotechnology Initiative was launched in Fiscal Year (FY) 2001. Since that time, the annual Federal investment in nanotechnology R&D has more than doubled to almost $1 billion, the number of Federal agencies investing in nanotechnology R&D has grown from 6 to 11, and the total number of participating agencies has grown from 6 to 22. Participating agencies are those for which nanotechnology is relevant to the agency mission, including both those with and without nanotechnology R&D funding. Interagency coordination is managed through the Nanoscale Science, Engineering, and Technology (NSET) Subcommittee of the National Science and Technology Council (NSTC) Committee on Technology.
DTIC
Nanotechnology; Research Management; Technology Assessment

20070017326 NASA Glenn Research Center, Cleveland, OH, USA
Assessment of Lithium-based Battery Electrolytes Developed under the NASA PERS Program
Bennett, William R.; Baldwin, Richard S.; [2006]; 20 pp.; In English; 4th International Energy Conversion Engineering Conference (IECEC), 26-29 Jun. 2006, San Diego, CA, USA
Contract(s)/Grant(s): WBS 038957.04.01.02.03; Copyright; Avail.: CASI: A03, Hardcopy

Recently, NASA formally completed the Polymer Energy Rechargeable System (PERS) Program, which was established

in 2000 in collaboration with the Air Force Research Laboratory (AFRL) to support the development of polymer-based, lithium-based cell chemistries and battery technologies to address the next generation of aerospace applications and mission needs. The goal of this program was to ultimately develop an advanced, space-qualified battery technology, which embodied a solid polymer electrolyte (SPE) and complementary components, with improved performance characteristics that would address future aerospace battery requirements. Programmatically, the PERS initiative exploited both interagency collaborations to address common technology and engineering issues and the active participation of academia and private industry. The initial program phases focused on R&D activities to address the critical technical issues and challenges at the cell level. A variety of cell and polymeric electrolyte concepts were pursued as part of the development efforts undertaken at numerous governmental, industrial and academic laboratories. Numerous candidate electrolyte materials were developed, synthesized and optimized for evaluation. Utilizing the component screening facility and the 'standardized' test procedures developed at the NASA Glenn Research Center, electrochemical screening and performance evaluations of promising candidate materials were completed. This overview summarizes test results for a variety of candidate electrolyte materials that were developed under the PERS Program. Electrolyte properties are contrasted and compared to the original project goals, and the strengths and weaknesses of the electrolyte chemistries are discussed. Limited cycling data for full-cells using lithium metal and vanadium oxide electrodes are also presented. Based on measured electrolyte properties, the projected performance characteristics and temperature limitations of batteries utilizing the advanced electrolytes and components have been estimated. Limitations for the achievement of practical performance levels are also discussed, as well as needs for future research and development.

Author

Aerospace Engineering; Lithium Batteries; Solid Electrolytes; Metal Oxides; Lithium Oxides; Electric Batteries

20070017359 NASA Langley Research Center, Hampton, VA USA

Hybrid Elecromechanical Actuator and Actuation System

Su, J., Inventor; Xu, T. B., Inventor; Sep. 7, 2006; 10 pp.; In English

Patent Info.: Filed Filed 4 Mar 05; US-Patent-Appl-SN-11-076-824

Report No.(s): PB2007-101687; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017359

A hybrid electromechanical actuator has two different types of electromechanical elements, one that expands in a transverse direction when electric power is applied thereto and one that contracts in a transverse direction when electric power is applied thereto. The two electromechanical elements are (1) disposed in relation to one another such that the transverse directions thereof are parallel to one another, and (2) mechanically coupled to one another at least at two opposing edges thereof. Electric power is applied simultaneously to the elements.

Official Gazette of the U.S. Patent and Trademark Office

Actuators; Electromechanical Devices

20070017399 Morris (Duane), LLP, Harrisburg, PA, USA

Charge Dissipative Dielectric for Cryogenic Devices

Canton, R. H., Inventor; Hall, J. A., Inventor; May 19, 2005; 11 pp.; In English

Contract(s)/Grant(s): NAS5-00236; NAS5-00237

Patent Info.: Filed 20 Oct. 2004; US-Patent-Appl-SN-970539; US-Patent-Appl-SN-513747

Report No.(s): PB2007-101574; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017399

A Superconducting Quantum Interference Device (SQUID) is disclosed comprising a pair of resistively shunted Josephson junctions connected in parallel within a superconducting loop and biased by an external direct current (dc) source. The SQUID comprises a semiconductor substrate and at least one superconducting layer. The metal layer(s) are separated by or covered with a semiconductor material layer having the properties of a conductor at room temperature and the properties of an insulator at operating temperatures (generally less than 100 Kelvin). The properties of the semiconductor material layer greatly reduces the risk of electrostatic discharge that can damage the device during normal handling of the device at room temperature, while still providing the insulating properties desired to allow normal functioning of the device at its operating temperature. A method of manufacturing the SQUID device is also disclosed.

Author

SQUID (Detectors); Superconductivity; Josephson Junctions; Thin Films; Cryogenics

20070017410 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

High Power, High Voltage Electric Power System for Electric Propulsion

Aintablian, Harry; Kirkham, Harold; Timmerman, Paul; June 26, 2006; 7 pp.; In English; AIAA 4th International Energy Conversion Engineering Conference, 26-29 Jun. 2006, San Diego, CA, USA; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39929

This paper provides an overview of the 30 KW, 600 V MRHE power subsystem. Descriptions of the power subsystem elements, the mode of power transfer, and power and mass estimates are presented. A direct-drive architecture for electric propulsion is considered which reduces mass and complexity. Solar arrays with concentrators are used for increased efficiency. Finally, the challenges due to the environment of a hypothetical lunar mission as well as due to the advanced technologies considered are outlined.

Author

Electric Propulsion; High Voltages; Mechanical Drives; Electric Power; Electrical Engineering

20070017434 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

A Compact 600 GHz Electronically Tunable Vector Measurement System for Submillimeter Wave Imaging

Dengler, Robert J.; Maiwald, Frank; Siegel, Peter H.; June 11, 2006; 4 pp.; In English; IEEE Microwave Theory and Techniques Symposium, 11-16 Jun. 2006, San Francisco, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39830

A compact submillimeter wave transmission / reflection measurement system has been demonstrated at 560-635 GHz, with electronic tuning over the entire band. Maximum dynamic range measured at a single frequency is 90 dB (60 dB typical), and phase noise is less than +/- 2(deg). By using a frequency steerable lens at the source output and mixer input, the frequency agility of the system can be used to scan the source and receive beams, resulting in near real-time imaging capability using only a single pixel.

Author

Submillimeter Waves; Tuning; Imaging Techniques; Electronics; Vectors (Mathematics); Network Analysis

20070017437 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Terahertz Waveguide Standards

Ward, John S.; June 16, 2006; 28 pp.; In English; IEEE MTT-s International Microwave Symposium, 16 Jun. 2006, San Francisco, CA, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39834

A viewgraph presentation on terahertz waveguide standards is shown. The topics include: 1) Why new standards are needed; 2) Rectangular waveguide sizes; and 3) Waveguide flanges

CASI

Standards; Electrical Engineering; Fabrication; Submillimeter Waves; Rectangular Waveguides

20070017445 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Compendium of Single Event Effects Results for Candidate Spacecraft Electronics for NASA

O'Bryan, Martha V.; Poivey, Christian; Kniffin, Scott D.; Buchner, Stephen P.; Ladbury, Ray L.; Oldham, Timothy R.; Howard, James W., Jr.; LaBel, Kenneth A.; Sanders, Anthony B.; Berg, Melanie; Marshall, Cheryl J.; Marshall, Paul W.; Kim, Hak S.; Phan, Anthony M.; Hawkins, Donald K.; Carts, Martin A.; Forney, James D.; Irwin, Tim; Seidleck, Christina M.; Cox, Stephen R.; Friendlich, Mark; Flanigan, Ryan J.; Petrick, Dave; Powell, Wes; Karsh, Jeremy; [2006]; 7 pp.; In English; 2006 IEEE Nuclear and Space Radiation Effects Conference, 17-21 Jul. 2006, Ponte Vedra, FL, USA; Original contains black and white illustrations

Contract(s)/Grant(s): IACRO-06-4012I; Copyright; Avail.: CASI: A02, Hardcopy

Susceptibility of a variety of candidate spacecraft electronics to proton and heavy ion induced single event effects is studied. Devices tested include digital, linear bipolar, and hybrid devices.

Author

Spacecraft Electronic Equipment; Avionics; Single Event Upsets; Test Facilities

20070017487 NASA Goddard Space Flight Center, Greenbelt, MD, USA

SiC-based Photo-detectors for UV, VUV, EUV and Soft X-ray Detection

Yan, Feng; September 07, 2006; 40 pp.; In English; European Conference on Si-C and Related Materials, 3-7 Sept. 2006, New Castle Upon Tyne, UK; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

A viewgraph presentation describing an ideal Silicon Carbide detector for ultraviolet, vacuum ultraviolet, extreme ultraviolet and soft x-ray detection is shown. The topics include: 1) An ideal photo-detector; 2) Dark current density of SiC photodiodes at room temperature; 3) Dark current in SiC detectors; 4) Resistive and capacitive feedback trans-impedance amplifier; 5) Avalanche gain; 6) Excess noise; 7) SNR in single photon counting mode; 8) Structure of SiC single photon counting APD and testing structure; 9) Single photon counting waveform and testing circuit; 10) Amplitude of SiC single photon counter; 11) Dark count of SiC APD photon counters; 12) Temperature-dependence of dark count rate; 13) Reduce the dark count rate by reducing the breakdown electric field; 14) Spectrum range for SiC detectors; 15) QE curves of Pt/4H-SiC photodiodes; 16) QE curve of SiC; 17) QE curves of SiC photodiode vs. penetration depth; 18) Visible rejection of SiC photodiodes; 19) Advantages of SiC photodiodes; 20) Competitors of SiC detectors; 21) Extraterrestrial solar spectra; 22) Visible-blind EUV detection; 23) Terrestrial solar spectra; and 24) Less than 1KeV soft x-ray detection.

CASI

Extreme Ultraviolet Radiation; Photodiodes; Silicon Carbides; Far Ultraviolet Radiation; X Ray Detectors

20070017852 NASA Johnson Space Center, Houston, TX, USA

E-Textile Antennas for Space Environments

Kennedy, Timothy F.; Fink, Patrick W.; Chu, Andrew W.; [2007]; 1 pp.; In English; URSI 2007 North American Radio Science Meeting, 22-26 Jul. 2007, Ottawa, Ontario, Canada; Original contains black and white illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017852

The ability to integrate antennas and other radio frequency (RF) devices into wearable systems is increasingly important as wireless voice, video, and data sources become ubiquitous. Consumer applications including mobile computing, communications, and entertainment, as well as military and space applications for integration of biotelemetry, detailed tracking information and status of handheld tools, devices and on-body inventories are driving forces for research into wearable antennas and other e-textile devices. Operational conditions for military and space applications of wireless systems are often such that antennas are a limiting factor in wireless performance. The changing antenna platform, i.e. the dynamic wearer, can detune and alter the radiation characteristics of e-textile antennas, making antenna element selection and design challenging. Antenna designs and systems that offer moderate bandwidth, perform well with flexure, and are electronically reconfigurable are ideally suited to wearable applications. Several antennas, shown in Figure 1, have been created using a NASA-developed process for e-textiles that show promise in being integrated into a robust wireless system for space-based applications. Preliminary characterization of the antennas with flexure indicates that antenna performance can be maintained, and that a combination of antenna design and placement are useful in creating robust designs. Additionally, through utilization of modern smart antenna techniques, even greater flexibility can be achieved since antenna performance can be adjusted in real-time to compensate for the antenna s changing environment.

Author

Antenna Design; Textiles; Technology Utilization; Aerospace Environments; Antenna Components; Radio Frequencies; Military Technology; Biotelemetry

20070017859 Senterfitt (Akerman), West Palm Beach, FL, USA

Time-Mode Analog Computation Circuits and Methods

Ravinuthula, V. V., Inventor; Harris, J. G., Inventor; Fortes, J. A. B., Inventor; October 20, 2005; 20 pp.; In English

Contract(s)/Grant(s): NCC2-1363; NSF EIA-01-35946

Patent Info.: Filed 12 Apr. 2005; US-Patent-Appl-SN-104141; US-Patent-Appl-SN-561354

Report No.(s): PB2007-105971; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017859

A time-mode analog computation circuit is provided. The time-mode analog computation circuit includes one or more inputs for receiving one or more temporal input signals. The time-mode analog computation circuit further includes circuitry for performing a mathematical operation based on the one or more temporal input signals. A result of the mathematical operation is expressed in a timing of an output signal generated by the circuit.

Author

Analog Circuits; Signal Processing

20070017861

Electromagnetic Radial Forces in a Hybrid Eight-Stator-Pole, Six-Rotor-Pole Bearingless Switched-Reluctance Motor

[2007]; 16 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): 561581.02.08.03.15.02; Copyright; Avail.: CASI: A03, Hardcopy

Analysis and experimental measurement of the electromagnet force loads on the hybrid rotor in a novel bearingless switched-reluctance motor (BSRM) have been performed. A BSRM has the combined characteristics of a switched-reluctance motor and a magnetic bearing. The BSRM has an eight-pole stator and a six-pole hybrid rotor, which is composed of circular and scalloped lamination segments. The hybrid rotor is levitated using only one set of stator poles. A second set of stator poles imparts torque to the scalloped portion of the rotor, which is driven in a traditional switched reluctance manner by a processor. Analysis was done for nonrotating rotor poles that were oriented to achieve maximum and minimum radial force loads on the rotor. The objective is to assess whether simple one-dimensional magnetic circuit analysis is sufficient for preliminary evaluation of this machine, which may exhibit strong three-dimensional electromagnetic field behavior. Two magnetic circuit geometries, approximating the complex topology of the magnetic fields in and around the hybrid rotor, were employed in formulating the electromagnetic radial force equations. Reasonable agreement between the experimental results and the theoretical predictions was obtained with typical magnetic bearing derating factors applied to the predictions.

Author

Rotors; Electromagnetic Fields; Network Analysis; Reluctance; Switching; Stators; Magnetic Fields; Magnetic Bearings

20070017903 NASA Glenn Research Center, Cleveland, OH, USA

In-Flight Manual Electronics Repair for Deep-Space Missions

Pettegrew, Richard; Easton, John; Struk, Peter; Anderson, Eric; [2007]; 16 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 706801.04.15.01.02

Report No.(s): IEEE Paper 1208; Copyright; Avail.: CASI: A03, Hardcopy

Severe limitations on mass and volume available for spares on long-duration spaceflight missions will require electronics repair to be conducted at the component level, rather than at the sub-assembly level (referred to as Orbital Replacement Unit, or 'ORU'), as is currently the case aboard the International Space Station. Performing reliable component-level repairs in a reduced gravity environment by crew members will require careful planning, and some specialty tools and systems. Additionally, spacecraft systems must be designed to enable such repairs. This paper is an overview of a NASA project which examines all of these aspects of component level electronic repair. Results of case studies that detail how NASA, the U.S. Navy, and a commercial company currently approach electronics repair are presented, along with results of a trade study examining commercial technologies and solutions which may be used in future applications. Initial design recommendations resulting from these studies are also presented.

Author

Deep Space; Space Missions; International Space Station; Electrical Engineering; Maintenance; Manned Space Flight; Spacecraft Electronic Equipment

20070017962 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Self-Adaptive System based on Field Programmable Gate Array for Extreme Temperature Electronics

Keymeulen, Didier; Zebulum, Ricardo; Rajeshuni, Ramesham; Stoica, Adrian; Katkoori, Srinivas; Graves, Sharon; Novak, Frank; Antill, Charles; June 16, 2006; 5 pp.; In English; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39860

In this work, we report the implementation of a self-adaptive system using a field programmable gate array (FPGA) and data converters. The self-adaptive system can autonomously recover the lost functionality of a reconfigurable analog array (RAA) integrated circuit (IC) [3]. Both the RAA IC and the self-adaptive system are operating in extreme temperatures (from 120 C down to -180 C). The RAA IC consists of reconfigurable analog blocks interconnected by several switches and programmable by bias voltages. It implements filters/amplifiers with bandwidth up to 20 MHz. The self-adaptive system controls the RAA IC and is realized on Commercial-Off-The-Shelf (COTS) parts. It implements a basic compensation algorithm that corrects a RAA IC in less than a few milliseconds. Experimental results for the cold temperature environment (down to -180 C) demonstrate the feasibility of this approach.

Author

Field-Programmable Gate Arrays; Electronics; Genetic Algorithms; Self Adaptive Control Systems; High Temperature Environments

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*.

20070016703 NASA Johnson Space Center, Houston, TX, USA
Testing of the Multi-Fluid Evaporator Engineering Development Unit
Quinn, Gregory; O'Connor, Ed; Riga, Ken; Anderson, Molly; Westheimer, David; July 12, 2007; 11 pp.; In English; International Conference on Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): 119103.04.01.04.02.10
Report No.(s): 07ICES-122; Copyright; Avail.: CASI: A03, Hardcopy

Hamilton Sundstrand is under contract with the NASA Johnson Space Center to develop a scalable, evaporative heat rejection system called the Multi-Fluid Evaporator (MFE). It is being designed to support the Orion Crew Module and to support future Constellation missions. The MFE would be used from Earth sea level conditions to the vacuum of space. The current Shuttle configuration utilizes an ammonia boiler and flash evaporator system to achieve cooling at all altitudes. The MFE system combines both functions into a single compact package with significant weight reduction and improved freeze-up protection. The heat exchanger core is designed so that radial flow of the evaporant provides increasing surface area to keep the back pressure low. The multiple layer construction of the core allows for efficient scale up to the desired heat rejection rate. The full scale MFE prototype will be constructed with four core sections that, combined with a novel control scheme, manage the risk of freezing the heat exchanger cores. A sub-scale MFE engineering development unit (EDU) has been built, and is identical to one of the four sections of a full scale prototype. The EDU has completed testing at Hamilton Sundstrand. The overall test objective was to determine the thermal performance of the EDU. The first set of tests simulated how each of the four sections of the prototype would perform by varying the chamber pressure, evaporant flow rate, coolant flow rate and coolant temperature. A second set of tests was conducted with an outlet steam header in place to verify that the outlet steam orifices prevent freeze-up in the core while also allowing the desired thermal turn-down ratio. This paper discusses the EDU tests and results.

Author

Heat Exchangers; Evaporators; Spacecraft Modules; Radial Flow; Weight Reduction; Temperature Effects; Pressure

20070016727 Air Force Inst. for Environment, Safety and Occupational Health Risk Analysis, Brooks AFB, TX USA
Technical Basis Document for the GR-460, Contamination Monitoring System
Hensley, Jerry R; Dec 2006; 25 pp.; In English
Report No.(s): AD-A464650; IOH-SD-BR-SR-2006-0008; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464650

The Air Force Institute for Operational Health is directed to support environmental remediation activities when radioactive materials are involved and has an emergency response element to respond to emergencies involving missing or dispersed radioactive materials. The Contamination Monitoring System (CMS) was designed to locate, identify, estimate activity, and reject natural background radiation with associated location (global positioning satellite system). The system collects the GPS coordinates via a Trimble GPS and associates the position with the spectral information collected by the 512 channel multi-channel analyzer (SAIC/Exploranium GR-460). The data is easily retrieved using the software supplied by the manufacturer. If a specific data point is located, the spectral information related to that position can be easily retrieved and viewed using various gamma analysis programs to determine if the material is the radionuclide of concern or naturally occurring background radiation.

DTIC

Contamination; Detectors; Monitors; Radiation Measuring Instruments

20070017000 Naval Research Lab., Stennis Space Center, MS USA
Flow Response of a Segregating Mixture by Interacting Lattice Gas Simulation
Pandey, R B; Gettrust, J F; Jan 2005; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464968; NRL/JA/7430-05-1; No Copyright; Avail.: CASI: A03, Hardcopy

Steady-state flow and structural profiles of immiscible components A and B (molecular weights MA and MB, MA \hMB) in a non-conservative open System are studied by an interacting lattice gas Monte Carlo simulation. Concentration gradient and hydrostatic bias H drive the constituents (A, B) which are continuously released from the bottom with equal probability

against gravity. At low bias, the segregation of A and B leading to a partial layering is enhanced toward the bottom. The longitudinal density profile with a high density in the bottom region and low toward the top shows linear, exponential, and power-law decays in different regions of depth or altitude which varies systematically with the pressure bias. The transverse density profiles show segregation with different domain sizes and layering depending on the bias. Response of their steady-state flux density j to the hydrostatic bias H is found to be linear at higher bias. The difference in response of the flux density of the two components becomes more pronounced at low bias and higher miscibility gap.
DTIC
Flow; Flux Density; Gases; Simulation

20070017048 Princeton Univ., NJ USA
High Reynolds Number Turbulence
Smits, Alexander J; Mar 27, 2007; 16 pp.; In English
Contract(s)/Grant(s): N00014-03-1-0320
Report No.(s): AD-A465164; No Copyright; Avail.: CASI: A03, Hardcopy

The objectives of the grant were to provide a systematic study to fill the gap between existing research on low Reynolds number turbulent flows to the kinds of turbulent flows encountered on full-scale vehicles. We report specifically on (1) the behavior of wakes at high Reynolds numbers with increasing complexity, varying from axisymmetric wakes, to wakes typical of appended undersea platforms; and (2) the effects of roughness at high Reynolds numbers. We have gained a better understanding of complex flow interactions in wakes typical of naval platform flow fields, especially wakes with concentrated regions of streamwise vorticity. We have also made progress in the understanding of high Reynolds number flows over rough surfaces, especially pipes and flat plates with roughness that relate to marine surfaces. We expect these studies to lead to improved flow prediction and improved flow control. The work was performed in two unique facilities: the Superpipe and the High Reynolds number Test Facility (HRTF) that can obtain very high Reynolds numbers on a laboratory scale using compressed air as the working fluid.
DTIC
High Reynolds Number; Reynolds Number; Turbulence; Turbulent Flow

20070017068 Illinois Univ., Urbana, IL USA
Building Qualitative Models of Thermodynamic Processes
Collins, John W; Forbus, Kenneth D; Jan 2007; 77 pp.; In English
Contract(s)/Grant(s): N00014-85-K-0225; NAG-9137
Report No.(s): AD-A465196; No Copyright; Avail.: CASI: A05, Hardcopy

This paper describes a qualitative domain theory for core phenomena in engineering thermodynamics, expressed in Qualitative Process theory. It represents many of the best features of domain models developed by our group over the past five years. It focuses on supporting system-level qualitative analyses of typical fluid and thermal systems, such as refrigerators and power plants. We use explicit modeling assumptions [3] to control the level of detail used in building models of specific scenarios. We begin by outlining the primitives of the specific QP modeling language. The bulk of the paper describes the domain model itself, highlighting our design choices, simplifications, and use of modeling assumptions. Next we demonstrate how this domain model can be used to build models of a variety of specific scenarios, including simplified versions of a refrigerator, a steam plant, and a thermal control system. Finally, we describe some planned extensions to the model.
DTIC
Fluid Flow; Thermodynamic Properties; Thermodynamics

20070017855 NASA Glenn Research Center, Cleveland, OH, USA
Stirling Analysis Comparison of Commercial vs. High-Order Methods
Dyson, Rodger W.; Wilson, Scott D.; Tew, Roy C.; Demko, Rikako; [2007]; 33 pp.; In English
Contract(s)/Grant(s): WBS 138494.04.01.01; Copyright; Avail.: CASI: A03, Hardcopy

Recently, three-dimensional Stirling engine simulations have been accomplished utilizing commercial Computational Fluid Dynamics software. The validations reported can be somewhat inconclusive due to the lack of precise time accurate experimental results from engines, export control/ proprietary concerns, and the lack of variation in the methods utilized. The last issue may be addressed by solving the same flow problem with alternate methods. In this work, a comprehensive examination of the methods utilized in the commercial codes is compared with more recently developed high-order methods. Specifically, Lele's Compact scheme and Dyson s Ultra Hi-Fi method will be compared with the SIMPLE and PISO methods

currently employed in CFD-ACE, FLUENT, CFX, and STAR-CD (all commercial codes which can in theory solve a three-dimensional Stirling model although sliding interfaces and their moving grids limit the effective time accuracy). We will initially look at one-dimensional flows since the current standard practice is to design and optimize Stirling engines with empirically corrected friction and heat transfer coefficients in an overall one-dimensional model. This comparison provides an idea of the range in which commercial CFD software for modeling Stirling engines may be expected to provide accurate results. In addition, this work provides a framework for improving current one-dimensional analysis codes.
Author
Computational Fluid Dynamics; Stirling Engines; Stirling Cycle; Three Dimensional Models; Coefficient of Friction; Calculus of Variations; Mathematical Models

20070017978 NASA Ames Research Center, Moffett Field, CA, USA
Turbulence Measurements on a 2D NACA 0036 with Synthetic Jet Flow Control
Wilson, J. S.; May 11, 2006; 17 pp.; In English; AHS 62nd Annual Forum, 9-11 May 2006, Phoenix, AZ, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS2-03144; Copyright; Avail.: CASI: A03, Hardcopy

An active flow control experiment was conducted on a 2-ft chord NACA 0036 airfoil in a 3-ft by 4-ft Wind Tunnel at Re = 1 x 10(exp 6). The model was equipped with synthetic jet actuators at x/c = 0.30 and 0.65 that provided 120 Hz periodic excitation at a C(sub mu) 0.86% through 0.06-in wide slots. Three different slot con gurations were tested, including a baseline with no slots. Surface pressure data was collected to compare to previous tests and to combine with turbulence data to aid future CFD modeling efforts. Turbulence data, measured by hot-wire, was compared with and without flow control. Pressure data corroborates previous test data and provides more points for CFD validation. Hot-wire results showed ow control reduced the separated wake size and brought the high Reynolds stress shear layer closer to the airfoil surface. The position of this layer to the surface was altered more significantly than the magnitude of the peak stresses. Flow control was shown to increase turbulent energy in the attached boundary layer downstream of the slot but to have little effect upstream. These results provide further justification to continue assessing the potential of active flow control to reduce drag of helicopter airframe components.
Author
Airfoils; Jet Flow; Turbulent Flow; Wind Tunnel Tests; Computational Fluid Dynamics; Flow Regulators; Two Dimensional Flow

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*.

20070017411 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Nulling at the Keck Interferometer
Colavita, M. Mark; Serabyn, Gene; Wizinowich, Peter L.; Akeson, Rachel L.; May 24, 2006; 10 pp.; In English; SPIE Conference on Astronomical Telescopes and Instrumentation, 24-31 May 2006, Orlando, FL, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39855

The nulling mode of the Keck Interferometer is being commissioned at the Mauna Kea summit. The nuller combines the two Keck telescope apertures in a split-pupil mode to both cancel the on-axis starlight and to coherently detect the residual signal. The nuller, working at 10 um, is tightly integrated with the other interferometer subsystems including the fringe and angle trackers, the delay lines and laser metrology, and the real-time control system. Since first 10 um light in August 2004, the system integration is proceeding with increasing functionality and performance, leading to demonstration of a 100:1 on-sky null in 2005. That level of performance has now been extended to observations with longer coherent integration times. An overview of the overall system is presented, with emphasis on the observing sequence, phasing system, and differences with respect to the V2 system, along with a presentation of some recent engineering data.
Author
Infrared Telescopes; Interferometers; Astronomical Interferometry; Apertures

20070017440 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Cassini Distributed Instrument Operations: What We've Learned Since Saturn Orbit Insertion

Linick, Susan H.; Boyles, C.; Woncik, P.; June 19, 2006; 9 pp.; In English; AIAA 9th International Conference on Space Operations (SpaceOps, 10-24 Jun. 2006, Rome, Italy; Original contains black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39837

The Cassini mission to Saturn is complex with 12 science teams conducting distributed operations across the USA and Europe. Each Team includes scientists from around the world who actively participate in operations, including observation design, instrument commanding, downlink processing, and archiving. This represents a change in how JPL complex deep-space missions have been operated. Since Saturn Orbit Insertion (SOI), the Cassini Project has spent 17 months conducting science operations and has gained real-world experience that has tested the assumptions and rationale for this approach. We have learned that many of the expected benefits have been realized, but there were numerous unexpected challenges as well. This paper will discuss the lessons learned from the Cassini Tour experience to date. It will revisit the assumptions and rationale behind the distributed instrument operations design and will describe the results, good and bad, of implementing this method of operations. We will describe how Instrument Teams are structured, their roles and responsibilities, what challenges they faced going into orbital operations (the 'tour') and what creative solutions were proposed when funding limitations and schedule milestones prevented optimum solutions. We will also discuss the problems that have been encountered both on the ground and with the instruments, how these problems and anomalies were overcome, and what was learned along the way about the characteristics of distributed instrument operations.

Author

Cassini Mission; Orbit Insertion; Saturn (Planet); Spacecraft Instruments

20070017923 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Towards Dualband Megapixel QWIP Focal Plane Arrays

Gunapala, S. D.; Bandara, S. V.; Liu, J. K.; Mumolo, J. M.; Hill, C. J.; Rafol, S. B.; Salazar, D.; Woolaway, J.; LeVan, P. D.; Tidrow, M. Z.; [2006]; ISSN 1350-4495; 11 pp.; In English

Report No.(s): AD-A464853; Copyright; Avail.: Other Sources

ONLINE: http://dx.doi.org/10.1016/j.infrared.2006.10.005

Mid-wavelength infrared (MWIR) and long-wavelength infrared (LWIR) 1024 x 1024 pixel quantum well infrared photodetector (QWIP) focal planes have been demonstrated with excellent imaging performance. The MWIR QWIP detector array has demonstrated a noise equivalent differential temperature of (NE(delta)T) 17 mK at a 95 K operating temperature with f/2.5 optics at 300 K background, and the LWIR detector array has demonstrated a NE(delta)T of 13 mK at a 70 K operating temperature with the same optical and background conditions as the MWIR detector array after the subtraction of system noise. Both MWIR and LWIR focal planes have shown background limited performance (BLIP) at 90 K and 70 K operating temperatures respectively, with similar optical and background conditions. In addition, we have demonstrated MWIR and LWIR pixel co-registered simultaneously readable dualband QWIP focal plane arrays. In this paper, we will discuss the performance in terms of quantum efficiency, NE(delta)T, uniformity, operability, and modulation transfer functions of the 1024 x 1024 pixel arrays and the progress of dualband QWIP focal plane array development work.

Author

Focal Plane Devices; Infrared Detectors; Photometers; Quantum Wells

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*.

20070016739 Department of the Army, Washington, DC USA

Control of Hazards to Health From Laser Radiation

Jan 2006; 294 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464670; TB-MED-524; No Copyright; Avail.: CASI: A13, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464670

This bulletin provides guidelines and establishes procedures for personnel protection from laser radiation within the

framework of currently documented experimental evidence. Medical guidance is limited to biological data available. This bulletin encompasses the portion of the electromagnetic spectrum in which laser radiation can be produced including: ultraviolet (UV), visible light, and infrared (IR) radiation.
DTIC
Electromagnetic Spectra; Hazards; Health; Laser Beams; Radiation Effects

20070016801 University of Central Florida, Orlando, FL USA
Software Development for Modeling High Power Solid State Slab Lasers
Bass, Michael; Feb 2007; 12 pp.; In English
Contract(s)/Grant(s): FA9550-05-1-0005; Proj-2305
Report No.(s): AD-A464957; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464957

We will extend this study to smaller grain sizes to determine if the trend observed continues or if the curve eventually turns down. During this period we identified an error in our earlier work on depolarization in crystalline lasers. This error, was caused by a problem in writing the reduced form of the 4th rank tensor that gives the piezo optic effect. It was essential to have found this error as we started evaluating depolarization losses in ceramic crystal lasers. These lasers are of general interest and are in use in the Textron Thin-Zag laser. We discuss the error, its correction and the evaluation of depolarization losses in ceramic crystals in this report. Since this report was first drafted we detected an error in our method of calculating the path of a ray through a random array of crystallities. This has been corrected and the results are being revised.
DTIC
Computer Programming; Slabs; Software Engineering; Solid State Lasers

20070016861 Naval Research Lab., Washington, DC USA
Spatial Intensity Correlation and Aperture Averaging Measurements in a 20 Mile Retro-Reflected Lasercom Link
Moore, Christopher I; Burris, Harris R; Suite, Michele R; Stell, Mena F; Vilcheck, Michael J; Davis, Mark A; Mahon, Rita; Rabinovich, William S; Gilbreath, G C; Oh, Eun; Jan 2004; 10 pp.; In English
Report No.(s): AD-A465092; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465092

The Naval Research Laboratory has established a lasercom test bed across the Chesapeake Bay. The test bed uses a bi-static transmitter/receiver arrangement on the western shore of the Chesapeake Bay and various configurations of 5 cm retro-reflectors on the eastern shore to produce a 32 km retro-reflected lasercom test range. Experiments measuring the laser's transverse spatial profile after propagation over the test range have been performed. These experiments use an InGaAs CCD to image the pupil plane of the 40 cm receiver telescope and a frame grabber to store contiguous images for analysis. Analysis of these image sequences allows measurement of transverse spatial correlations across the received beam after 32 km retro-reflected propagation of the beam. Various configurations and numbers of retroreflectors were studied to investigate the impact of number and arrangement of retro-reflectors on the received beam's spatial profile and spatial correlations. Additionally, since the CCD output is stored as a contiguous stream of images, analysis of these images' intensity variance in time allows measurement of aperture averaging effects as a function of number of retro-reflectors and their geometry. Results from these experiments are presented.
DTIC
Apertures; Correlation; Measurement; Optical Communication; Retroreflectors

20070016924 Air Force Research Lab., Wright-Patterson AFB, OH USA
A Novel Temperature Measurement Approach for a High Pressure Dielectric Barrier Discharge Using Diode Laser Absorption Spectroscopy (Preprint)
Leiweke, R J; Ganguly, B N; Sep 2006; 18 pp.; In English
Contract(s)/Grant(s): Proj-2301
Report No.(s): AD-A464837; AFRL-PR-WP-TP-2007-202; No Copyright; Avail.: CASI: A03, Hardcopy

A tunable diode laser absorption spectroscopic technique is used to measure both electronically excited state production efficiency and gas temperature rise in a dielectric barrier discharge in argon. The effect of voltage pulse rise time on the power deposition and electronically excited state production efficiency have been measured over a operating pressure range from 100 Torr up to 500 Torr.
DTIC
Absorption; Absorption Spectroscopy; Dielectrics; Diodes; High Pressure; Laser Spectroscopy; Semiconductor Lasers; Temperature Measurement; Tunable Lasers

20070016932 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

Direct Diode Pumped Raman Fiber Amplifier Based on a Multimode Graded Index Fiber

Baird, C J; Mar 2007; 62 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464846; AFIT/GAP/ENP/07-01; No Copyright; Avail.: CASI: A04, Hardcopy

The direct pumping of a Raman fiber amplifier (RFA) was attempted using an array of four 25W, fiber pigtailed diodes at 936nm, combined via a 7 channel fiber beam combiner. The initial attempt was conducted using a 1.8 km, 100 micron core, GRIN fiber with an NA of .29 and attenuation 3.6 dB/km at 936nm. While amplification was not achieved, over 200mW of conversion was shown, with 10.4W of pump power and 3.5W of seed. This corresponds to an average conversion efficiency of 2.2%. The subsequent effort utilized a 2km long, 200 micron core, GRIN fiber, with NA of .27 and attenuation of 2.8dB/km at pump wavelength. Again, amplification was not achieved, but a gain of 80mW was present, with 3.5W of seed power and 14W of pump. This corresponds to an average conversion efficiency of 0.6% and only 2.5% of the coupled seed power. The final experiment attempted to solve the problem of coupling efficiency and high Raman threshold by utilizing a 50/250 dual-clad fiber, with NAs of .28 and .46 for the core and inner cladding, respectively. Again, amplification was not realized, as only 100mW of gain was present, with 25W of pump and 4.2W of coupled seed power, corresponding to 36% of the coupled seed, and an average conversion efficiency of only 0.4%. Although amplification was not achieved for any of the three fibers, gain was shown possible in all, showing that directly pumping an RFA with a diode source is possible.

DTIC

Diodes; Fiber Optics; High Power Lasers

20070016992 Southampton Univ., UK

Fiber-Based 589 nm Laser for Sodium Guide Star

Nilsson, Lars J; Jeong, Yoonchan; Dupriez, Pascal; Feb 2006; 22 pp.; In English

Contract(s)/Grant(s): FA8655-04-1-3065

Report No.(s): AD-A464946; No Copyright; Avail.: CASI: A03, Hardcopy

This report results from a contract tasking University of Southampton as follows: The work will entail the construction of the required sub-assemblies, their integration into the laser source, and the exploration and adjustment of parameters in order to obtain adequate performance. We have reasonable versions of several of the needed fibers, and though we are likely to have to fabricate new fiber, this requirement is assumed to be modest. The 1060 nm pulsed diode-based seed source is based on our previous work in the field. A simple low-power pre-amplifier (YDFA) with high gain efficiency will be built with all-fiber technology and core-pumping. The 1178 nm Raman fiber seed source requires appropriate highly nonlinear fiber to be acquired or fabricated and, more challenging, narrow-linewidth FBGs to be written. A cladding-pumped Yb-doped fiber laser with a few watts of output power will be assembled, to be used as a pump source for the Raman seed source. Fiber for the high-power amplifier and Raman converter will be fabricated as necessary. We hope to be able to use modest-size, strictly single-mode cores, as this will simplify system integration (splicing in particular). We plan to use a pre-configured frequency-doubler which requires minimum effort on our part. Besides fabrication and assembly of the source, most effort will go into characterization and evaluation of components, sub-assemblies, and the system as a whole. This is important to identify the right operating point, which is relatively narrow in a pulsed system based on nonlinear conversion. It will also enable us to assess the power-scaling potential and overall potential of the approach.

DTIC

Fiber Lasers; Laser Guide Stars; Lasers; Sodium

20070017053 Virginia Univ., Charlottesville, VA USA

Time-Resolved Diffraction Profiles and Atomic Dynamics in Short-Pulse Laser-Induced Structural Transformations: Molecular Dynamics Study

Lin, Zhibin; Zhigilei, Leonid V; May 16, 2006; 20 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): CTS-0348503

Report No.(s): AD-A465173; No Copyright; Avail.: CASI: A03, Hardcopy

The diffraction profiles and density correlation functions are calculated for transient atomic configurations generated in molecular dynamics simulations of a 20 nm Au film irradiated with 200 fs laser pulses of different intensity. The results of the calculations provide an opportunity to directly relate the detailed information on the atomic-level structural rearrangements available from the simulations to the diffraction spectra measured in time-resolved x-ray and electron diffraction experiments. Three processes are found to be responsible for the evolution of the diffraction profiles. During the first several picoseconds after the laser excitation, the decrease of the intensity of the diffraction peaks is largely due to the increasing amplitude of thermal atomic vibrations and can be well described by the Debye-Waller factor. The effect of thermoelastic deformation of

the film prior to melting is reflected in shifts and splittings of the diffraction peaks, providing an opportunity for experimental probing of the ultrafast deformations. Finally, the onset of the melting process results in complete disappearance of the crystalline diffraction peaks. The homogeneous nucleation of a large number of liquid regions throughout the film is found to be more effective in reducing long-range correlations in atomic positions and diminishing the diffraction peaks as compared to the heterogeneous melting by melting front propagation. For the same fraction of atoms retaining the local crystalline environment, the diffraction peaks are more pronounced in heterogeneous melting. A detailed analysis of the real space correlations in atomic positions is also performed and the atomic-level picture behind the experimentally observed fast disappearance of the correlation peak corresponding to the second nearest neighbors in the fcc lattice during the laser heating and melting processes is revealed.
DTIC
Atoms; Diffraction; Dynamic Response; Dynamic Structural Analysis; Irradiation; Laser Outputs; Molecular Dynamics; Pulsed Lasers

20070017331 NASA Glenn Research Center, Cleveland, OH, USA
Development of a HTSMA-Actuated Surge Control Rod for High-Temperature Turbomachinery Applications
Padula, Santo, II; Noebe, Ronald; Bigelow, Glen; Culley, Dennis; Stevens, Mark; Penney, Nicholas; Gaydosh, Darrell; Quackenbush, Todd; Carpenter, Bernie; Apr. 23, 2007; 12 pp.; In English; 15th AIAA/ASME/AHS Adaptive Structures Conference, 23-26 Apr. 2007, Waikiki, HI, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 984754.02.07.03.04.02; Copyright; Avail.: CASI: A03, Hardcopy

In recent years, a demand for compact, lightweight, solid-state actuation systems has emerged, driven in part by the needs of the aeronautics industry. However, most actuation systems used in turbomachinery require not only elevated temperature but high-force capability. As a result, shape memory alloy (SMA) based systems have worked their way to the forefront of a short list of viable options to meet such a technological challenge. Most of the effort centered on shape memory systems to date has involved binary NiTi alloys but the working temperatures required in many aeronautics applications dictate significantly higher transformation temperatures than the binary systems can provide. Hence, a high temperature shape memory alloy (HTSMA) based on NiTiPdPt, having a transformation temperature near 300 C, was developed. Various thermo-mechanical processing schemes were utilized to further improve the dimensional stability of the alloy and it was later extruded/drawn into wire form to be more compatible with envisioned applications. Mechanical testing on the finished wire form showed reasonable work output capability with excellent dimensional stability. Subsequently, the wire form of the alloy was incorporated into a benchtop system, which was shown to provide the necessary stroke requirements of approx.0.125 inches for the targeted surge-control application. Cycle times for the actuator were limited to ~4 seconds due to control and cooling constraints but this cycle time was determined to be adequate for the surge control application targeted as the primary requirement was initial actuation of a surge control rod, which could be completed in approximately one second.
Author
Turbomachinery; Control Rods; Heat Resistant Alloys; High Temperature; Shape Memory Alloys; Thermodynamics; Titanium Alloys; Actuators

20070017332 Naval Research Lab., Washington, DC USA
Research in Free Space Optical Data Transfer at the U.S. Naval Research Laboratory
Gilbreath, G C; Rabinovich, William S; Jan 2004; 10 pp.; In English
Report No.(s): AD-A465094; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465094

In this paper, a review of the progress and initiatives in free space optical data transfer and communications at the Naval Research Laboratory is presented. NRL has been investing in research and development in optical communications and laser ranging, both conventional, and advanced. Efforts include developing amplifiers and components for lasers to be used in long range, one-way and retro-reflected links. NRL has been developing Multiple Quantum Well retromodulators for space-based and terrestrial-based applications as well. These include spacecraft-to-spacecraft data links for navigation and communications, intra-bus networks on spacecraft, and optical tagging. Terrestrial applications in the eyesafe regime have led to additional studies in how the atmosphere affects one-way and modulated retroreflected signals in the maritime environment, in particular. New results from retrodiversity experiments, over-the-water propagation studies, and field tests are discussed.
DTIC
Information Transfer; Free-Space Optical Communication; Quantum Wells

20070017431 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Efficient Dual Head Nd:YAG 100mJ Oscillator for Remote Sensing
Coyle, Donald B.; Stysley, Paul R.; Kay, Richard b.; Poulios, Demetrios; [2007]; ISSN 0146-9592; 12 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

A diode pumped, Nd:YAG laser producing 100 mJ Q-switched pulses and employing a dual-pump head scheme in an unstable resonator configuration is described. Each head contains a side pumped zig-zag slab and four 6-bar QCW 808 nm diodes arrays which are de-rated 23%. Denoting 'z' as the lasing axis, the pump directions were along the x-axis in one head and the y-axis in the other, producing a circularized thermal lens, more typical in laser rod-based cavities. The dual head design's effective thermal lens is now corrected with a proper HR mirror curvature selection. This laser has demonstrated over 100 mJ output with high optical efficiency (24%), good TEM(sub 00) beam quality, and high pointing stability.
Author
Neodymium Lasers; Oscillators; Remote Sensing; YAG Lasers

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*.

20070016833 Georgia Inst. of Tech., Atlanta, GA USA
Strain-Modulated Epitaxy: A Flexible Approach to 3-D Band Structure Engineering Without Surface Patterning
Carter-Coman, Carrier; Brown, April S; Bicknell-Tassius, Robert; Jokerst, Nan M; Allen, Mark; Jul 8, 1996; 4 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAH04-95-1-0367
Report No.(s): AD-A465042; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465042

Thin compliant growth substrates have been used to reduce the strain in lattice-mismatched overlayers during epitaxial growth. This letter reports a new thin compliant substrate technology which allows these thin substrates to be patterned on the bottom, bonded surface. This lateral strain variation (inverted stressor) in the growing film can be combined with the additional effects of strain-dependent growth kinetics to realize the lateral control of composition and thickness without any surface topography on the substrate. Initial demonstrations of the growth of InGaAs on GaAs bottom-patterned thin substrates are presented herein.
DTIC
Bonded Joints; Elastic Properties; Epitaxy; Heterojunctions

20070017373 NASA Glenn Research Center, Cleveland, OH, USA
Fast Whole-Engine Stirling Analysis
Dyson, Rodger W.; Wilson, Scott D.; Tew, Roy C.; Demko, Rikako; [2007]; 35 pp.; In English
Contract(s)/Grant(s): WBS 138494.04.01.01; Copyright; Avail.: CASI: A03, Hardcopy

An experimentally validated approach is described for fast axisymmetric Stirling engine simulations. These simulations include the entire displacer interior and demonstrate it is possible to model a complete engine cycle in less than an hour. The focus of this effort was to demonstrate it is possible to produce useful Stirling engine performance results in a time-frame short enough to impact design decisions. The combination of utilizing the latest 64-bit Opteron computer processors, fiber-optical Myrinet communications, dynamic meshing, and across zone partitioning has enabled solution times at least 240 times faster than previous attempts at simulating the axisymmetric Stirling engine. A comparison of the multidimensional results, calibrated one-dimensional results, and known experimental results is shown. This preliminary comparison demonstrates that axisymmetric simulations can be very accurate, but more work remains to improve the simulations through such means as modifying the thermal equilibrium regenerator models, adding fluid-structure interactions, including radiation effects, and incorporating mechanodynamics.
Author
Stirling Engines; Regenerators; Thermodynamic Equilibrium; Stirling Cycle; Calibrating

20070017909 NASA Glenn Research Center, Cleveland, OH, USA

Radiative Extinction of Gaseous Spherical Diffusion Flames in Microgravity

Santa, K. J.; Chao, B. H.; Sunderland, P. B.; Urban, D. L.; Stocker, D. P.; Axelbaum, R. L.; March 28, 2007; 13 pp.; In English; 5th U.S. Combustion Meeting, 25-28 Mar. 2006, San Diego, CA, USA

Contract(s)/Grant(s): WBS 732759.03.01.02.21

Report No.(s): Paper A06; Copyright; Avail.: CASI: A03, Hardcopy

Radiative extinction of spherical diffusion flames was investigated experimentally and numerically. The experiments involved microgravity spherical diffusion flames burning ethylene and propane at 0.98 bar. Both normal (fuel flowing into oxidizer) and inverse (oxidizer flowing into fuel) flames were studied, with nitrogen supplied to either the fuel or the oxygen. Flame conditions were chosen to ensure that the flames extinguished within the 2.2 s of available test time; thus extinction occurred during unsteady flame conditions. Diagnostics included color video and thin-filament pyrometry. The computations, which simulated flow from a porous sphere into a quiescent environment, included detailed chemistry, transport and radiation, and yielded transient results. Radiative extinction was observed experimentally and simulated numerically. Extinction time, peak temperature, and radiative loss fraction were found to be independent of flow rate except at very low flow rates. Radiative heat loss was dominated by the combustion products downstream of the flame and was found to scale with flame surface area, not volume. For large transient flames the heat release rate also scaled with surface area and thus the radiative loss fraction was largely independent of flow rate. Peak temperatures at extinction onset were about 1100 K, which is significantly lower than for kinetic extinction. One observation of this work is that while radiative heat losses can drive transient extinction, this is not because radiative losses are increasing with time (flame size) but rather because the heat release rate is falling off as the temperature drops.

Author

Ethylene; Diffusion Flames; Propane; Flow Velocity; Gaseous Diffusion; Radiative Heat Transfer; Microgravity

38
QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, quality control, inspection, maintainability, and standardization.

20070017328 NASA Glenn Research Center, Cleveland, OH, USA

Incident Involving 30-Ah Li-ion Cell at NASA Glenn Research Center

Bennett, William; [2006]; 17 pp.; In English; 74th Linthium Battery Technical/Safety Group Meeting, 6-7 Sep. 2006, Beaver Creek, OH, USA

Contract(s)/Grant(s): WBS 038957.04.01.02.03; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017328

The key lesson learned from the February 17, 2006 cell explosion incident is that PC-based test-systems, even those having built-in watchdog monitors, can lose control and malfunction. In the case of lithiumion cell/battery testing, the stored energy can be released explosively causing considerable injury and damage to facilities. The investigation showed that although the Arbin system has a built-in watchdog monitor, the circumstances of the incident defeated the action of the watchdog and allowed the cycler to continue operation without control. An upgrade to the most recent version of Arbin software (version 4) was provided as a fix to the presumed control problem. This upgrade included newer EPROM s for the cycler microprocessor. Investigation revealed that similar incidents have occurred at other NASA centers with a variety of PC-based test instruments. JPL suffered an incident with Maccor testers and the GRC fuel cell group observed similar problems with LabView software. This is not exclusively an Arbin problem, but an issue with all PC-based systems. In this incident, it was fortunate that the event occurred after-hours with no-one in the room. The facility arrangement placed control consoles adjacent to the test chamber doors. Had someone been in the room during the event, they would have been exposed to hot debris and toxic combustion products. It was also fortunate that the exploded cell stayed inside the chamber after the door was forced open. If the cell had been ejected into the room it could have caused serious facility damage by impact and possibly caused a fire in the facility.

Author

Impact Damage; Explosions; Fuel Cells; Test Chambers; Malfunctions; Electric Batteries; Combustion Products

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*.

20070016712 E2M Engineering-Environmental Management, Inc., Fairfax, VA USA
Environmental Assessment of the Relocation and Construction of a Military Working Dog (MWD) Kennel
Dec 2006; 205 pp.; In English
Report No.(s): AD-A464465; XC-460SPW; No Copyright; Avail.: CASI: A10, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464465

The USA Air Force (USAF) 460th Space Wing (460 SW) proposes to relocate and construct a Military Working Dog (MWD) kennel facility on Buckley Air Force Base (AFB) in response to changing land use surrounding the existing kennel and to accommodate additional MWDs. The Proposed Action, two Action Alternatives, and the No Action Alternative were assessed in an Environmental Assessment (EA) which is incorporated herein by reference.
DTIC
Construction; Dogs; Relocation

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*.

20070017324 NASA Johnson Space Center, Houston, TX, USA
Aqueous Alteration on Mars, Chapter 23
Ming, Douglas W.; Morris, Richard V.; Clark, Benton C.; [2007]; 38 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Aqueous alteration is the change in composition of a rock, produced in response to interactions with H2O-bearing ices, liquids, and vapors by chemical weathering. A variety of mineralogical and geochemical indicators for aqueous alteration on Mars have been identified by a combination of surface and orbital robotic missions, telescopic observations, characterization of Martian meteorites, and laboratory and terrestrial analog studies. Mineralogical indicators for aqueous alteration include goethite (lander), jarosite (lander), kieserite (orbiter), gypsum (orbiter) and other Fe-, Mg-, and Ca-sulfates (landers), halides (meteorites, lander), phyllosilicates (orbiter, meteorites), hematite and nanophase iron oxides (telescopic, orbiter, lander), and Fe-, Mg-, and Ca-carbonates (meteorites). Geochemical indicators (landers only) for aqueous alteration include Mg-, Ca-, and Fe-sulfates, halides, and secondary aluminosilicates such as smectite. Based upon these indicators, several styles of aqueous alteration have been suggested on Mars. Acid-sulfate weathering (e.g., formation of jarosite, gypsum, hematite, and goethite), may occur during (1) the oxidative weathering of ultramafic igneous rocks containing sulfides, (2) sulfuric acid weathering of basaltic materials, and (3) acid fog (i.e., vapors rich in H2SO4) weathering of basaltic or basaltic-derived materials. Near-neutral or alkaline alteration occurs when solutions with pH near or above 7 move through basaltic materials and form phases such as phyllosilicates and carbonates. Very low water:rock ratios appear to have been prominent at most of the sites visited by landed missions because there is very little alteration (leaching) of the original basaltic composition (i.e., the alteration is isochemical or in a closed hydrologic system). Most of the aqueous alteration appears to have occurred early in the history of the planet (3 to 4.5 billion years ago); however, minor aqueous alteration may be occurring at the surface even today (e.g., in thin films of water or by acid fog).
Author
Geochemistry; Igneous Rocks; Meteorites; Mineralogy; Weathering; Iron Oxides; Silicates

20070017941 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Contribution of the AIRS Shortwave Sounding Channels to Retrieval Accuracy
Susskind, Joel; Kouvaris, Louis; [2006]; 10 pp.; In English; SPIE, Defense and Security Symposium, 17-21 Apr. 2006, Orlando, FL, USA; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

AIRS contains 2376 high spectral resolution channels between 650/cm and 2665/cm, including channels in both the 15

micron (near 667/cm) and 4.2 micron (near 2400/cm) COP sounding bands. Use of temperature sounding channels in the 15 micron CO2 band has considerable heritage in infra-red remote sensing. Channels in the 4.2 micron CO2 band have potential advantages for temperature sounding purposes because they are essentially insensitive to absorption by water vapor and ozone, and also have considerably sharper lower tropospheric temperature sounding weighting functions than do the 15 micron temperature sounding channels. Potential drawbacks with regard to use of 4.2 micron channels arise from effects on the observed radiances of solar radiation reflected by the surface and clouds, as well as effects of non-local thermodynamic equilibrium on shortwave observations during the day. These are of no practical consequences, however, when properly accounted for. We show results of experiments performed utilizing different spectral regions of AIRS, conducted with the AIRS Science Team candidate Version 5 algorithm. Experiments were performed using temperature sounding channels within the entire AIRS spectral coverage, within only the spectral region 650/cm to 1614 /cm; and within only the spectral region 1000/cm-2665/cm. These show the relative importance of utilizing only 15 micron temperature sounding channels, only the 4.2 micron temperature sounding channels, and both, with regards to sounding accuracy. The spectral region 2380/cm to 2400/cm is shown to contribute significantly to improve sounding accuracy in the lower troposphere, both day and night. Author

Atmospheric Sounding; High Resolution; Spectral Bands; Radiation Effects; Remote Sensing; Solar Radiation; Infrared Detectors; Atmospheric Temperature

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*.

20070016686 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Fabry-Perot Based Differential Radiometers for Precise Determination of Atmospheric Column

Heaps, William S.; Wilson, Emily L.; Goergieva, Elena; [2006]; 1 pp.; In English; American Geophysical Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; Copyright; Avail.: Other Sources; Abstract Only

We have developed at Goddard over the last 5 years a new type of remote sensing instrument based upon the Fabry-Perot interferometer that has broad applicability to a variety of problems of great current interest. The instrument detects absorption features of various atmospheric trace species in direct or reflected sunlight. The Fabry-Perot offers high resolution and high optical throughput with small size and simplicity of operation. We have developed instruments for use as ground based, airborne and satellite sensors for species such as carbon dioxide, oxygen and water vapor. Our current concentration is to develop an ultra precise, inexpensive, ground based device suitable for wide deployment as a validation instrument for the OCO satellite scheduled to launch in 2008. We shall show sensitivity measurements for these three species, compare our water vapor measurements to those obtained using other types of sensors and discuss some of the peculiarities that must be addressed in order to provide the very high quality column measurements required to validate the OCO carbon dioxide measurements. Author

Fabry-Perot Interferometers; Remote Sensing; Trace Elements; Sunlight; High Resolution; Carbon Dioxide; Airborne Equipment

20070016740 Naval Research Lab., Stennis Space Center, MS USA

Nontronite Particle Aggregation Induced by Microbial Fe(III) Reduction and Exopolysaccharide Production

Jaisi, Deb P; Dong, Hailiang; Kim, Jinwook; He, Ziqi; Morton, John P; Jan 2007; 13 pp.; In English

Report No.(s): AD-A464671; NRL/JA/7430-06-5; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464671

Clay particle aggregation affects a number of environmental processes, such as contaminant sorption/desorption, particle movement/deposition, and sediment structure and stability, yet factors that control clay aggregation are not well understood. This study was designed to investigate how microbial reduction Fe(III) in clay structure, a common process in soils and sediments, affects clay-particle aggregation. Microbial Fe(III) reduction experiments were conducted with Shewanella putrefaciens CN32 in bicarbonate buffer with structural Fe(III) in nontronite as the sole electron acceptor, lactate as the sole

electron donor, and AQDS as an electron shuttle. Four size fractions of nontronite were used to evaluate size-dependent aggregation kinetics. The extent of Fe(III) bioreduction and the amount of exopolysaccharide (EPS), a major biopolymer secreted by CN32 cells during Fe(III) bioreduction, were measured with chemical methods.
DTIC
Clays; Iron; Microorganisms; Minerals

20070016905 Army Cold Regions Research and Engineering Lab., Hanover, NH USA
Disturbance Measurements From Off-Road Vehicles on Seasonal Terrain
Affleck, Rosa T; Jul 2005; 95 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464712; ERDC/CRREL-TR-05-12; No Copyright; Avail.: CASI: A05, Hardcopy

Vehicle operations on cross-country terrain for military, commercial or industrial, and recreational purposes can disturb the terrain, especially during spring thaw season. Terrain disturbance from off-road vehicle operations can be measured in terms of rut depth and vegetation damage. Ruts occur when vehicle load is greater than the terrain's bearing capacity, especially in soft soils. Rutting is the physical disturbance of the soil, including compaction and deformation. Estimates of rut depth for wheeled and tracked vehicles in soft, unfrozen soils can be calculated using an empirical equation based on the vehicle and soil properties. The vehicle parameters include vehicle load, tire or tracked footprint area, and wheel slip. The terrain soil properties are very important elements for estimating rut depth, including soil type and strength. Rut depth measurements were collected from military vehicles during Stryker (wheeled) vehicle impact tests at three locations at Donnelly Training Area, Alaska, and from M60A3 (tracked) and HEMTT (wheeled) vehicles at Fort McCoy, Wisconsin, during spring thaw seasons. These rut depth data are coupled with information about vehicle maneuvers (multiple passes and turning) and soil properties, such as soil type, moisture content, and soil strength. The scope of this report is to compare the actual rut depth measurements with the empirical equations to relate the physical disturbance of the soil and vegetation to a severity index, quantify the volumetric soil displacement, and assess disturbance on winter operations.
DTIC
Roads; Terrain; Traffic

20070016907 Stollar (R. L.) and Associates, Inc., Denver, CO USA
Asbestos Survey Results for Fort Douglas, Utah. Fort Douglas Environmental Investigation/Alternatives Analysis. Volume 2
Dec 1991; 259 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAA-15-90-D-0018
Report No.(s): AD-A464798; No Copyright; Avail.: CASI: A12, Hardcopy

Partial contents: Air-Cell Insulation, Joint Compound, Joint Compound on Fiberglass, MAG-Block Insulation, Paper Pipe Wrap Insulation, Wool Pipe Wrap Insulation, Soundproofing Material, Adhesive Materials, Ceiling and Wall Plaster, Ceiling paper, Ceiling Sheet Panels, Concrete Expansion/Joint Material, Linoleum, Roof Sealant, Roof Shingles, Sheetrock, Tar Paper, Textured Plaster, Transite Panels, White Powder, Wire Wrap, 9*9 Floor Tiles, 12*12 Ceiling Tiles, 2*4 Ceiling Panels, 2*2 Ceiling Panels.
DTIC
Absorbers (Materials); Acoustic Attenuation; Alternatives; Asbestos; Coverings; Hazardous Materials; Sound Waves; Surveys; Toxic Hazards

20070016946 Army Engineer Research and Development Center, Vicksburg, MS USA
Geomorphic Identification and Verification of Recent Sedimentation Patterns in the Woonasquatucket River, North Providence, Rhode Island
Corcoran, Maureen K; Mar 2007; 138 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464865; ERDC/GSL-TR-07-2; No Copyright; Avail.: CASI: A07, Hardcopy

The Woonasquatucket River in North Providence, RI, is a postglacial river flowing approximately 18 miles from its headwaters in North Smithfield, RI, to Providence, RI, where it joins the Moshassuck River and enters the Providence River. In 1776, a powder mill was constructed along the river to support the Colonies efforts in the American Revolutionary War. The powder mill exploded in 1779, sending tons of gunpowder into the river. Subsequently, with the onset of the American Industrial Revolution in the early 1800s, the river also proved an ideal setting for textile mills. Because the mills operated machinery by waterpower, the river was directed into raceways that flowed through the mills. Dams were strategically placed on the river to aid in the diversion. Mill ponds that formed in response to the obstruction substantially altered sedimentation

patterns and depositional features. This research studies a section of the Woonasquatucket River in North Providence to assess the impact of these developments on the sediment regime. By using 210Pb and 137Cs, accepted methods of radioisotope dating used primarily in lacustrine and marine environments, a geochronology of sedimentation is established. However, because the mills predate the validity of these methods (approximately 150 years before present), other sediment dating techniques are needed to establish a geochronology of events prior to mill construction. Elemental sulfur and potassium nitrate, components of gunpowder, were analyzed in the sediment to determine a historic timeline prior to the nineteenth century. Although soils at the site of the powder mill contain unusually high levels of sulfur, samples taken in areas away from the effects of the powder mill explosion also reveal high elemental sulfur levels.
DTIC
Geochronology; Geomorphology; Pollen; Rivers; Sediments

20070016947 Army Engineer Research and Development Center, Vicksburg, MS USA
Recycled Glass and Dredged Materials
Lee ,Jr, Landris T; Mar 2007; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464866; ERDC-TN-DOER-T8; No Copyright; Avail.: CASI: A03, Hardcopy

This technical note explores the concepts and applications of recovering and reusing two common disposable materials (crushed glass and dredged spoil) for beneficial engineering purposes. Dewatered fine-grained dredged material (DM) amended with glass cullet may prove to be a marketable combination especially useful as an engineered material and construction aggregate substitute. RECYCLED GLASS: Glass is manufactured from silica sand (SiO2) and other compounds, and occurs naturally as black obsidian rock (volcanic deposit) and fulgurite (from lightning strikes). Man-made glass was first made by heating a sand, soda, and lime mixture, which formed a clear liquid that turned into a hard solid when cooled. Glass has been made into containers since about 1500 BC, and glass-making evolved from the Roman times about 50 AD when transparent glass with various colors was formed into mouth-blown shapes. By the early Middle Ages, the Italians had developed an advanced glass industry, which eventually spread across Europe. Today, there are over 1000 chemical formulations known to produce glass, and the glassmaking industry has gone global (Glass Packaging Institute 2005). Glass is a recyclable product at just about any stage in its life cycle. A visit to a crystal factory where lead-oxide glass is transformed into beautiful pieces of art allows one to observe broken or imperfect pieces being placed back into the manufacturing process. Glass containers are recyclable when empty, and are processed for remanufacture into glass containers after being color-separated. Glass can also be recycled into numerous other products such as substitutes for construction aggregates.
DTIC
Dredged Materials; Glass; Industrial Plants; Limestone; Rocks; Sands; Silicon Dioxide

20070016982 Army Engineer Research and Development Center, Vicksburg, MS USA
Impact of Herbivory and Plant Competition on the Growth of Hydrilla in Small Ponds
Grodowitz, Michael J; Owens, Chetta S; Smart, R M; Nachtrieb, Julie G; Feb 2007; 10 pp.; In English
Report No.(s): AD-A464926; ERDC/TN-APCRP-BC-08; No Copyright; Avail.: CASI: A02, Hardcopy

Insect herbivory and competition have been shown to negatively impact the ability of hydrilla (Hydrilla verticillata (L.f.) Royle) to grow and reproduce (Doyle et al. 2002). Previous research conducted at the Lewisville Aquatic Ecosystem Research Facility (LAERF), Lewisville, TX and other field sites has shown that sustained levels of herbivory by the leaf-mining flies (Hydrellia pakistanae Deonier and H. balciunasi Bock) can reduce hydrilla biomass by 30 percent, reduce reproduction via reduction in flowering and tuber/turion production, and impact the ability of hydrilla to photosynthesize (Grodowitz et al. 2003; Doyle et al. 2002; Doyle et al., in review). This technical note evaluates the impacts of insect herbivory and competition on dioecious hydrilla biomass, and tuber and turion production in small ponds.
DTIC
Aquatic Plants; Competition; Ecosystems; Geological Surveys; Ponds; Vegetation Growth; Water Quality

20070016998 Army Engineer Research and Development Center, Vicksburg, MS USA
Condition Assessment of Levees, U.S. Section of the International Boundary and Water Commission. Report 5: Flood Simulation Study of Retamal Levee, Lower Rio Grande Valley, Texas, Using Seismic and Electrical Geophysical Models
Dunbar, Joseph B; Llopis, Jose L; Sills, George L; Smith, Eric W; Miller, Rick D; Ivanov, Julian; Corwin, Robert F; Jan 2007; 332 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464953; ERDC-TR-03-4; No Copyright; Avail.: CASI: A15, Hardcopy

In November 2004, a team from the U.S. Army Engineer Research and Development Center conducted a ponding test on

a reach of the Retamal levee in the Lower Rio Grande Valley to simulate performance of the levee during a flood event. The work was performed for and with the assistance of the International Boundary and Water Commission, U.S. Section, on a levee reach with a significant number of surface cracks. Surface cracking of the levee was caused primarily by drought conditions as they affected expansive clay soils where total annual rainfall, in south Texas, was less than 20 in. (0.5 m) for several years between 1998 and 2003. Geophysical monitoring of the levee provided important information about levee performance during a maximum flood event and measured changes in moisture in clay soils in the levee. Various types of state-of-the-art electrical and seismic methods were appraised to monitor seepage caused by floodwater ponded against the levee. Seismic methods are especially attractive for levee screening, as velocity data from shear and body waves correlate directly to engineering properties that measure shear strength of soils. Seismic data indicated the higher rainfall in 2004 positively affected the core of the levee. Measurable increases in the seismic velocity of both body and shear waves were observed in 2004, compared with conditions in 2003, near the end of the drought period. Velocity values prior to the flood test in 2003 were much lower, likely caused by a levee core that was internally cracked and caused slower P- and S-wave velocities.
DTIC
Boundaries; Floods; Geophysics; Simulation; Valleys; Water

20070017243 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Alaska at the Crossroads of Migration: Space Based Ornithology
Deppe, Jill; Wessels, Konrad; Smith, James A.; [2007]; 1 pp.; In English; National Park Service 2006 Alaska Park Science Symposium; No Copyright; Avail.: Other Sources; Abstract Only

Understanding bird migration on a global scale is one of the most compelling and challenging problems of modern biology with major implications for human health and conservation biology. Revolutionary advances in remote sensing now provide us with near real-time measurements of atmospheric and land surface conditions at high spatial resolution over entire continents. We use spatially-explicit, individual based bird migration models driven by numerical weather prediction models of atmospheric conditions, dynamic habitat suitability maps derived from remotely sensed land surface conditions, biophysiological models, and biological field data to simulate migration routes, timing, energy budgets, and survival of individual birds and populations. Long-distance migratory birds travel annually between breeding grounds in Alaska and wintering grounds in Latin Amierica. Approximately 25% of these species are potential vectors of Avian Influenza. Alaska is at the crossroads of Asian and New World migratory flyways and is likely to be a point of introduction of Asian H5N1 AI into the western hemisphere. If/when an infected bird is detected, a pressing question will be where was this bird several days ago, and where is it likely to go after it was released from the survey site? Answers to such questions will increase effectiveness of AI surveillance and mitigation measures. From a conservation perspective, Alaska's diverse landscape provides breeding sites for many migrants, and climatic and land surface changes along migratory flyways in the western hemisphere may reduce bird survival and physical condition upon arrival at Alaskan breeding territories, success and migrant populations.
Author
Birds; Breeding (Reproduction); Migration; Alaska; Remote Sensing

20070017244 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Assessment of EOS Aqua AMSR-E Arctic Sea Ice Concentrations using Landsat-7 and Airborne Microwave Imagery
Cavalieri, Donald J.; Markus, Thorsten; Hall, Dorothy K.; Gasiewski, Albin J.; Klein, Marian; Ivanoff, Alvaro; IEEE Transactions on Geoscience and Remote Sensing; [2006]; Volume 44, No. 11; 9 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

An assessment of Advanced Microwave Scanning Radiometer Earth Observing System (AMSR-E) sea ice concentrations under winter conditions using ice concentrations derived from Landsat-7 Enhanced Thematic Mapper Plus (ETM+) imagery obtained during the March 2003 Arctic sea ice validation field campaign is presented. The National Oceanic and Atmospheric Administration Environmental Technology Laboratory's Airborne Polarimetric Scanning Radiometer Measurements, which were made from the National Aeronautics and Space Administration P 3B aircraft during the campaign, were used primarily as a diagnostic tool to understand the comparative results and to suggest improvements to the AMSR-E ice concentration algorithm. Based on the AMSR-E/ETM+ comparisons, a good overall agreement with little bias (approx. 1%) for areas of first year and young sea ice was found. Areas of new ice production result in a negative bias of about 5% in the AMSR-E ice concentration retrievals, with a root mean square error of 8%. Some areas of deep snow also resulted in an underestimate of the ice concentration (approx. 10%). For all ice types combined and for the full range of ice concentrations, the bias ranged from 0% to 3%, and the rms errors ranged from 1% to 7%, depending on the region. The new-ice and deep-snow biases are

expected to be reduced through an adjustment of the new-ice and ice-type C algorithm tie points.
Author
Airborne Equipment; Aqua Spacecraft; Earth Observing System (EOS); Landsat 7; Microwave Imagery; Sea Ice; Microwave Radiometers

20070017255 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Bulk Surface Momentum Parameters for Satellite-Derived Vegetation Fields
Jasinski, Michael F.; Borak, Jordan; Crago, Richard; Agricultural and Forest Meteorology; 2005; ISSN 0168-1923; Volume 133, pp. 55-68; In English; Original contains color illustrations; Copyright; Avail.: Other Sources

The bulk aerodynamic parameters associated with the absorption of surface momentum by vegetated landscapes are theoretically estimated within the context of Raupach's roughness sublayer formulation. The parameters include the bulk plant drag coefficient, maximum u*/U(sub h), sheltering coefficient, and canopy area density at onset of sheltering. Parameters are estimated for the four principal IGBP land cover classes within the U.S. Southern Great Plains: evergreen needleleaf forests, grasslands, croplands, and open shrublands. The estimation approach applies the Method of Moments to roughness data from several international field experiments and other published sources. The results provide the necessary land surface parameters for satellite-based estimation of momentum aerodynamic roughness length and zero-plane displacement height for seasonally variable vegetation fields employed in most terrestrial and atmospheric simulation models used today. Construction of sample displacement and roughness maps over the Southern USA using MODIS land products demonstrates the potential of this approach for regional to global applications.
Author
Momentum; Satellite Observation; Topography; Vegetation; Vegetative Index; Remote Sensing

20070017413 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Evaluation of AIRS, MODIS, and HIRS 11 Micron Brightness Temperature Difference Changes from 2002 through 2006
Broberg, Steven E.; Aumann, Hartmut H.; Gregorich, David T.; Xiong, X.; August 13, 2006; 7 pp.; In English; SPIE Earth Observing Systems XI, 14 Aug. 2006, San Diego, CA, USA; Original contains color illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39856

In an effort to validate the accuracy and stability of AIRS data at low scene temperatures (200-250 K range), we evaluated brightness temperatures at 11 microns with Aqua MODIS band 31 and HIRS/3 channel 8 for Antarctic granules between September 2002 and May 2006. We found excellent agreement with MODIS (at the 0.2 K level) over the full emperature range in data from early in the Aqua mission. However, in more recent data, starting in April 2005, we found a scene temperature dependence in MODIS-AIRS brightness temperature differences, with a discrepancy of 1- 1.5 K at 200 K. The comparison between AIRS and HIRS/3 (channel 8) on NOAA 16 for the same time period yields excellent agreement. The cause and time dependence of the disagreement with MODIS is under evaluation, but the change was coincident with a change in the MODIS production software from collection 4 to 5.
Author
Brightness Temperature; MODIS (Radiometry); Remote Sensing; Airborne Integrated Reconnaissance System

20070017415 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Polarimetric Microwave Remote Sensing of Hurricane Ocean Winds
Yueh, Simon H.; July 31, 2006; 4 pp.; In English; International Geoscience and Remote Sensing Symposium (IGARSS, 31 Jul. - 4 aug. 2006, Boulder, CO, USA; Original contains color illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39893

We presented the analysis of Windsat data for hurricanes Isabel and Fabian in 2003. The polarimetric third and fourth Stokes parameter observations from the Windsat 10, 18 and 37 GHz channels were collocated with the ocean surface winds from the Holland wind model, the QuikSCAT wind vectors and the Global Data Assimilation System (GDAS) operated by the National Center for Environmental Prediction (NCEP). The collocated data were binned as a function of wind speed and wind direction, and were expanded by sinusoidal series of the relative azimuth angles between wind and observation directions. The coefficients of the sinusoidal series, corrected for atmospheric attenuation, have been used to develop an

empirical geophysical model function (GMF). The Windsat GMF for extreme high wind compares very well with the aircraft radiometer and radar measurements.
Author
Remote Sensing; Microwave Imagery; Polarimetry; Hurricanes; Ocean Surface; Wind (Meteorology); Geophysics

20070017450 NASA Goddard Space Flight Center, Greenbelt, MD, USA
A New Algorithm for Retrieving Aerosol Properties Over Land from MODIS Spectral Reflectance
Levy, Robert C.; Remer, Lorraine A.; Mattoo, Shana; Vermote, Eric F.; Kaufman, Yoram J.; July 2006; 55 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A04, Hardcopy

Since first light in early 2000, operational global quantitative retrievals of aerosol properties over land have been made from MODIS observed spectral reflectance. These products have been continuously evaluated and validated, and opportunities for improvements have been noted. We have replaced the original algorithm by improving surface reflectance assumptions, the aerosol model optical properties and the radiative transfer code used to create the lookup tables. The new algorithm (known as Version 5.2 or V5.2) performs a simultaneous inversion of two visible (0.47 and 0.66 micron) and one shortwave-IR (2.12 micron) channel, making use of the coarse aerosol information content contained in the 2.12 micron channel. Inversion of the three channels yields three nearly independent parameters, the aerosol optical depth (tau) at 0.55 micron, the non-dust or fine weighting (eta) and the surface reflectance at 2.12 micron. Finally, retrievals of small magnitude negative tau values (down to -0.05) are considered valid, thus normalizing the statistics of tau in near zero tau conditions. On a 'test bed' of 6300 granules from Terra and Aqua, the products from V5.2 show marked improvement over those from the previous versions, including much improved retrievals of tau, where the MODIS/AERONET tau (at 0.55 micron) regression has an equation of: y = 1.01+0.03, R = 0.90. Mean tau for the test bed is reduced from 0.28 to 0.21.
Author
Aerosols; Algorithms; Optical Properties; Optical Thickness; Spectral Reflectance; Earth Observations (From Space)

20070017474 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Rapid, Repeat-sample Monitoring of Crustal Deformations and Environmental Phenomena with the Uninhabited Aerial Vehicle Synthetic Aperture Radar
Smith, Robert C.; [2006]; 1 pp.; In English; American Geophysical Union (AGU) Fall Conference, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) is a precision repeat-pass Interferometric Synthetic Aperture Radar (InSAR) mission being developed by the Jet Propulsion Laboratory and the Dryden Flight Research Center in support of NASA s Science Mission Directorate. UAVSAR's unique ability to fly a repeatable flight path, along with an electronically steerable array, allows interferometric data to be obtained with accuracies measured in millimeters. Deploying the radar on an airborne platform will also allow for radar images to be collected and compared with images from the same area taken hours or even years later - providing for long-term trending and near real-time notification of changes and deformations. UAVSAR s data processing algorithms will provide for near-real time data reduction providing disaster planning and response teams with highly accurate data to aid in the prediction of, and response to, natural phenomena. UAVSAR data can be applied to increasing our understanding of the processes behind solid earth, cryosphere, carbon cycle and other areas of interest in earth science. Technologies developed for UAVSAR may also be applicable to a future earth-orbiting InSAR mission and possibly for missions to the Moon or Mars. The UAVSAR is expected to fly on a Gulfstream III aircraft this winter, followed by a flight test program lasting until the second half of 2007. Following radar calibration and data reduction activities, the platform will be ready for science users in the summer of 2008.
Author
Deformation; Synthetic Aperture Radar; Pilotless Aircraft; Interferometry; Flight Tests; Earth Sciences; Crustal Fractures

20070017889 NASA Goddard Space Flight Center, Greenbelt, MD, USA
An Experimental Global Monitoring System for Rainfall-triggered Landslides using Satellite Remote Sensing Information
Hong, Yang; Adler, Robert F.; Huffman, George J.; June 22, 2006; 28 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Landslides triggered by rainfall can possibly be foreseen in real time by jointly using rainfall intensity-duration thresholds and information related to land surface susceptibility. However, no system exists at either a national or a global scale to monitor or detect rainfall conditions that may trigger landslides due to the lack of extensive ground-based observing network

in many parts of the world. Recent advances in satellite remote sensing technology and increasing availability of high-resolution geospatial products around the globe have provided an unprecedented opportunity for such a study. In this paper, a framework for developing an experimental real-time monitoring system to detect rainfall-triggered landslides is proposed by combining two necessary components: surface landslide susceptibility and a real-time space-based rainfall analysis system (http://trmm.gsfc.nasa.aov). First, a global landslide susceptibility map is derived from a combination of semi-static global surface characteristics (digital elevation topography, slope, soil types, soil texture, and land cover classification etc.) using a GIs weighted linear combination approach. Second, an adjusted empirical relationship between rainfall intensity-duration and landslide occurrence is used to assess landslide risks at areas with high susceptibility. A major outcome of this work is the availability of a first-time global assessment of landslide risk, which is only possible because of the utilization of global satellite remote sensing products. This experimental system can be updated continuously due to the availability of new satellite remote sensing products. This proposed system, if pursued through wide interdisciplinary efforts as recommended herein, bears the promise to grow many local landslide hazard analyses into a global decision-making support system for landslide disaster preparedness and risk mitigation activities across the world.
Author
Landslides; Rain; Remote Sensing; Earth Surface; Precipitation (Meteorology); Satellite Instruments

20070017916 NASA Langley Research Center, Hampton, VA, USA
Spectroscopic Detection of COCLF in the Tropical and Mid-Latitude Lower Stratosphere
Rinsland, Curtis P.; Nassar, Ray; Boone, Chris D.; Bernath, Peter; Chiou, Linda; Weisenstein, Debra K.; Mahieu, Emmanuel; Zander, Rodolphe; November 16, 2006; ISSN 0022-4073; 9 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNH04CC39C; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1016/j.jqsrt.2006.11.013

We report retrievals of COClF (carbonyl chlorofluoride) based on atmospheric chemistry experiment (ACE) solar occultation spectra recorded at tropical and mid-latitudes during 2004-2005. The COClF molecule is a temporary reservoir of both chlorine and fluorine and has not been measured previously by remote sensing. A maximum COClF mixing ratio of 99.7+/- 48.0 pptv per unit volume, (10 (exp -12)I sigma) is measured at 28km for tropical and subtropical occultations (latitudes below 20 degrees in both hemispheres) with lower mixing ratios at both higher and lower altitudes. Northern hemisphere mid-latitude mixing ratios (30-50 degrees N) resulted in an average profile with a peak mixing ratio of 51.7 +/1 32.1 pptv, 1 sigma, at 27 km, also decreasing above and below that altitude. We compare the measured average profiles with the one reported set of in situ lower stratospheric mid-latitude measurements from 1986 and 1987, a previous two-dimensional (2-D) model calculation for 1987 and 1993, and a 2-D-model prediction for 2004. The measured average tropical profile is in close agreement with the model prediction; the northern mid-latitude profile is also consistent, although the peak in the measured profile occurs at a higher altitude (2.5-4.5km offset) than in the model prediction. Seasonal average 2-D-model predictions of the COClF stratospheric distribution for 2004 are also reported.
Author
Atmospheric Chemistry; Stratosphere; Remote Sensing; Carbonyl Compounds; Chlorine; Fluorine

20070017975 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Initial Results of the Geosynchronous Synthetic Thinned Array Radiometer (GeoSTAR)
Tanner, Alan B.; Wilson, W. J.; Lambrigsten, B. H.; Dinardo, S. J.; Brown, S. T.; Kangaslahti, P.; Gaier, T. C.; Ruf, C. S.; Gross, S. M.; Lim, B. H.; Musko, S.; Rogacki, S.; July 26, 2006; 4 pp.; In English; IEEE GeoScience and Remote Sensing Symposium, 26 Jul. - 4 Aug. 2006, Denver, CO, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39875

An error budget is presented to meet 1 Kelvin radiometric accuracy in a geostationary atmospheric sounder with 50 km spatial resolution on the earth. The gain and phase errors are weighted by the magnitude of visibility versus antenna separation, and requirements range between approx.0.5% and 0.3 degrees of amplitude and phase, respectively, for the closest spacings at the center of the array, and about 5% and 3 degrees for the majority of the array. The latter requirement is met by our design without any special testing or stabilizations by reference signals. The former is met using an internal noise diode reference and by measuring the detailed antenna patterns on the antenna range. Biases and other additive errors in the raw visibility samples must be below about 2 mK on average, and this requirement is met by a phase shifting scheme applied to the local oscillator distribution. An outline of the data processing is presented, along with the first images from this system.
Author
Synthetic Arrays; Radiometric Resolution; Antenna Radiation Patterns; Oscillators; Spatial Resolution; Radiometers; Errors; Diodes

20070017998 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Architecture and Data Management Challenges in GEOSS and IEOS
Fontaine, Kathleen S.; [2007]; 10 pp.; In English; IEEE Aerospace Conference, 3-10 Mar. 2006, Big Sky, MT, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017998

The international Group on Earth Observations (GEO) was initiated in 2003 to engage all the nations of the Earth in building a coordinated, comprehensive, and sustained Earth observation capability, known as the Global Earth Observation System (GEOSS). The GEO website describes GEOSS this way: 'GEOSS will build on and add value to existing Earth-observation systems by coordinating their efforts, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements, and improving delivery of information to users.' Each member nation has responded to GEO by establishing some sort of coordinating body; within the USA, that is the USA Group on Earth Observations (USGEO). This paper will describe the establishment of GEO and USGEO, will provide an overview of the activities and challenges in the area of architecture and data management, and will highlight some of the major efforts underway within USGEO today.
Author
Data Management; Earth Observing System (EOS); Remote Sensing; Architecture (Computers)

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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*.

20070016743 Library of Congress, Washington, DC USA
Critical Infrastructures: Background, Policy, and Implementation
Moteff, John D; Jan 8, 2007; 39 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464675; CRS-RL30153; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464675

The nation's health, wealth, and security rely on the production and distribution of certain goods and services. The array of physical assets, functions, and systems across which these goods and services move are called critical infrastructures (e.g., electricity, the power plants that generate it, and the electric grid upon which it is distributed). The national security community has been concerned for sometime about the vulnerability of critical infrastructure to both physical and cyber attack. In May 1998, President Clinton released Presidential Decision Directive No. 63. The Directive set up groups within the federal government to develop and implement plans that would protect government-operated infrastructures and called for a dialogue between government and the private sector to develop a National Infrastructure Assurance Plan that would protect all of the nation's critical infrastructures by the year 2003. The Bush Administration released Executive Order 13228, signed October 8, 2001, establishing the Office of Homeland Security. Among its duties, the Office shall coordinate efforts to protect the USA and its critical infrastructure from the consequences of terrorist attacks. In December 2003, the Bush Administration released Homeland Security Presidential Directive 7, reiterating and expanding upon infrastructure protection policy and responsibilities. In June 2006, the Bush Administration released its National Infrastructure Protection Plan. This report discusses in more detail the evolution of a national critical infrastructure policy and the institutional structures established to implement it. The report highlights five issues of Congressional concern: identifying critical assets; assessing vulnerabilities; allocating resources; information sharing; and, regulation.
DTIC
Law (Jurisprudence); Policies; Protection

20070016747 Library of Congress, Washington, DC USA
Energy: Selected Facts and Numbers
Glover, Carol; Behrens, Carl E; Nov 29, 2006; 32 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464682; CRS-RL31849; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464682

Energy supplies and prices are major economic factors in the USA, and energy markets are volatile and unpredictable. For both these reasons, energy policy is of frequent interest to Congress. This report presents a statistical view of the supply

and consumption of various forms of energy. After an introductory overview of aggregate energy consumption, the report presents detailed analysis of trends and statistics regarding specific energy sources: oil, electricity, natural gas, and coal. A section on trends in energy efficiency is also presented.
DTIC
Energy Conservation; Energy Consumption; United States

20070016749 Library of Congress, Washington, DC USA
The European Union's Energy Security Challenges
Morelli, Vince L; Sep 11, 2006; 35 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464691; CRS-RL33636; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464691

Recent increases in energy prices and a steady escalation in world energy demand that is expected to rise by nearly 60% over the next twenty years has led U.S. policy-makers to engage in a wide ranging debate over how best to address this nation's future energy requirements. Similarly, the European Union, along with its member states, is also engaged in an intense discussion of Europe's future energy challenges. The USA and the European Union, together, represent the world's largest energy market. Today, the USA and the EU produce approximately 23% of the world's energy but consume almost 40% of the world's supply of energy. The EU consumes approximately 18% of global oil consumption and 19% of gas produced. In 2005, the EU imported approximately 50% of its energy needs. That figure is expected to rise to 70% by 2030. Almost 50% of the EU's imported energy in the form of oil and natural gas comes from Russia. Europe's growing dependency on Russian energy supplies has led some observers to express their concern that Moscow could use the 'energy weapon' to try to influence future foreign or economic policy in Europe.
DTIC
Security

20070016852 Georgia Inst. of Tech., Atlanta, GA USA
High-Speed Characterization and Mechanical Modeling of Microscale, Axial-Flux, Permanent-Magnet Generators
Arnold, David P; Joung, Yeun-Ho; Zana, Iulica; Park, Jin-Woo; Das, Sauparna; Lang, Jeffrey H; Veazie, David; Allen, Mark G; Jan 2005; 5 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-01-2-0010
Report No.(s): AD-A465069; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465069

This paper reports the high-speed experimental characterization of a microscale, axial-flux, permanentmagnet (PM) generator to failure. A single-phase, opencircuit voltage of 0.9 Vrms was measured at 225 krpm, which corresponds to 3.3 W of DC power if the machine were connected via power electronics to a matched resistive load. Finite-element analysis was used to model and examine the mechanical design of the high-speed rotor assembly to increase the speed and, hence, output power of the device. Ultimately, rotor speeds of 325 krpm were achieved using a titanium rotor housing.
DTIC
Electric Generators; High Speed; Permanent Magnets

20070016937 Sequoia Technologies, Inc., Albuquerque, NM USA
Simulation of Flywheel Energy Storage System
Danielson, Claus R; Frank, Nicolas W; Wilson, Brian; Jan 2006; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464855; No Copyright; Avail.: CASI: A02, Hardcopy

Presented is a comprehensive power model for the Flywheel Attitude Control, Energy Transmission, and Storage (FACETS) system located at the Air Force Research Laboratory Space Vehicles Directorate at Kirtland AFB, NM. The system consists of three advanced flywheel units and the Agile Multi-Purpose Satellite Simulator (AMPSS). The purpose of FACETS is to demonstrate integrated attitude control maneuvers and energy storage. The FACETS power model is constructed using blocks provided in the Matlab Simulink package. Several electrical elements are represented by state space averaged models using Cuk's methods for averaged power converters. The model is demonstrated over an orbital profile derived from a notional space radar application. The model is verified by comparing the performance to previous power subsystem simulations produced by the FACETS program.
DTIC
Attitude Control; Energy Storage; Energy Transfer; Flat Surfaces; Flywheels; Simulation

20070017325 NASA Glenn Research Center, Cleveland, OH, USA

Carbon-Carbon Recuperators in Closed-Brayton-Cycle Space Power Systems

Barrett, Michael J.; Johnson, Paul K.; [2006]; 13 pp.; In English; 2nd International Energy Conversion Engineering Conference (IECED), 16-19 Aug. 2004, Providence, RI, USA

Contract(s)/Grant(s): 22-973-80-10

Report No.(s): AIAA-2004-5652; Copyright; Avail.: CASI: A03, Hardcopy

The use of carbon-carbon (C-C) recuperators in closed-Brayton-cycle space power conversion systems was assessed. Recuperator performance was forecast based on notional thermodynamic cycle state values for planetary missions. Resulting thermal performance, mass and volume for plate-fin C-C recuperators were estimated and quantitatively compared with values for conventional offset-strip-fin metallic designs. Mass savings of 40-55% were projected for C-C recuperators with effectiveness greater than 0.9 and thermal loads from 25-1400 kWt. The smaller thermal loads corresponded with lower mass savings; however, at least 50% savings were forecast for all loads above 300 kWt. System-related material challenges and compatibility issues were also discussed.

Author

Brayton Cycle; Regenerators; Closed Cycles; Carbon; Spacecraft Power Supplies; Thermodynamic Cycles; Satellite Solar Energy Conversion

20070017901 NASA Glenn Research Center, Cleveland, OH, USA

An Implanted, Stimulated Muscle Powered Piezoelectric Generator

Lewandowski, Beth; Gustafson, Kenneth; Kilgore, Kevin; [2007]; 24 pp.; In English; University of Texas Workshop on Piezoelectric Energy Harvesting, 30-31 Jan. 2007, Arlington, TX, USA; Original contains color illustrations

Contract(s)/Grant(s): NIH HD40298; BRTT0-03-10; Copyright; Avail.: CASI: A03, Hardcopy

A totally implantable piezoelectric generator system able to harness power from electrically activated muscle could be used to augment the power systems of implanted medical devices, such as neural prostheses, by reducing the number of battery replacement surgeries or by allowing periods of untethered functionality. The features of our generator design are no moving parts and the use of a portion of the generated power for system operation and regulation. A software model of the system has been developed and simulations have been performed to predict the output power as the system parameters were varied within their constraints. Mechanical forces that mimic muscle forces have been experimentally applied to a piezoelectric generator to verify the accuracy of the simulations and to explore losses due to mechanical coupling. Depending on the selection of system parameters, software simulations predict that this generator concept can generate up to approximately 700 W of power, which is greater than the power necessary to drive the generator, conservatively estimated to be 50 W. These results suggest that this concept has the potential to be an implantable, self-replenishing power source and further investigation is underway.

Author

Piezoelectricity; Electric Batteries; Implantation; Medical Equipment

20070017910 NASA Glenn Research Center, Cleveland, OH, USA

Developmental Considerations on the Free-Piston Stirling Power Convertor for Use in Space

Schreiber, Jeffrey G.; 2006; 16 pp.; In English; 2006 4th International Energy Conversion Engineering Conference (IECEC-2006), 26-29 Jn. 2006, San Diego, CA, USA

Contract(s)/Grant(s): WBS 138494.04.01.01; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017910

Free-piston Stirling power conversion has been considered a candidate for radioisotope power systems for space for more than a decade. Prior to the free-piston Stirling architecture, systems were designed with kinematic Stirling engines with rotary alternators to convert heat to electricity. These systems were proposed with lightly loaded linkages to achieve the necessary life. When the free-piston configuration was initially proposed, it was thought to be attractive due to the relatively high conversion efficiency, acceptable mass, and the potential for long life and high reliability. These features have consistently been recognized by teams that have studied technology options for radioisotope power systems. Since free-piston Stirling power conversion was first considered for space power applications, there have been major advances in three general areas of development: demonstration of life and reliability, the success achieved by Stirling cryocoolers in flight, and the overall developmental maturity of the technology for both flight and terrestrial applications. Based on these advances, free-piston Stirling convertors are currently being developed for a number of terrestrial applications. They commonly operate with the power, efficiency, life, and reliability as intended, and much of the development now centers on system integration. This paper

will summarize the accomplishments of free-piston Stirling power conversion technology over the past decade, review the status, and discuss the challenges that remain.
Author
Stirling Engines; Stirling Cycle; Power Efficiency; Energy Conversion Efficiency; Cryogenic Cooling; AC Generators; Satellite Solar Energy Conversion; Piston Engines

20070017911 NASA Glenn Research Center, Cleveland, OH, USA
Final Results for the GRC Supporting Technology Development Project for the 110-Watt Stirling Radioisotope Generator (SRG110)
Schreiber, Jeffrey G.; Thieme, Lanny G.; Feb. 13, 2007; 19 pp.; In English; 2007 Space Technology Applications International Forum, 13 Feb, 2997, Albuquerque, NM, USA; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017911

From 1999-2006, the NASA Glenn Research Center (GRC) supported the development of a high-efficiency, nominal 110-We Stirling Radioisotope Generator (SRG110) for potential use on NASA missions, including deep space missions, Mars rovers, and lunar applications. Lockheed Martin (LM) was the system integrator for the SRG110, under contract to the Department of Energy (DOE). Infinia Corporation (formerly Stirling Technology Company) developed the Stirling convertor, first as a contractor to DOE and then under subcontract to LM. The SRG110 development has been redirected, and recent program changes have been made to significantly increase the specific power of the generator. System development of an Advanced Stirling Radioisotope Generator (ASRG) has now begun, using a lightweight, advanced convertor from Sunpower, Inc. This paper summarizes the results of the supporting technology effort that GRC completed for the SRG110. GRC tasks included convertor extended-duration testing in air and thermal vacuum environments, heater head life assessment, materials studies, permanent magnet aging characterization, linear alternator evaluations, structural dynamics testing, electromagnetic interference (EMI) and electromagnetic compatibility (EMC) characterization, organic materials evaluations, reliability studies, and development of an end-to-end system dynamic model. Related efforts are now continuing in many of these areas to support ASRG development.
Author
Stirling Cycle; Thermal Environments; Electric Generators; Permanent Magnets; Electromagnetic Compatibility; Linear Alternators; Dynamic Tests

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*.

20070016818 Naval Research Lab., Washington, DC USA
The NRL Mountain Wave Forecast Model (MWFM) [Preprint]
Eckermann, Stephen D; Ma, Jun; Broutman, Dave; Jun 17, 2004; 21 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465017; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465017

The Department of Defense has a large and increasing investment in high-altitude long-endurance (HALE) reconnaissance aircraft. HALE aircraft have lightweight broad-winged designs, enabling them to reach stratospheric altitudes. These properties make them both aerodynamically and structurally vulnerable to any severe turbulence they intercept at altitude. Since the stratosphere is very dry and thus has no in situ cloud-related sources of turbulence from severe weather, only clear-air turbulence (CAT) can occur. Nearly a half-century of accumulated U-2 experience has revealed that, away from deep convective tropical weather, severe turbulence encounters at altitude usually occur near mountains. The only plausible connection between underlying topography and severe in-flight CAT in the middle stratosphere at ~20 km is via the direct communication of mountain-generated gravity waves (mountain waves) from the ground to the stratosphere, where they break and generate turbulence. Thus forecasts of stratospheric mountain wave CAT are required, but current operational numerical weather prediction (NWP) models cannot provide them. The exception is the NRL Mountain Wave Forecast Model (MWFM), first developed in the early 1990's with the specific goal of forecasting stratospheric mountain wave CAT for polar stratospheric science flights with NASA's ER-2. The MWFM has now clocked up over a decade's worth of experience and has been continuously maintained and significantly upgraded at NRL over that time: the upgrades have both significantly improved the stratospheric CAT forecasts, and yielded new forecast products such as mountain wave-induced cloud formation

potential and upper tropospheric mountain wave CAT. Our focus in this paper is to provide a general introductory overview of the MWFM, focusing less on the mathematical details and more on its current status and performance as a relatively mature global forecasting tool for stratospheric mountain wave CAT.
DTIC
Clear Air Turbulence; Forecasting; Mathematical Models; Mountains; Stratosphere

20070016913 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Assessment of the Impact of Various Ionospheric Models on High-Frequency Signal Raytracing
Werner, Joshua T; Mar 2007; 84 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464815; AFIT/GAP/ENP/07-07; No Copyright; Avail.: CASI: A05, Hardcopy

An assessment of the impact of various ionospheric models on high-frequency (HF) signal raytracing is presented. Ionospheric refraction can strongly affect the propagation of HF signals. Consequently, Department of Defense missions such as over-the-horizon RADAR, HF communications, and geo-location all depend on an accurate specification of the ionosphere. Five case studies explore ionospheric conditions ranging from quiet conditions to solar flares and geomagnetic storms. It is shown that an E layer by itself can increase an HF signal?s ground range by over 100 km, stressing the importance of accurately specifying the lower ionosphere. It is also shown that the GPSII model has the potential to capture the expected daily variability of the ionosphere by using Total Electron Content data. This daily variability can change an HF signal?s ground range by as much as 5 km per day. The upper-ionospheric response to both a solar flare and a geomagnetic storm is captured by the GPSII model. In contrast, the GPSII model does not capture the lower-ionospheric response to either event. These results suggest that using the GPSII model?s passive technique by itself may only be beneficial to specifying the ionosphere above the E region, especially during solar flares and geomagnetic storms.
DTIC
Atmospheric Models; Earth Ionosphere; Ray Tracing

20070016935 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Holes: Ionospheric Scintillation, GPS and Imputation
Steenburgh, Robert A; Mar 2007; 102 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464850; AFIT/GAP/ENP/07-06; No Copyright; Avail.: CASI: A06, Hardcopy

Ionospheric scintillation of Global Positioning System (GPS) signals threatens navigation and military operations by degrading performance or making GPS unavailable. Scintillation is particularly active, although not limited to, a belt encircling the earth within +/- 20 degrees of the geomagnetic equator. This belt also hosted roughly half of the completed U.S. military operations in the last decade. The authors examined scintillation data from Ascension Island, UK, and Ancon, Peru, in the Atlantic longitudinal sector as well as data from Parepare, Indonesia, and Marak Parak, Malaysia, in the Pacific longitudinal sector. From these data, they calculate percent probability of occurrence of scintillation at various intensities described by the S(sub 4) index. In addition, they determine Horizontal Dilution of Precision (HDOP) at one minute resolution; examine diurnal, seasonal, and solar cycle characteristics; and compare latitudinal and longitudinal data. Their findings are consistent with previous research, but unlike previous research they attempt to replace, or impute, missing S(sub 4) values to better capture the extent of scintillation. In doing so, they study data gaps, or holes, and characterize them. The scheme results in an increase in the observed fraction of scintillated satellites.
DTIC
Degradation; Equatorial Regions; Failure; Global Positioning System; Navigation Satellites; Scintillation

20070017010 Naval Research Lab., Washington, DC USA
Atmospheric Turbulence Studies of a 16 km Maritime Path
Moore, Christopher I; Burris, Harris R; Stell, Mena F; Wasiczko, Linda; Suite, Michele R; Mahon, Rita; Rabinovich, William S; Gilbreath, G C; Scharpf, William J; Jan 2005; 12 pp.; In English
Report No.(s): AD-A464988; No Copyright; Avail.: CASI: A03, Hardcopy

The Naval Research Lab (NRL) is currently operating a lasercom test facility (LCTF) across the Chesaepeake Bay between NRL's Chesapeake Bay Detachment (NRL-CBD) and NRL-Tilghman Island. This lasercom test facility has successfully demonstrated 32 km retro-reflected links at data rates up to 2.5 Gbps. Along with lasercom link studies, atmospheric characterization of the NRL-CBD to Tilghman Island optical path has been investigated. These studies range from passive optical turbulence monitoring based on angle-of-arrival measurements of a spotlight s apparent motion, to intensity and angle-of-arrival measurements of a retro-reflected laser beam. Currently the LCTF is being upgraded from a retro-reflected

link to a direct one-way link from NRL-CBD to NRL-Tilghman Island. Initial measurements of atmospheric turbulence effects in this one-way configuration have recently been performed. Results of these past and current atmospheric turbulence studies are presented.
DTIC
Atmospheric Circulation; Atmospheric Turbulence

20070017011 Catholic Univ. of America, Washington, DC USA
Satellite Remote Sensing of Atmospheric Meteoric Ions and Neutral Species
Aikin, Arthur C; Sep 30, 2006; 15 pp.; In English
Contract(s)/Grant(s): F49620-03-1-0422; Proj-2301
Report No.(s): AD-A464989; No Copyright; Avail.: CASI: A03, Hardcopy

Radiances measured with the GOME spectrometer on the ERS-2 satellite are used to derive the total content of the meteoric metal species Mg+, Mg, Fe+ and Fe. A retrieval algorithm has been developed and applied to determine the species content on a global scale for the year 1996. Results show total content for all the species has a maximum in late summer in both the northern and southern hemispheres. The content of neutrals relative to ions decreases in summer and the same ratio increases in winter. The content of Fe+ is approximately equal to that of Fe. In contrast the Mg+ content is twice that of Mg. The Fe content is five to ten times that of the Mg content. An examination of the content around the times of known meteor showers shows no measurable increases during or following the showers.
DTIC
Atmospheric Composition; Ions; Metals; Meteoroids; Satellite Observation; Upper Atmosphere

20070017473 NASA Johnson Space Center, Houston, TX, USA
Os-He Isotope Systematics of Iceland Picrites: Evidence for a Deep Origin of the Iceland Plume
Brandon, Alan D.; Graham, David W.; Waight, Tod; Gautason, Bjarni; [2007]; 1 pp.; In English; 17th Annual Goldschmidt Conference, 19-24 Aug. 2007, Cologne, Germany; Copyright; Avail.: CASI: A01, Hardcopy

Recent work on the origin of the Iceland hotspot suggests that it may result from upwelling upper mantle material rather than a deep plume. To constrain the depths of origins of Iceland mantle sources, Os and He isotope systematics were obtained on a suite picrites that span the compositional range observed within the neovolcanic zones.
Derived from text
Osmium Isotopes; Helium Isotopes; Basalt; Volcanology; Earth Mantle; Plumes

20070017477 NASA Johnson Space Center, Houston, TX, USA
Iron Mineralogy and Aqueous Alteration on Mars from the MER Moessbauer Spectrometers, Chapter 15
Morris, Richard V.; Klingelhoefer, Goestar; [2007]; 60 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): GSA-50-QM-99022; Copyright; Avail.: CASI: A04, Hardcopy

The twin Mars Exploration Rovers Spirit (Gusev crater) and Opportunity (Meridiani Planum) used MIMOS II Moessbauer spectrometers to analyze martian surface materials in the first application of extraterrestrial Moessbauer spectroscopy. The instruments acquired spectra that identified the speciation of Fe according to oxidation state, coordination state, and mineralogical composition and provided quantitative information about the distribution of Fe among oxidation states, coordination states, and Fe-bearing phases. A total of 12 unique Fe-bearing phases were identified: Fe(2+) in olivine, pyroxene, and ilmenite; Fe(2+) and Fe(3+) in magnetite and chromite; Fe(3+) in nanophase ferric oxide (npOx), hematite, goethite, jarosite, an unassigned Fe3+ sulfate, and an unassigned Fe(3+) phase associated with jarosite; and Fe(0) in kamacite. Weakly altered basalts at Gusev crater (SO3 = 2.5 +/- 1.4 wt.% and Fe(3+)/Fe(sub T) = 0.24 +/- 0.11) are widespread on the Gusev plains and occur in less abundance on West Spur and Husband Hill in the Columbia Hills. Altered low-S rocks (SO3 = 5.2 +/- 2.0 wt.% and Fe(3+)/Fe(sub T) = 0.63 +/- 0.18) are the most common type of rock in the Columbia Hills. Ilm-bearing, weakly altered basalts were detected only in the Columbia Hills, as was the only occurrence of chromite in an altered low-S rock named Assemblee. Altered high-S rocks (SO3 \g 14.2 wt.% and Fe(3+)/Fe(sub T) = 0.83 +/- 0.05) are the outcrop rocks of the ubiquitous Burns formation at Meridiani Planum. Two Fe(0)-bearing rocks at Meridiani Planum (Barberton and Heat Shield Rock) are meteorites. Laguna Class soil is weakly altered (SO3 = 6 +/- 2 wt.% and Fe(3+)/Fe(sub T) = 0.29 +/- 0.08) and widely distributed at both Gusev crater and Meridiani Planum, implying efficient global mixing processes or a global distribution of precursor rocks with comparable Fe mineralogical compositions. Paso Robles Class soil is heavily altered (SO3 approx. 31 wt.% and Fe(3+)/Fe(sub T) = 0.83 +/- 0.05), is relatively uncommon, and occurs as subsurface deposits in the Columbia Hills. Berry Class soil is also heavily altered (SO3 = 5 +/- 1 wt.% and Fe(3+)/Fe(sub T) = 0.60 +/- 0.13) and occurs

at Meridiani Planum as lag deposits, at the crests of aeolian bedforms, and as isolated pockets on outcrop surfaces. Magnetite is identified as the strongly magnetic component in martian soil. Jarosite (in the Burns outcrop at Meridiani Planum) and goethite (in Clovis Class rocks at Gusev crater) are mineralogical markers for aqueous processes because they contain the hydroxide anion (OH(-)) as an essential part of their structure. Each yields approx.10 wt.% H2O upon dehydroxylation. The presence of Fe sulfates on opposite sides of Mars is evidence that aqueous processes under acid sulfate conditions are or were common. Except for Independence Class rocks in the Columbia Hills, the overall Fe mineralogical compositions and similar basaltic bulk chemical compositions (calculated with respect to S = Cl = 0) of the population of altered rocks analyzed by MER imply isochemical alteration of basaltic precursors at low water-to-rock ratios.
Author
Iron; Mineralogy; Minerals; Iron Oxides; Chemical Composition; Surface Properties; Spectrometers; Oxidation; Coordination; Soils; Basalt

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METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20070016683 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Revised Correlation between Odin/OSIRIS PMC Properties and Coincident TIMED/SABER Mesospheric Temperatures
Feofilov, A. G.; Petelina, S. V.; Kutepov, A. A.; Pesnell, W. D.; Goldberg, R. A.; Llewellyn, E. J.; Russell, J. M.; [2006]; 1 pp.; In English; The Polar Summer MLT Plasma Environment as seen by the Drops Sounding Rockets, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070016683

The Optical Spectrograph and Infrared Imaging System (OSIRIS) instrument on board the Odin satellite detects Polar Mesospheric Clouds (PMCs) through the enhancement in the limb-scattered solar radiance. The Sounding of the Atmosphere using the Broadband Emission Radiometry (SABER) instrument on board the TIMED satellite is a limb scanning infrared radiometer that measures temperature and vertical profiles and energetic parameters for minor constituents in the mesosphere and lower thermosphere. The combination of OSIRIS and SABER data has been previously used to statistically derive thermal conditions for PMC existence [Petelina et al., 2005]. a, A.A. Kutepov, W.D. Pesnell, In this work, we employ the simultaneous common volume measurements of PMCs by OSIRIS and temperature profiles measured by SABER for the Northern Hemisphere summers of 2002-2005 and corrected in the polar region by accounting for the vibrational-vibrational energy exchange among the CO2 isotopes [Kutepov et al., 2006]. For each of 20 coincidences identified within plus or minus 1 degree latitude, plus or minus 2 degrees longitude and less than 1 hour time the frost point temperatures were calculated using the corresponding SABER temperature profile and water vapor densities of 1,3, and 10 ppmv. We found that the PMC presence and brightness correlated only with the temperature threshold that corresponds to the frost point. The absolute value of the temperature below the frost point, however, didn't play a significant role in the intensity of PMC signal for the majority of selected coincidences. The presence of several bright clouds at temperatures above the frost point is obviously related to the limitation of the limb geometry when some near- or far-field PMCs located at higher (and warmer) altitudes appear to be at lower altitudes.
Author
Infrared Imagery; Mesosphere; Noctilucent Clouds; Polar Regions; Spectrographs; Broadband; Radiometers; Atmospheric Sounding; Atmospheric Temperature

20070016690 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Estimating Rain Rates from Tipping-Bucket Rain Gauge Measurements
Wang, Jianxin; Fisher, Brad L.; Wolff, David B.; [2007]; 47 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

This paper describes the cubic spline based operational system for the generation of the TRMM one-minute rain rate product 2A-56 from Tipping Bucket (TB) gauge measurements. Methodological issues associated with applying the cubic spline to the TB gauge rain rate estimation are closely examined. A simulated TB gauge from a Joss-Waldvogel (JW) disdrometer is employed to evaluate effects of time scales and rain event definitions on errors of the rain rate estimation. The comparison between rain rates measured from the JW disdrometer and those estimated from the simulated TB gauge shows good overall agreement; however, the TB gauge suffers sampling problems, resulting in errors in the rain rate estimation. These errors are very sensitive to the time scale of rain rates. One-minute rain rates suffer substantial errors, especially at low

rain rates. When one minute rain rates are averaged to 4-7 minute or longer time scales, the errors dramatically reduce. The rain event duration is very sensitive to the event definition but the event rain total is rather insensitive, provided that the events with less than 1 millimeter rain totals are excluded. Estimated lower rain rates are sensitive to the event definition whereas the higher rates are not. The median relative absolute errors are about 22% and 32% for 1-minute TB rain rates higher and lower than 3 mm per hour, respectively. These errors decrease to 5% and 14% when TB rain rates are used at 7-minute scale. The radar reflectivity-rainrate (Ze-R) distributions drawn from large amount of 7-minute TB rain rates and radar reflectivity data are mostly insensitive to the event definition.
Author
Meteorological Radar; Rain Gages; Precipitation Measurement; Estimating

20070016710 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Cloud Resolving Modeling
Tao, Wei-Kuo; [2007]; 54 pp.; In English; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070016710

One of the most promising methods to test the representation of cloud processes used in climate models is to use observations together with cloud-resolving models (CRMs). CRMs use more sophisticated and realistic representations of cloud microphysical processes, and they can reasonably well resolve the time evolution, structure, and life cycles of clouds and cloud systems (with sizes ranging from about 2-200 km). CRMs also allow for explicit interaction between clouds, outgoing longwave (cooling) and incoming solar (heating) radiation, and ocean and land surface processes. Observations are required to initialize CRMs and to validate their results. This paper provides a brief discussion and review of the main characteristics of CRMs as well as some of their major applications. These include the use of CRMs to improve our understanding of: (1) convective organization, (2) cloud temperature and water vapor budgets, and convective momentum transport, (3) diurnal variation of precipitation processes, (4) radiative-convective quasi-equilibrium states, (5) cloud-chemistry interaction, (6) aerosol-precipitation interaction, and (7) improving moist processes in large-scale models. In addition, current and future developments and applications of CRMs will be presented.
Author
Climate Models; Cloud Physics; Earth Surface; Earth Sciences

20070016732 Naval Research Lab., Bay Saint Louis, MS USA
Seasonal Variability of Atlantic Water on the Continental Slope of the Laptev Sea During 2002-2004
Dmitrenko, Igor; Polyakov, Igor; Kirillov, Sergey; Timokhov, Leonid; Simmons, Harper; Ivanov, Vladimir; Walsh, David; Jan 2006; 10 pp.; In English
Contract(s)/Grant(s): 0327664
Report No.(s): AD-A464657; NRL/JA/7330-05-6064; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464657

In 2002-2004 observations carried out on the Laptev Sea continental slope as part of the Nansen and Amundsen Basins Observational System (NABOS) project are used to study variations of the intermediate (150-800 m) Atlantic water (AW) layer of the Arctic Ocean. At the mooring site, AW exhibits seasonal changes, with higher/lower temperature and salinity in winter/summer. This variability is attributed to the shift of the AW core toward the slope in winter and away from the slope in summer. Seasonal variation of wind is among the possible factors governing seasonal changes of the AW layer.
DTIC
Annual Variations; Continental Shelves; Sea Water; Seas; Water

20070016748 Naval Research Lab., Bay Saint Louis, MS USA
Bottom-Up Determination of Air-Sea Momentum Exchange Under a Major Tropical Cyclone
Jarosz, Ewa; Mitchell, Douglas A; Wang, David W; Teague, William J; Mar 23, 2007; 5 pp.; In English
Report No.(s): AD-A464687; NRL/JA/7330-06-6313; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464687

As a result of increasing frequency and intensity of tropical cyclones, an accurate forecasting of cyclone evolution and ocean response is becoming even more important to reduce threats to lives and property in coastal regions. To improve predictions, accurate evaluation of the air-sea momentum exchange is required. Using current observations recorded during a major tropical cyclone, we have estimated this momentum transfer from the ocean side of the air-sea interface, and we

discuss it in terms of the drag coefficient. For winds between 20 and 48 meters per second, this coefficient initially increases and peaks at winds of about 32 meters per second before decreasing.
DTIC
Air Water Interactions; Cyclones; Forecasting; Momentum; Tropical Storms

20070016815 Naval War Coll., Newport, RI USA
Joint Seabasing and the Natural Environment: Environmental Impacts on the Operational Functions of Movement and Maneuver, Logistics and Protection When Employing a Joint Sea Base
Matthews, Paul E; Feb 14, 2005; 26 pp.; In English
Report No.(s): AD-A465012; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465012

Seabasing is envisioned to become a key joint capability for the future. It will provide the Joint Force Commander with great flexibility when dealing with regional crises in locations where traditional land basing will be challenged or denied. When a joint sea base is brought together under the leadership of a Joint Force Maritime Component Commander (JFMCC), it will capitalize on the vast expanses of the sea for the operational functions of movement and maneuver, logistics (to include sustainment), and protection. The natural environment will affect each of these operational functions and play a key role in the JFMCC planning considerations for operations conducted from or through a joint sea base. This paper examines some of the environmental factors that will affect these operational functions from a historical perspective and through the lens of a simple scenario of a possible future operating environment. The author presents a case study of Operation Overlord, the Normandy invasion of World War II, and a future scenario of operations in the littoral South China Sea. He then presents recommendations on how the JFMCC can plan for and mitigate environmental effects on operational functions.
DTIC
Environmental Surveys; Logistics; Military Operations; Oceanography; Protection; Seas; Weather

20070016845 Johns Hopkins Univ., Baltimore, MD USA
Scintillation Measurements of Broadband 980nm Laser Light in Clear Air Turbulence
Davidson, F M; Bucaille, S; Gilbreath, C; Oh, E; Jan 2004; 13 pp.; In English
Report No.(s): AD-A465061; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465061

Intensity scintillation variances and intensity probability density functions (PDF) were experimentally measured for broad-band (2nm), 980 nm laser light reflected by two corner-cube retro-reflectors as a function of retro-reflector lateral spacing over a short (75 m) atmospheric optical path. The PDFs transitioned from broad double peaked beta shaped densities to log-normal ones as the retro-reflector spacing was increased to exceed the optical field lateral coherence length. Specific spacing for a given average atmospheric refractive index structure constant Cn2 eliminated coherent interference between light beams returned by each retro-reflector.
DTIC
Broadband; Clear Air Turbulence; Laser Outputs; Light Beams; Probability Density Functions; Scintillation

20070016923 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
High Resolution Mesoscale Weather Data Improvement to Spatial Effects for Dose-Rate Contour Plot Predictions
Jones, Christopher P; Mar 2007; 147 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464835; AFIT/GNE/ENP/07-04; No Copyright; Avail.: CASI: A07, Hardcopy

Reanalysis weather data is obtained for dates surrounding historical nuclear tests and processed through Regional Atmospheric Modeling System (RAMS) software to produce a high-resolution weather forecast. Output from RAMS is visualized to check for validity and input into Hazard Prediction and Assessment Capability (HPAC) software and modeled predictions are compared to historical observation data. Simulations are conducted using constant high resolution weather and varying terrain resolution. The HPAC prediction is numerically compared to historical observation data. The result of this research culminated in the knowledge that early-time, low-altitude wind data was neglected by HPAC's incorporation of the Defense Land Fallout Interpretive Code (DELFIC) Cloud Rise Module, resulting in HPAC predictions being inaccurate for early fallout deposition.
DTIC
Contours; Deposition; Detonation; Dosage; Fallout; Forecasting; High Resolution; Mesometeorology; Mesoscale Phenomena

20070016928 Naval Research Lab., Washington, DC USA

The WindSat Spaceborne Polarimetric Microwave Radiometer: Sensor Description and Early Orbit Performance

Gaiser, Peter W; St Germain, Karen M; Twarog, Elizabeth M; Poe, Gene A; Purdy, William; Richardson, Donald; Grossman, Walter; Jones, W L; Spencer, David; Golba, Gerald; Cleveland, Jeffrey; Choy, Larry; Bevilacqua, Richard M; Chang, Paul S; Nov 2004; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464841; No Copyright; Avail.: CASI: A03, Hardcopy

Abstract The global ocean surface wind vector is a key parameter for short-term weather forecasting, the issuing of timely weather warnings, and the gathering of general climatological data. In addition, it affects a broad range of naval missions, including strategic ship movement and positioning, aircraft carrier operations, aircraft deployment, effective weapons use, underway replenishment, and littoral operations. WindSat is a satellite-based multifrequency polarimetric microwave radiometer developed by the Naval Research Laboratory for the U.S. Navy and the National Polar-orbiting Operational Environmental Satellite System Integrated Program Office. It is designed to demonstrate the capability of polarimetric microwave radiometry to measure the ocean surface wind vector from space. The sensor provides risk reduction for the development of the Conical Microwave Imager Sounder, which is planned to provide wind vector data operationally starting in 2010. WindSat is the primary payload on the Department of Defense Coriolis satellite, which was launched on January 6, 2003. It is in an 840-km circular sun-synchronous orbit. The WindSat payload is performing well and is currently undergoing rigorous calibration and validation to verify mission success.

DTIC

Forecasting; Microwave Equipment; Microwave Sensors; Ocean Surface; Orbits; Polarimetry; Radiometers; Spacecraft Instruments; Wind (Meteorology)

20070017370 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Aircraft Measurements of Heat Fluxes Over Wind-Driven Coastal Polynyas in the Bering Sea

Walter, Bernard; Cavalieri, Donald J.; Thornhill, K. Lee; Gasiewski, Albin J.; IEEE Transactions on Geoscience and Remote Sensing; November 2006; ISSN 0196-2892; Volume 44, No. 11, pp. 3117-3134; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NNH04CC21C; Copyright; Avail.: Other Sources

ONLINE: http://dx.doi.org/10.1109/TGRS.2006.883348

The first estimates of the average bulk heat transfer coefficient for Arctic sea ice are presented as a function of mean ice thickness. Turbulent heat flux measurements made by the NASA P-3 over the St. Lawrence Island polynya (SLIP) and Kuskokwim Bay in the Bering Sea during AMSR-Ice03 were used to estimate the values of the heat transfer coefficient CH. Estimates of ice thickness were made from the algorithm of Perovich et al. using broadband albedos obtained from Moderate Resolution Imaging Spectroradiometer data. Plots of CH as a function of ice thickness showed a nearly linear relationship for ice thicknesses in the range of 0-14 cm in the polynyas. Previous estimates of CH for different cases over the SLIP were 1.2 x 10(exp -3), but no estimates of ice thickness were available. These results will allow more accurate estimates of heat fluxes from the thin-ice areas of polynyas using satellite retrievals.

Author

Bering Sea; Heat Flux; Polynyas; Wind (Meteorology); Wind Measurement; Remote Sensing

20070017429 NASA Goddard Space Flight Center, Greenbelt, MD, USA

The Plane-parallel Albedo Bias of Liquid Clouds from MODIS Observations

Oreopoulos, Lazaros; Cahalan, Robert F.; Platnick, Steven; [2007]; 34 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

In our most advanced modeling tools for climate change prediction, namely General Circulation Models (GCMs), the schemes used to calculate the budget of solar and thermal radiation commonly assume that clouds are horizontally homogeneous at scales as large as a few hundred kilometers. However, this assumption, used for convenience, computational speed, and lack of knowledge on cloud small scale variability, leads to erroneous estimates of the radiation budget. This paper provides a global picture of the solar radiation errors at scales of approximately 100 km due to warm (liquid phase) clouds only. To achieve this, we use cloud retrievals from the instrument MODIS on the Terra and Aqua satellites, along with atmospheric and surface information, as input into a GCM-style radiative transfer algorithm. Since the MODIS product contains information on cloud variability below 100 km we can run the radiation algorithm both for the variable and the (assumed) homogeneous clouds. The difference between these calculations for reflected or transmitted solar radiation constitutes the bias that GCMs would commit if they were able to perfectly predict the properties of warm clouds, but then assumed they were homogeneous for radiation calculations. We find that the global average of this bias is approx.2-3 times

larger in terms of energy than the additional amount of thermal energy that would be trapped if we were to double carbon dioxide from current concentrations. We should therefore make a greater effort to predict horizontal cloud variability in GCMs and account for its effects in radiation calculations.
Author
Climate Change; Atmospheric General Circulation Models; Radiative Transfer; Thermal Energy; Atmospheric Radiation; Energy Budgets

20070017432 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Asian Dust Storm Outbreaks: A Satellite-Surface Perspective
Tsay, Si-Chee; [2006]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

Airborne dusts from northern China contribute a significant part of the air quality problem and, to some extent, regional climatic impact in Asia during springtime. Asian dust typically originates in desert areas far from polluted urban regions. During the transport, dust layers can interact with anthropogenic sulfate and soot aerosols from heavily polluted urban areas. Added to the complex effects of clouds and natural marine aerosols, dust particles reaching the marine environment can have drastically different properties than those from the source. Thus, understanding the unique temporal and spatial variations of Asian dust is of special importance in regional-to-global climate issues (e.g., radiative forcing, hydrological cycle, and primary biological productivity in the mid-Pacific Ocean, etc.), as well as societal concerns (e.g., adverse health effects to humans). The Asian dust and air pollution aerosols can be detected by its colored appearance on current Earth observing satellites (e.g., MODIS, SeaWiFS, TOMS, etc.) and its evolution monitored by satellites and surface network (e.g. AERONET, SKY NET, MPLNET, etc.). Recently, many field campaigns (e.g., ACE-Asia-2001, TRACEP-2001, ADE-2002 & -2003, APEX-2001 & -2003, etc.) were designed and executed to study the compelling variability in spatial and temporal scale of both pollution-derived and naturally occurring aerosols, which often exist in high concentrations over eastern Asia and along the rim of the western Pacific. I will present an overview of the outbreak of Asian dust storms from space and surface observations and to address the climatic effects and societal impacts.
Author
Air Pollution; Aerosols; Dust Storms; Temporal Distribution

20070017446 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Cloud Motion Vectors from MISR using Sub-pixel Enhancements
Davies, Roger; Horvath, Akos; Moroney, Catherine; Zhang, Banglin; Zhu, Yanqiu; January 1, 2007; 20 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

The operational retrieval of height-resolved cloud motion vectors by the Multiangle Imaging SpectroRadiometer on the Terra satellite has been significantly improved by using sub-pixel approaches to co-registration and disparity assessment, and by imposing stronger quality control based on the agreement between independent forward and aft triplet retrievals. Analysis of the fore-aft differences indicates that CMVs pass the basic operational quality control 67% of the time, with rms differences - in speed of 2.4 m/s, in direction of 17 deg, and in height assignment of 290 m. The use of enhanced quality control thresholds reduces these rms values to 1.5 m/s, 17 deg and 165 m, respectively, at the cost of reduced coverage to 45%. Use of the enhanced thresholds also eliminates a tendency for the rms differences to increase with height. Comparison of CMVs from an earlier operational version that had slightly weaker quality control, with 6-hour forecast winds from the Global Modeling and Assimilation Office yielded very low bias values and an rms vector difference that ranged from 5 m/s for low clouds to 10 m/s for high clouds.
Author
Imaging Techniques; Spectroradiometers; Satellite Imagery; Cloud Cover

20070017475 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The High Resolution Tropospheric Ozone Residual
Schoeberl, Mark R.; [2006]; 1 pp.; In English; 2006 Fall AGU Meeting, 11-15 Dec. 2006, San Francisco, CA, USA; No Copyright; Avail.: Other Sources; Abstract Only

The co-flight of the MLS stratospheric limb sounder and the Ozone Monitoring Instrument (OMI) provides the capability of computing the Tropospheric Ozone Residual (TOR) in much greater detail [Ziemke et al., 2006]. Using forward trajectory calculations of MLS ozone measurements combined with OMI column ozone we have developed a high horizontal resolution tropospheric ozone residual (HTOR) which can provide even more detail than the standard TOR product. HTOR is especially useful for extra-tropical studies of tropospheric ozone transport. We find that both the Pacific pollution corridor (East Asia to

Alaska) and the Atlantic pollution corridor (North America east coast to Europe) are also preferred locations for strat-trop folds leading to systematic overestimates of pollution amounts. In fact, fold events appear to dominate extra-tropical Northern Hemisphere day-to-day maps of HTOR. Model estimates of the tropospheric column are in reasonable agreement with the HTOR amounts when offsets due to different tropopause height calculations are taken into consideration.
Author
High Resolution; Ozone; Troposphere; Residues

20070017486 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Equatorial Annual Oscillation with QBO-driven 5-year Modulation in NCEP Data
Mayr, H. G.; Mengel, J. G.; Huang, F. T.; Nash, E. R.; [2007]; 21 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

An analysis is presented of the zonal wind and temperature variations supplied by the National Center for Environmental Prediction (NCEP), which have been assimilated in the Reanalysis and the Climate Prediction Center (CCP) data sets. The derived zonal-mean variations are employed. Stimulated by modeling studies, the data are separated into the hemispherically symmetric and anti-symmetric components, and spectral analysis is applied to study the annual 12-month oscillation and Quasi-biennial Oscillation (QBO). For data samples that cover as much as 40 years, the results reveal a pronounced 5-year modulation of the symmetric AO in the lower stratosphere, which is confined to equatorial latitudes. This modulation is also inferred for the temperature variations but extends to high latitudes, qualitatively consistent with published model results. A comparison between different data samples indicates that the signature of the 5-year oscillation is larger when the QBO of 30 months is more pronounced. Thus there is circumstantial evidence that this periodicity of the QBO is involved in generating the oscillation. The spectral analysis shows that there is a weak anti-symmetric 5-year oscillation in the zonal winds, which could interact with the large antisymmetric A0 to produce the modulation of the symmetric AO as was shown in earlier modeling studies. According to these studies, the 30-month QBO tends to be synchronized by the equatorial Semi-annual Oscillation (SAO), and this would explain why the inferred 5-year modulation is observed to persist and is phase locked over several cycles.
Author
Quasi-Biennial Oscillation; Modulation; Annual Variations; Weather Forecasting; Wind (Meteorology); Equatorial Atmosphere; Climatology

20070017488 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Origin of Systematic Errors in the GCM Simulation of ITCZ Precipitation over Oceans
Chao, Winston C.; Suarez, Max J.; Bacmeister, Julio T.; Chen, Baode; Takacs, Lawrence L.; April 2006; 26 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

This study provides explanations for some of the experimental findings of Chao (2000) and Chao and Chen (2001) concerning the mechanisms responsible for the ITCZ in an aqua-planet model. These explanations are then applied to explain the origin of some of the systematic errors in the GCM simulation of ITCZ precipitatin over oceans. The ITCZ systematic errors are highly sensitive to model physics and by extension model horizontal resolution. The findings in this study along with those of Chao (2000) and Chao and Chen (2001, 2004) contribute to building a theoretical foundation for ITCZ study. A few possible methods of alleviating the systematic errors in the GCM simulaiton of ITCZ are discussed. This study uses a recent version of the Goddard Modeling and Assimilation Office's Goddard Earth Observing System (GEOS-5) GCM.
Author
Oceans; Precipitation (Meteorology); Systematic Errors; Atmospheric General Circulation Models; Computerized Simulation; Intertropical Convergent Zones

20070017492 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Comparison of Recent Modeled and Observed Trends in Total Column Ozone
Andersen, S. B.; Weatherhead, E. C.; Stevermer, A.; Austin, J.; Bruehl, C.; Fleming, E. L.; deGrandpre, J.; Grewe, V.; Isaksen, I.; Pitari, G.; Portmann, R. W.; Rognerud, B.; Rosenfield, J. E.; Smyshlyaev, S.; Nagashima, T.; Velders, G. J. M.; Weisenstein, D. K.; Xia, J.; Journal of Geophysical Research; 2006; ISSN 0148-0227; Volume 111, Issue D2; 10 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNH04CC39C; EVK2-2001-00024; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1029/2005JD006091

We present a comparison of trends in total column ozone from 10 two-dimensional and 4 three-dimensional models and

solar backscatter ultraviolet-2 (SBUV/2) satellite observations from the period 1979-2003. Trends for the past (1979-2000), the recent 7 years (1996-2003), and the future (2000-2050) are compared. We have analyzed the data using both simple linear trends and linear trends derived with a hockey stick method including a turnaround point in 1996. If the last 7 years, 1996-2003, are analyzed in isolation, the SBUV/2 observations show no increase in ozone, and most of the models predict continued depletion, although at a lesser rate. In sharp contrast to this, the recent data show positive trends for the Northern and the Southern Hemispheres if the hockey stick method with a turnaround point in 1996 is employed for the models and observations. The analysis shows that the observed positive trends in both hemispheres in the recent 7-year period are much larger than what is predicted by the models. The trends derived with the hockey stick method are very dependent on the values just before the turnaround point. The analysis of the recent data therefore depends greatly on these years being representative of the overall trend. Most models underestimate the past trends at middle and high latitudes. This is particularly pronounced in the Northern Hemisphere. Quantitatively, there is much disagreement among the models concerning future trends. However, the models agree that future trends are expected to be positive and less than half the magnitude of the past downward trends. Examination of the model projections shows that there is virtually no correlation between the past and future trends from the individual models.
Author
Two Dimensional Models; Ozone; Backscattering; Depletion; Trends; Three Dimensional Models; Solar Backscatter UV Spectrometer

20070017831 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Influence of Tropospheric SO2 Emissions on Particle Formation and the Stratospheric Humidity
Notholt, J.; Luo, B. P.; Fueglistaler, S.; Weisenstein, D.; Rex, M.; Lawrence, M. G.; Bingemer, H.; Wohltmann, I.; Corti, T.; Warneke, T.; vonKuhlmann, R.; Peters, T.; Geophysical Research Letters; April 9, 2005; ISSN 0094-8276; Volume 32; 4 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNH04CC39C; Copyright; Avail.: Other Sources
ONLINE: http://dx.doi.org/10.1029/2004GL022159

Stratospheric water vapor plays an important role in the chemistry and radiation budget of the stratosphere. Throughout the last decades stratospheric water vapor levels have increased and several processes have been suggested to contribute to this trend. Here we present a mechanism that would link increasing anthropogenic SO2 emissions in southern and eastern Asia with an increase in stratospheric water. Trajectory studies and model simulations suggest that the SO2 increase results in the formation of more sulfuric acid aerosol particles in the upper tropical troposphere. As a consequence, more ice crystals of smaller size are formed in the tropical tropopause, which are lifted into the stratosphere more readily. Our model calculations suggest that such a mechanism could increase the amount of water that entered the stratosphere in the condensed phase by up to 0.5 ppmv from 1950-2000.
Author
Sulfur Dioxides; Troposphere; Stratosphere; Humidity; Water Vapor; Aerosols; Atmospheric Radiation

20070017895 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Abrupt Decline in the Arctic Winter Sea Ice Cover
Comiso, Josefino C.; [2007]; 12 pp.; In English; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017895

Maximum ice extents in the Arctic in 2005 and 2006 have been observed to be significantly lower (by about 6%) than the average of those of previous years starting in 1979. Since the winter maxima had been relatively stable with the trend being only about -1.5% per decade (compared to about -10% per decade for the perennial ice area), this is a significant development since signals from greenhouse warming are expected to be most prominent in winter. Negative ice anomalies are shown to be dominant in 2005 and 2006 especially in the Arctic basin and correlated with winds and surface temperature anomalies during the same period. Progressively increasing winter temperatures in the central Arctic starting in 1997 is observed with significantly higher rates of increase in 2005 and 2006. The Atlantic Oscillation (AO) indices correlate weakly with the sea ice and surface temperature anomaly data but may explain the recent shift in the perennial ice cover towards the western region. Results suggest that the trend in winter ice is finally in the process of catching up with that of the summer ice cover.
Author
Arctic Regions; Sea Ice; Greenhouse Effect; Surface Temperature; Structural Basins; Arctic Ocean; Oscillations

20070017973 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Mechanical Technology Development on A 35-m Deployable Radar Antenna for Monitoring Hurricanes

Fang, Houfei; Im, Eastwood; June 26, 2006; 6 pp.; In English; 6th Annual Earth Science Technology Conference University of Maryland, 26 Jun. 2006, Baltimore, MD, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39877

The NEXRAD in Space project develops a novel instrument concept and the associated antenna technologies for a 35-GHz Doppler radar to monitor hurricanes, cyclones, and severe storms from a geostationary orbit. Mechanical challenges of this concept include a 35-m diameter lightweight in space deployable spherical reflector and a feeder scanning mechanism. The feasibility of using shape memory polymer material to develop the large deployable reflector has been investigated by this study. A spiral scanning mechanism concept has been developed and demonstrated by an engineering model.

Author

Geosynchronous Orbits; Radar Antennas; Meteorological Radar; Storms (Meteorology); Doppler Radar; Cyclones; Large Deployable Reflector; Hurricanes

20070017984 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Effects of the 2004 El Nino on Tropospheric Ozone and Water Vapor

Chandra, S.; Ziemke, J. R.; Schoeberl, M. R.; Froidevaux, L.; Read, W. G.; Levelt, P. F.; Bhartia, P. K.; [2007]; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NGC5-494; Copyright; Avail.: CASI: A03, Hardcopy

The global effects of the 2004 El Nino on tropospheric ozone and H2O based on Aura OM1 and MLS measurements are analyzed. Although it was a weak El Nino from a historical perspective, it produced significant changes in these parameters in tropical latitudes. Tropospheric ozone increased by 10-20% over most of the western Pacific region and decreased by about the same amount over the eastern Pacific region. H2O in the upper troposphere showed similar changes but with opposite sign. These zonal changes in tropospheric ozone and H2O are caused by the eastward shift in the Walker circulation in the tropical pacific region during El Nino. For the 2004 El Nino, biomass burning did not have a significant effect on the ozone budget in the troposphere unlike the 1997 El Nino. Zonally averaged tropospheric column ozone did not change significantly either globally or over the tropical and subtropical latitudes.

Author

El Nino; Tropical Regions; Biomass Burning; Microwave Landing Systems; Ozone; Troposphere; Water Vapor

20070017990 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Improved AIRS/AMSU Surface and Atmospheric Soundings Under Partial Cloud Cover Using an AIRS Only Cloud Clearing Approach

Susskind, Dr. Joel; [2007]; 4 pp.; In English; Fourier Transform Spectroscopy (FTS) Topical Meeting and Tabletop Exhibit and Hyperspectral Imaging and Sounding of the Environment Topical Meeting (HISE), 11 - 15 Feb. 2007, Santa Fe, NM, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017990

AIRS was launched on EOS Aqua on May 4,2002, together with AMSU-A and HSB, to form a next generation polar orbiting infrared and microwave atmospheric sounding system. This paper describes the latest scientific advances made in the AIRS Science Team Version 5.0 retrieval algorithm. Starting in early 2007, the Goddard DAAC will use this algorithm to analyze near real time AIRS/AMSU observations. These products are then made available to the scientific community for research purposes. The products include twice daily measurements of the Earth's three dimensional global temperature, water vapor, and ozone distribution as well as cloud cover. In addition, accurate twice daily measurements of the earth's land and ocean temperatures are derived and reported. Scientists use this important set of observations for two major uses. They provide important information for climate studies of global and regional variability and trends of different aspects of the earth's atmosphere. They also provide information for researchers to improve the skill of weather forecasting. A very important new product of the AIRS Version 5 algorithm is accurate case-by-case error estimates of the retrieved products. This heightens their utility for use in both weather and climate applications. These error estimates are also used directly for quality control of the retrieved products.

Author

Atmospheric Sounding; Earth Atmosphere; Real Time Operation; Ozone; Microwave Sounding; Infrared Radiation; Error Analysis; Climate; Cloud Cover; Atmospheric Temperature

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*.

20070016730 Medical Univ. of South Carolina, Charleston, SC USA
Minimally Invasive Molecular Staging (MIMS) RT-PCR Breast Cancer Study
Cole, David J; Baker-Ruppel, Megan; Mitas, Michael; Mar 31, 2007; 17 pp.; In English
Contract(s)/Grant(s): N00014-99-1-0784
Report No.(s): AD-A464655; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464655

We have been able to successfully complete the establishment of a 14 institution study group with the enrollment of 550 patients and associated data base. Based on known recurrence rates by our statistical support group predicted That there was enough redundancy in the study to support an appropriate power analysis. As such, the MIMS study the five-year follow up completion with data lock anticipated within the next two months. At the moment, there are 69 outstanding Data Clarification Requests (DCRs) and only 7 patients lost to follow up. To date, our interim analysis has been promising and productive. Overall 18 related publications in peer review journals and two patent applications have resulted directly and/or indirectly from the MIMS project. We anticipate being able to address our primary endpoints, and the majority of the secondary endpoints by the conclusion of the study. Additionally, it is notable that the MIMS study per se has led to the successful establishment of several productive and not independently funded research initiatives which are likely to have a 'ripple' effect beyond that of the MIMS trial per se.
DTIC
Breast; Cancer; Diagnosis; Mammary Glands; Metastasis

20070016766 Columbia Univ., New York, NY USA
Molecular Mechanisms and Treatment Strategies for Obesity-Associated Coronary Artery Disease, an Imminent Military Epidemic
Tabas, Ira; Dec 2006; 53 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-06-1-0212
Report No.(s): AD-A464728; No Copyright; Avail.: CASI: A04, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464728

There is an epidemic of obesity in the military. Obesity leads to insulin resistance syndromes, notably metabolic syndrome and type 2 diabetes. The major cause of death in these syndromes is atherothrombotic vascular disease, including coronary artery disease. Therefore, when retired military personnel and their families reach middle age, there will be an epidemic of obesity-related vascular disease. The studies completed as part of this project have revealed new cellular and molecular links between obesity/insulin resistance and atherothrombotic vascular disease. We have shown that a side effect of a class of insulin-sensitizing PPAR yamma-activating drugs called TZDs, which are used widely in obese people, may promote vascular disease. We have also shown how adiponectin, a hormone that is decreased in obese subjects, might protect against vascular disease. These advances suggest new ideas for drug therapy: a 'super' TZD that would eliminate the potential pro-atherogenic effects; and an adiponectin mimetic, which would protect macrophages from advanced lesional apoptosis. If successful, these drugs would help stem the rising tide of obesity-related heart disease in middle-aged and older military personnel and their families as well as in the general population.
DTIC
Arteries; Coronary Artery Disease; Coronary Circulation; Heart Diseases; Obesity

20070016768 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Comparison of Five Commercial DNA Extraction Kits for the Recovery of Francisella Tularensis DNA from Spiked Soil Samples
Whitehouse, Chris A; Hottel, Hannah E; Jan 2007; 7 pp.; In English
Report No.(s): AD-A464750; TR-06-090; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464750

Francisella tularensis is the etiologic agent of the zoonotic disease tularemia and is thought to be maintained in the environment principally by various terrestrial and aquatic vertebrate animals. The organism is known to persist in water or

mud for long periods of time and Francisella-specific DNA has been identified from water and soil. To gain a better understanding of the ecology and epidemiology of F. tularensis, it will be important to further explore its distribution in the environment. Therefore, methods must be established to efficiently extract Francisella-specific DNA from the soil and be able to eliminate potential PCR inhibitors. Thus, we evaluated five commercial DNA extraction kits for their ability to recover F. tularensis-specific DNA from soil samples and eliminate potential PCR inhibitors. The kits evaluated included the Puregene DNA purification kit, QIAamp Stool Mini kit, Epicentre Biotech SoilMaster DNA extraction kit, and the UltraClean and PowerMax soil DNA isolation kits from MoBio. Soil samples were spiked with gamma-irradiated F. tularensis SHU-4 strain (corresponding to a range from 10 to 10(5)CFU). Spiked samples were extracted with each kit and evaluated using a F. tularensis-specific real-time PCR assay and an internal positive control assay that measures the presence of potential PCR inhibitors. DNA extraction using the UltraClean and PowerMax kits resulted in the most consistently positive results at the lowest limit of detection (20 and 100CFU/g soil, respectively) for all soil types tested, suggesting that these kits can provide the most sensitive methods for extracting F. tularensis from environmental soil samples. Processing time and cost were also evaluated.
DTIC
Deoxyribonucleic Acid; Diseases; Extraction; Kits; Sampling; Soil Sampling; Soils

20070016769 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Inhibition of Metalloprotease Botulinum Serotype A from a Pseudo-Peptide Binding Mode to a Small Molecule that is Active in Primary Neurons
Burnett, James C; Ruthel, Gordon; Stegmann, Christian M; Panchal, Rekha G; Nguyen, Tam L; Hermone, Ann R; Stafford, Robert G; Lane, Douglas J; Kenny, Tara A; McGarth, Connor F; Feb 16, 2007; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464751; TR-06-090; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464751

An efficient research strategy integrating empirically-guided, structure-based modeling and chemoinformatics was used to discover potent small molecule inhibitors of the botulinum neurotoxin serotype A light chain. First, a modeled binding mode for inhibitor 2-mercapto-3-phenylpropionyl-RATKML (K(i) = 330 nM) was generated, and required the use of a molecular dynamic conformer of the enzyme displaying the reorientation of surface loops bordering the substrate binding cleft. These flexible loops are conformationally variable in X-ray crystal structures, and the model predicted that they were pivotal for providing complementary binding surfaces and solvent shielding for the pseudo-peptide. The docked conformation of 2-mercapto-3-phenylpropionyl-RATKML was then used to refine our pharmacophore for botulinum serotype A light chain inhibition. Database search queries derived from the pharmacophore were employed to mine small molecule (non-peptidic) inhibitors from the National Cancer Institute's Open Repository. Four of the inhibitors possess K(i) values ranging from 3.0 to 10.0 M. Of these, NSC 240898 is a promising lead for therapeutic development, as it readily enters neurons, exhibits no neuronal toxicity, and elicits dose dependent protection of synaptosomal-associated protein (of 25 kDa) in a primary culture of embryonic chicken neurons. Isothermal titration calorimetry showed that the interaction between NSC 240898 and the botulinum A light chain is largely entropy-driven, and occurs with a 1:1 inhibitor:enzyme ratio)and a dissociation constant of 4.6 M.
DTIC
Bacteria; Blood; Cells (Biology); Clostridium Botulinum; Nervous System; Neurons; Peptides; Serums; Toxicity; Toxins and Antitoxins

20070016789 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Designing a Biocontainment Unit to Care for Patients with Serious Communicable Diseases: A Consensus Statement
Smith, Philip W; Anderson, Arthur O; Christopher, George W; Cieslak, Theodore J; Devreede, G J; Fosdick, Glen A; Greiner, Carl B; Hauser, John M; Hinrichs, Steven H; Huebner, Kermit D; Aug 29, 2006; 16 pp.; In English
Report No.(s): AD-A464786; TR-06-038; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464786

In spite of great advances in medicine, serious communicable diseases are a significant threat. Hospitals must be prepared to deal with patients who are infected with pathogens introduced by a bioterrorist act (e.g., smallpox), by a global emerging infectious disease (e.g., avian influenza, viral hemorrhagic fevers), or by a laboratory accident. One approach to hazardous infectious diseases in the hospital setting is a biocontainment patient care unit (BPCU). This article represents the consensus recommendations from a conference of civilian and military professionals involved in the various aspects of BPCUs. The role of these units in overall U.S. preparedness efforts is discussed. Technical issues, including medical care issues (e.g., diagnostic

services, unit access); infection control issues (e.g., disinfection, personal protective equipment); facility design, structure, and construction features; and psychosocial and ethical issues, are summarized and addressed in detail in an appendix. The consensus recommendations are presented to standardize the planning, design, construction, and operation of BPCUs as one element of the U.S. preparedness effort.
DTIC
Health; Infectious Diseases; Medical Services; Microorganisms; Pathogens; Patients; Pollution; Viruses

20070016790 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Status and Challenges of Filovirus Vaccines
Reed, Douglas S; Mohamadzadeh, Mansour; Mar 2007; 13 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464787; TR-06-095; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464787

Vaccines that could protect humans against the highly lethal Marburg and Ebola viruses have eluded scientists for decades. Classical approaches have been generally unsuccessful for Marburg and Ebola viruses and pose enormous safety concerns as well. Modern approaches, in particular those using vector-based approaches have met with success in nonhuman primate models although success against Ebola has been more difficult to achieve than Marburg. Despite these successes, more work remains to be done. For the vector-based vaccines, safety in humans and potency in the face of pre-existing anti-vector immunity may be critical thresholds for licensure. The immunological mechanism(s) by which these vaccines protect has not yet been convincingly determined. Licensure of these vaccines for natural outbreaks may be possible through clinical trials although this will be very difficult; licensure may also be possible by pivotal efficacy studies in animal models with an appropriate challenge. Nevertheless, nonhuman primate studies have shown that protection against Marburg and Ebola is possible and there is hope that one day a vaccine will be licensed for human use.
DTIC
Animals; Fever; Hemorrhages; Vaccines; Viruses

20070016792 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Passage of Ingested Mansonella ozzardi (Spirurida: Onchocercideae) Microfilariae Through the Midgut of Aedes aegypti (Diptera: Culicidae)
Vaughan, Jefferson A; Bell, Jeffrey A; Turell, Michael J; Chadee, Dave D; Oct 12, 2006; 7 pp.; In English
Report No.(s): AD-A464789; TR-06-072; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464789

When virus and microfilariae are ingested concurrently by a mosquito, microfilariae (mf) may penetrate the mosquito midgut and introduce virus directly into the mosquito hemocoel, allowing mosquitoes to become infectious much sooner than normal and enhancing transmission of viruses by mosquitoes. Mansonella ozzardi (Manson) is a benign filarial nematode parasite of humans in Latin America and is transmitted by black flies (Diptera: Simuliidae) and biting midges (Diptera: Ceratopogonidae). Because M. ozzardi and dengue are sympatric, we wanted to know whether M. ozzardi mf had the ability to penetrate the midgut of Aedes aegypti (L.) (Diptera: Culicidae) and thus play a potential role in the enhancement of dengue transmission. To test this, the F1 progeny from locally collected Ae. aegypti were fed on M. ozzardi-infected human males in an endemic village in northern Trinidad. Mosquitoes were dissected at various times after feeding and examined for mf in the midguts and thoraces. Microfilariae penetrated the midguts of 43% of 63 mosquitoes that ingested mf. Overall, 11% of mf penetrated the midgut by 17 h after being ingested. The intensity of midgut penetration was positively correlated to the numbers of mf ingested. Because midgut penetration is a key requirement for mf enhancement to occur, the potential exists that M. ozzardi could be involved in the enhancement of dengue virus transmission.
DTIC
Entomology; Infectious Diseases; Insects; Parasites; Viruses

20070016793 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Effect of Aluminum Hydroxide Adjuvant and Formaldehyde in the Formulation of rPA Anthrax Vaccine
Little, S F; Ivins, B E; Webster, W M; Norris, S L; Andrews, G P; Jan 2, 2007; 9 pp.; In English
Report No.(s): AD-A464790; TR-06-124; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464790

The serological response and efficacy of Bacillus anthracis recombinant protective antigen (rPA) vaccines formulated with aluminum hydroxide adjuvant, either with or without formaldehyde, were evaluated in rabbits. Rabbits that had been injected

with a single dose of 25mug of rPA adsorbed to 500mug of aluminum in aluminum hydroxide gel (Alhydrogel) had a significantly higher quantitative anti-rPA IgG ELISA titers (p\h0.0001) and toxin neutralizing antibody (TNA) assay titers (p\h0.0001) than rabbits tested at the next lowest concentration of aluminum (158mug). Rabbits injected with two doses of 50mug of rPA formulated with 500mug of aluminum also had significantly higher serological responses, as measured by a quantitative anti-rPA IgG ELISA (p\h0.0001) and TNA assay (p\h0.0001), than sera from rabbits injected with a rPA vaccine formulated without adjuvant. Short-term protection against an aerosol spore challenge (448 LD(50)), however, was not significantly different between the two groups (12/12 and 11/12, respectively). Rabbits injected with a single dose of 50mug of rPA formulated with 500mug of aluminum and 0.2% formaldehyde had significantly higher ELISA (p\h0.0001) and TNA assay (p\h0.0001) titers than rabbits that had been injected with a rPA vaccine formulated with adjuvant but without formaldehyde. Short-term protection against a 125 LD(50) parenteral spore challenge, however, was not significantly different between the two groups (14/24 and 9/24, respectively; p=0.2476). Under the conditions tested in the rabbit animal model, significantly higher serological responses were observed in rabbits that had been injected with rPA formulated with aluminum hydroxide gel adjuvant and formaldehyde. However, differences in short-term efficacy were not observed.
DTIC

Aluminum; Formaldehyde; Hydroxides; Infectious Diseases; Vaccines

20070016794 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA

Genetic Analysis of South American Eastern Equine Encephalitis Viruses Isolated from Mosquitoes Collected in the Amazon Basin Region of Peru

Kondig, John P; Turell, Michael J; Lee, John; O'Guinn, Monica L; Wasieloski ,Jr, Leon P; Mar 2007; 10 pp.; In English
Report No.(s): AD-A464791; RPP-06-044; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464791

Identifying viral isolates from field-collected mosquitoes can be difficult and time-consuming, particularly in regions of the world where numerous closely related viruses are co-circulating (e.g., the Amazon Basin region of Peru). The use of molecular techniques may provide rapid and efficient methods for identifying these viruses in the laboratory. Therefore, we determined the complete nucleotide sequence of two South American eastern equine encephalomyelitis viruses (EEEVs): one member from the Peru-Brazil (Lineage II) clade and one member from the Argentina-Panama (Lineage III) clade. In addition, we determined the nucleotide sequence for the nonstructural P3 protein (nsP3) and envelope 2 (E2) protein genes of 36 additional isolates of EEEV from mosquitoes captured in Peru between 1996 and 2001. The 38 isolates were evenly distributed between lineages II and III virus groupings. However, analysis of the nsP3 gene for lineage III strongly suggested that the 19 isolates from this lineage could be divided into two sub-clades, designated as lineages III and IIIA. Compared with North American EEEV (lineage I, GA97 strain), we found that the length of the nsP3 gene was shorter in the strains isolated from South America. A total of 60 nucleotides was deleted in lineage II, 69 in lineage III, and 72 in lineage IIIA. On the basis of the sequences we determined for South American EEEVs and those for other viruses detected in the same area, we developed a series of primers for characterizing these viruses.
DTIC

Amazon Region (South America); Arthropods; Diseases; Encephalitis; Genetics; Insects; Peru; Structural Basins; Viruses

20070016803 Pittsburgh Univ., Pittsburgh, PA USA

Safar Symposium (3rd) Held in Pittsburgh, Pennsylvania on June 23, 2005

Kochanek, Patrick M; Jul 2006; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-05-C-0143
Report No.(s): AD-A464960; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464960

This grant funded expenses related to the third Safar Symposium held at the University of Pittsburgh School of Medicine on June 23, 2005. This symposium is held each year in honor of the late Dr. Peter Safar, pioneer of CPR, resuscitation, critical care, and disaster medicine. The symposium focused on two aspects of medical research of importance to the field of resuscitation medicine in its broadest scope, namely, a morning session entitled The Inflammatory Response in Resuscitation and an afternoon session on Advances in Human Simulation Education. The symposium featured 10 speakers and was well received by over 200 attendees, including physicians, scientists, medical residents, fellows, and students, nurses, paramedics, and other allied professionals in the field of resuscitation medicine. The Symposium was linked to the annual Peter and Eva Safar Lecture for the Sciences and Humanities at the University of Pittsburgh School of Medicine along with the first clinical consortium of trauma investigators (both civilian and military) focused on a potential clinical trial of a novel resuscitation

approach to traumatic arrest called Emergency Preservation and Resuscitation.
DTIC
Conferences; Medical Science; Resuscitation

20070016850 Western General Hospital, Edinburgh, UK
Medical Ultrasound: a New Metric of Performance for Greyscale Imaging
Pye, S D; Ellis, W; MacGillivray, T; Jan 2004; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465066; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465066

The imaging performance of diagnostic ultrasound scanners is clinically important but difficult to assess objectively. Clinical trials are time consuming and subjective, while measurements made using test objects often have little clinical relevance and limited traceability. This paper describes the concept of a Resolution Integral as a single figure-of-merit for grey-scale ultrasound imaging. The concept is a general one that can be realized by a variety of methods. We describe one possible implementation that employs a novel test object containing 3D anechoic pipe structures embedded in tissue mimicking material.
DTIC
Clinical Medicine; Gray Scale; Imaging Techniques; International System of Units; Ultrasonics

20070016904 TRUE Research Foundation, San Antonio, TX USA
Modulation of T Cell Tolerance in a Murine Model for Immunotheraphy of Prostatic Adenocarcinoma
Hurwitz, Arthur A; Sep 2006; 28 pp.; In English
Contract(s)/Grant(s): DAMD17-01-0085
Report No.(s): AD-A464693; No Copyright; Avail.: CASI: A03, Hardcopy

The goal of this project is to characterize T cell tolerance to prostate tumor antigens and to identify the role of costimulatory receptors in overcoming this tolerance. Identification of these processes will assist in the development of novel therapeutic approaches for treating prostate cancer. We use the TRAMP model a transgenic mouse line that develops primary prostatic tumors due to expression of the SV4O T antigen (TAg) under the transcriptional control of a prostate-specific promoter. In this final summary we report that subsequent to adoptive transfer of na(ve TAg-specific T cells into TRAMP mice there is rapid expansion and contraction of the tumor-specific T cells followed by accumulation of a population of T cells that persist in the prostate as tolerant and suppressive. Co-transfer of TAg-specific CD4+ T cells partially rescues the tolerant suppressive phenotype of prostate-tumor-specific T cells although over time tolerance of the CD4+ T cells ensues. In contrast transfer of CD4+ T cells does not reverse tolerance of the previously-tolerized CD4+ cells. The suppressive nature of these CD4+ T cells was also studied and we present preliminary data on the characterization of these novel suppressor cells. These data demonstrate the critical balance between T cell activation and tolerance and support a mechanism by which tumor growth may induce tolerance and suppressor activity in T cells previously primed to tumor-specific antigens. A greater understanding of how tolerance of these tumor specific T cells can be reversed willcertainly lead to more potent anti-tumor immunotherapies.
DTIC
Cancer; Modulation; Prostate Gland; Rodents

20070016908 Texas Univ., San Antonio, TX USA
Characterization of Maze Performance in Adrenalectomized Sleep Disrupted Rats: A Comparison of Radial Arm Maze Performance Between Adrenalectromized and Sham Adrenalectomized Sleep Disrupted Rats
Mery, Laura; Jan 2007; 36 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA86500-05-6644; Proj-7757
Report No.(s): AD-A464806; No Copyright; Avail.: CASI: A03, Hardcopy

Sleep disruption is stressful. Sleep disruption affects performance in rats in several behavioral paradigms. Elevation of plasma corticosterone is associated with stress, and with sleep disruption in rats. Elevated corticosterone may contribute to dendritic regression in the hippocampus, a brain region associated with spatial learning. The working hypothesis of this study was that removing adrenal glands in a rat will ameliorate the effects of sleep disruption on maze performance. Animals adrenalcetomized and sham adrenalectomized were trained to criterion in the eight arm radial maze, and sleep disrupted for 12 hours during the light phase using a modified flowerpot in a cage with an inch of water. Removal of adrenal glands improved post sleep disruption performance slightly, but not significantly. However, the Barnes maze results did show an improvement of performance with a glucocorticoid receptor antagonist given 4 hours before the conclusion of 12 hours of

sleep disruption on the flowerpot the post sleep disruption performances were compared. In addition, animals were implanted with a venous jugular catheter, and sampled over a 36 hour period which included 12 hours of baseline, 12 hours of sleep disruption during the light phase and 12 hours of recovery. The results showed a significant elevation of corticosterone during the period of sleep disruption with recovery to cage control levels within 4 hours after return to home cage. In conclusion, some of the performance impairments associated with sleep disruption may be the result of elevated corticosterone.
DTIC
Adrenal Gland; Hormones; Maze Learning; Rats; Sleep; Sleep Deprivation

20070016911 Library of Congress, Washington, DC USA
Project BioShield: Appropriations, Acquisitions, and Policy Implementation Issues for Congress
Gottron, Frank; Mar 8, 2007; 26 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464812; CRS-RL33907; No Copyright; Avail.: CASI: A03, Hardcopy

The Project BioShield Act of 2004 (P.L. 108-276) established a 10-year program to acquire civilian medical countermeasures to chemical, biological, radiological and nuclear (CBRN) agents for the Strategic National Stockpile. Provisions of this act were designed to encourage private companies to develop these countermeasures by guaranteeing a government market for successfully developed countermeasures. Both the Department of Homeland Security (DHS) and the Department of Health and Human Services (HHS) have responsibilities in this program. Funds for this program are appropriated to DHS, while contracts are executed through HHS. The interagency process responsible for deciding which countermeasures to procure has changed multiple times since this program's inception. The Homeland Security Appropriations Act, 2004 (P.L. 108-90) provided an advance appropriation of $5.6 billion to acquire CBRN countermeasures over a 10-year period (FY2004 FY2013). This act also limited the amount that could be obligated during specified time periods. The Project BioShield Act of 2004 (P.L. 108-276) assigned the $5.6 billion advance appropriation to Project BioShield countermeasure acquisitions. The Consolidated Appropriations Act, 2004 (P.L. 108-199) and the Consolidated Appropriations Act, 2005 (P.L. 108-447) reduced the total amount available for Project BioShield by a total of $25 million. Congress retains the power to make additional appropriations and rescissions to this account. HHS has awarded Project BioShield contracts for a countermeasure against botulinum toxin, two types of anthrax vaccine, two types of anthrax treatments, and three kinds of countermeasures against radiological or nuclear agents. HHS reports that it has obligated approximately $1.831 billion from the Project BioShield account. However, the largest contract, $878 million for an anthrax vaccine, was cancelled in December 2006, for failure to meet a contract milestone.
DTIC
Appropriations; Biological Weapons; Biomedical Data; Government Procurement; Medical Science; Policies

20070016931 Virginia Polytechnic Inst. and State Univ., Blacksburg, VA USA
Eukaryotic Cell Cycle as a Test Case for Modeling Cellular Regulation in a Collaborative Problem-Solving Environment
Tyson, John J; Novak, Bela; Chen, Kathy; Sible, Jill C; Cross, Frederick R; Watson, Layne T; Shaffer, Clifford A; Mar 2007; 146 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F30602-01-2-0572; Proj-BIOC
Report No.(s): AD-A464845; No Copyright; Avail.: CASI: A07, Hardcopy

The purpose of DARPA's BioSPICE Program was to provide a new and useful set of software tools for modeling biochemical pathways and molecular regulatory networks within living cells. Using nonlinear ordinary differential equations to capture the temporal dynamics of molecular control systems, the modeling team built successful computer models of cell cycle regulation in a variety of organisms, including yeast cells, amphibian embryos, bacterial cells and human cells. These models accurately reproduce the physiological properties of normal cell division, and the bizarre properties of 200+ mutant cells that have been studied. The models predict phenotypes of novel mutants and unintuitive properties of the cell cycle machinery, which have been confirmed by the experimental teams on the project. The theorists used one- and two-parameter bifurcation diagrams to link gene-protein interaction networks to the physiological properties of cells. The Software Team developed tools for building mathematical models from a chemical reaction network, for associating experimental data with a model, for managing simulations of the data by the model, for evaluating how well the simulation fits the data, and for automatic parameter estimation. In addition a powerful tool for numerical bifurcation analysis was created. The major accomplishments of the Virginia Tech Consortium are (1) a set of downloadable, open-source computer programs that embody a Problem Solving Environment for dynamic modeling of macromolecular regulatory networks in living cells, and (2) an integrated set of models of cell cycle regulation in bacteria, yeasts, and metazoans that are accurate, predictive and informative. The models are described in the peer-reviewed literature and are freely available from web sites maintained at

Virginia Tech. Some of the experimental tests carried out by the group are cited as classic examples of modern molecular systems biology.
DTIC
Eukaryotes; Genetics; Mathematical Models; Problem Solving

20070016944 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
The Effect of Harp Music on Heart Rate, Mean Blood Pressure, Respiratory Rate, and Body Temperature in the African Green Monkey
Hinds, Sarah B; Raimond, Susan; Purcell, Bret K; Jan 2007; 7 pp.; In English
Report No.(s): AD-A464863; RPP-05-431; No Copyright; Avail.: CASI: A02, Hardcopy

The effectiveness of recorded harp music as a tool for relaxation for nonhuman primates (NHP) is explored in this study. Konigsberg Instruments Model T27F-1B cardiovascular telemetry devices were implanted into nine African green monkeys (Chlorocebus aethiops). After post-surgical recovery, animals were exposed to recorded harp music. Telemetry data were collected on heart rate, mean blood pressure, respiratory rate, and body temperature for a 30-minute baseline period before music exposure; a 90-minute period of music exposure; and a 90-minute postexposure period, where no music was played. The results showed no statistical differences in heart rate, mean blood pressure, respiratory rate, and body temperature among pre-exposure, exposure, and postexposure periods. The authors conclude that the lack of response in these African green monkeys may be attributable to their generally calm demeanor in captivity. Experiments with a more excitable species, such as the rhesus macaque, might demonstrate a significant relaxation response to music.
DTIC
Africa; Animals; Biotelemetry; Blood Pressure; Body Temperature; Heart Rate; Monkeys; Music; Physiological Effects; Respiratory Rate; Therapy

20070016950 Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD USA
Anthrax Vaccines: Pasteur to the Present
Scorpio, A; Blank, T E; Day, W A; Chabot, D J; Jan 2006; 13 pp.; In English
Report No.(s): AD-A464870; TR-06-014; No Copyright; Avail.: CASI: A03, Hardcopy

Anthrax has been a major cause of death in grazing animals and an occasional cause of death in humans for thousands of years. Since the late 1800s there has been an exceptional international history of anthrax vaccine development. Due to animal vaccinations, the rate of infection has dropped dramatically. Anthrax vaccines have progressed from uncharacterized whole-cell vaccines in 1881, to pXO2-negative spores in the 1930s, to culture filtrates absorbed to aluminum hydroxide in 1970, and likely to recombinant protective antigen in the near future. Each of these refinements has increased safety without significant loss of efficacy. The threat of genetically engineered, antibiotic and vaccine resistant strains of Bacillus anthracis is fueling hypothesis-driven research and global techniques--including genomics, proteomics and transposon site hybridization--to facilitate the discovery of novel vaccine targets. This review highlights historical achievements and new developments in anthrax vaccine research.
DTIC
Antigens; Bacillus; Gene Expression; Infectious Diseases

20070016970 Georgetown Univ., Washington, DC USA
Characterization and Modulation of Proteins Involved in Sulfur Mustard Vesication
Rosenthal, Dean S; May 2006; 70 pp.; In English
Contract(s)/Grant(s): DAMD17-00-C-0026
Report No.(s): AD-A464909; No Copyright; Avail.: CASI: A04, Hardcopy

In the current contracting period, we utilized specific and potent inhibitors of different caspases to determine the most effective means of preventing SM toxicity in vitro and vesication in vivo. We obtained tetrapeptide inhibitors to each of the caspases and treated KC for 30 min prior to SM exposure. In addition to determining total SM toxicity, we delineated the specific pathway for the activation of each of the caspases. When primary KC were treated for each of the caspase inhibitors, prior to SM exposure and assayed for activation of each caspase, IETD and LEHD (caspase-8 and caspase-9 inhibitors) were the most effective caspase inhibitors for human KCs in culture. These worked more effectively than the pan-caspase inhibitor, ZVAD. We have now utilized these inhibitors as compounds for testing in the in vivo human skin graft for their ability to block SM vesication. Primary human KC were used to establish a histologically and immunocytochemically normal epidermis grafted onto the back of nude mice. To test the effects of the peptide inhibitors of caspases on apoptosis and vesication in intact

human epidermis, normal human skin was grafted onto the back of athymic mice, and 6-8 weeks after grafting, we inhibited the activity of caspases in vivo by topical application of the inhibitors at the graft site 30 min prior to SM exposure. These human grafts were then exposed to SM by vapor cup method, and showed a vesication response, utilizing an end point of micro or macro blisters. Frozen and fixed sections derived from graft sites of these animals were analyzed for apoptosis markers. Histological analysis of SM-exposed animals grafted with primary KC showed that SM microvesication can be reduced by topical application of zVAD-fmk. While there was no difference in the DMSO (vehicle)- treated and ZFA-treated control skin grafts, there was a notable decrease in the amount of microvesication in grafts treated with zVAD-fmk.
DTIC
In Vitro Methods and Tests; Modulation; Proteins; Sulfur

20070016981 Georgia Inst. of Tech., Atlanta, GA USA
Three Dimensional Immobilization of Beta-Galactosidase on a Silicon Surface (Preprint)
Luckarift, Heather R; Betancor, Lorena; Spain, Jim C; Dec 2006; 28 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F08637-03-C-6006; Proj-4915
Report No.(s): AD-A464924; No Copyright; Avail.: CASI: A03, Hardcopy

Many alternative strategies to immobilize and stabilize enzymes have been investigated in recent years for applications in biosensors. The entrapment of enzymes within silica-based nanospheres formed through silicification reactions provides high loading capacities for enzyme immobilization, resulting in high volumetric activity and enhanced mechanical stability. Here we report a strategy for chemically-associating silica nanospheres containing entrapped enzyme to a silicon support. Beta-Galactosidase was used as a model enzyme due to its versatility as a biosensor for lactose. The immobilization strategy resulted in a three-dimensional network of silica attached directly at the silicon surface, providing a significant increase in surface area and a corresponding 3.5-fold increase in enzyme loading compared to enzyme attached directly at the surface. The immobilized beta-galactosidase prepared by silica deposition was stable and retained more than 80% of its initial activity after 10 days at 24 degrees C. The ability to generate three-dimensional structures with enhanced loading capacity for biosensing molecules offers the potential to substantially amplify biosensor sensitivity.
DTIC
Detectors; Enzymes; Hydrolysis; Immobilization; Silicon

20070016990 Stanford Univ., Stanford, CA USA
Genomic and Expression Profiling of Benign & Malignant Nerve Sheath Tumors in Neurofibromatosis Patients
van de Rijn, Matt; Nielsen, Torsten; Rubin, Brian; May 2006; 55 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAMD17-03-1-0297
Report No.(s): AD-A464943; No Copyright; Avail.: CASI: A04, Hardcopy

The goal of the study is to identify genes and pathways that are associated with the progression of neurofibroma to MPNST, and to identify potential therapeutic targets for MPNSTs. In the past year, to the existing 80 gene array data, we added an additional 23 tumor samples making to a total of 103 gene arrays. The analyses included 38 cases diagnosed as MPNSTs and 24 cases of neurofibromas. Our initial hierarchical clustering showed high degree of variability of MPNST cases. A centralized review of histology was performed; of the 38 cases with the original diagnosis as MPNST, 14 cases were reclassified. In addition all MPNST and SS cases underwent RT-PCR for t(X;18). The misdiagnosed tumor cases were removed from the study, and a subsequent analysis and hierarchical clustering showed a much more interpretable result. The clustering of the nerve sheath tumors revealed a distinct expression signature for majority of benign and malignant tumor types. A subset of MPNSTs clustered along with SS. Using a large tissue microarray (TMA) with about 200 nerve sheath tumors we have identified a novel diagnostic marker TLE1 to distinguish SS from other sarcomas. The signaling pathways TGFB, JAK- STAT, MET were identified as being potentially involved in the malignant transformation. Array comparative genomic hybridization was performed on 28 tumor cases and copy number changes were assessed for each case.
DTIC
Cancer; Genetics; Genome; Nerves; Patients; Sheaths; Tumors

20070016991 California Univ., Irvine, CA USA
The Role of the Caspase-8 Inhibitor FLIP in Androgen-Withdrawal Induced Death of Prostate Epithelium
Krolewski, John; Nastiuk, Kent; Jan 1, 2006; 53 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-04-1-0149
Report No.(s): AD-A464945; No Copyright; Avail.: CASI: A04, Hardcopy

Secretory prostatic epithelial cells undergo apoptosis in response to androgen deprivation. Similarly, metastatic prostate cancers, which resemble secretory epithelium, also undergo apoptosis following androgen deprivation. Recent evidence suggests that death receptor signaling is required for prostate epithelial cell death following androgen withdrawal. We sought to extend this observation by investigating the role of death receptor signaling components in models of prostate epithelial cell death. Preliminary experiments suggest that FLIP can inhibit apoptosis of prostate epithelial cells. FLIP is an enzymatically inactive version of pro-caspase-8 which negatively regulates cell death, apparently via a dominant-negative mechanism. Based on our preliminary data, we hypothesize that FLIP is a key regulator of prostate apoptosis in response to androgen withdrawal. To address our hypothesis we propose a systematic approach involving, sequentially, correlative (aim 1), functional (aim 2) and mechanistic (aims 3 and 4) experiments. The specific aims are: 1) correlate the pattern of FLIP expression with prostate epithelial cell death; 2) assess the functional consequences of forced FLIP expression on prostate epithelial apoptosis; 3) determine which death receptor pathway is involved in prostate epithelial cell death and 4) determine if androgens regulate the level of FLIP expression at the level of gene transcription.
DTIC
Cancer; Death; Enzymes; Epithelium; Hormones; Inhibitors; Males; Prostate Gland

20070016997 North Carolina Univ., Chapel Hill, NC USA
The Role of Nuclear Receptor Coactivators in Recurrent Prostate Cancer
Wilson, Elizabeth M; Feb 2006; 83 pp.; In English
Contract(s)/Grant(s): DAMD17-02-1-0110
Report No.(s): AD-A464952; No Copyright; Avail.: Defense Technical Information Center (DTIC)
The purpose of our studies supported by this DOD award has been to characterize the signaling pathways and interacting proteins that contribute to increased androgen receptor (AR) mediated gene activation in recurrent prostate cancer. We have followed up our previous studies on the AR by focusing on the EGF and heregulin-induced signaling pathways. We have used traditional yeast two hybrid screening methods to identify two key regulatory proteins that interact with AR. In collaborative studies with Dr. James Mohler, the levels of several androgen metabolites were determined in prostate cancer tissue specimens. In collaboration with Robert Gampe at GlaxoSmithKline, we determined the structural basis for FXXLF and LXXLL motif binding to AR AF2 in the ligand binding domain. In collaboration with Dr. Shelly Earp, we determined the presence of HER2 and HER3 receptors in the CWR-R1 prostate cancer cell line derived from the CWR22 recurrent human xenograft propagated in nude mice. We established the functional basis for an AR mutation in prostate cancer that involves increased AR recruitment of the SRC/p160 coactivators. Previously we reported increased levels of SRC1 and TIF2 in prostate cancer specimens obtained after recurrent growth following androgen ablation therapy. As outlined below, our studies have led to several important conclusions regarding AR function in prostate cancer cells. Importantly, the work has set the stage for our continued experiments designed to understand AR functional activity in prostate cancer.
DTIC
Activation; Cancer; Hormones; Males; Prostate Gland

20070017049 General Accounting Office, Washington, DC USA
Anthrax Detection. DHS Cannot Ensure That Sampling Activities Will Be Validated
Mar 29, 2007; 19 pp.; In English
Report No.(s): AD-A465165; GAO-07-687T; No Copyright; Avail.: CASI: A03, Hardcopy
Federal agencies responsible for responding to the 2001 anthrax incidents adopted a targeted sampling strategy that they based on their best judgment at the time. They primarily collected samples from specific areas, such as mail-processing areas, using their judgment about where anthrax would most likely be found. Such judgments can be effective in some situations for example, in determining whether a facility is contaminated when information on the source of potential contamination is definitive. However, in the case of a negative finding, when the source of potential contamination is not definitive, the basic question Is this building contaminated? will remain unanswered. Therefore, in the case of a negative result, a different strategy, probability sampling, is needed. Probability sampling would have allowed agencies to determine whether the building was contaminated with some defined level of confidence. The federal agencies CDC, EPA, and USPS involved in sampling the postal facilities in 2001 to detect anthrax undertook several activities. These included development of a sampling strategy followed by collection of samples using a variety of methods, transporting and extracting, and analysis of the samples. Neither these activities nor the overall process was validated for anthrax testing. Consequently, the agencies were challenged by the limited information available for reliably choosing one method over another and the lack of information on the detection limit to use when evaluating negative results.
DTIC
Confidence Limits; Contamination; Infectious Diseases; Sampling

20070017052 Louisiana State Univ., New Orleans, LA USA
Neural Control of Hemorrhage-Induced Tissue Cytokine Production
Molina, Patrica E; Mar 31, 2007; 5 pp.; In English
Contract(s)/Grant(s): N00014-00-1-0326; Proj-06PR06877-00
Report No.(s): AD-A465168; 110350017A; No Copyright; Avail.: CASI: A01, Hardcopy

Studies performed under this grant provided evidence that tissue injury and hypoperfusion activate systemic and central neural, hormonal and opiate mechanisms that regulate the hemodynamic, metabolic and proinflammatory counter regulatory responses involved in restoring homeostasis following trauma/hemorrhage. Opiate pathway activation favors hemodynamic instability and a pro-inflammatory tissue response while sympathetic nervous system activation counteracts the inflammatory response and contributes to cardiovascular responsiveness. Our studies demonstrated that the intact neuroendocrine response is critical to ensure survival and host defense mechanisms from secondary infectious challenges. Furthermore, stress-and analgesia-induced disruptions in response exacerbate hemodynamic instability, compromise tissue perfusion and predispose to tissue injury and impaired innate host-defense response to a subsequent challenge.
DTIC
Blood Circulation; Endocrine Systems; Hemorrhages; Hormones; Neurology; Neurophysiology; Shock (Physiology)

20070017058 California Univ., Los Angeles, CA USA
Role of CREB in CML
Sakamoto, Kathleen M; Feb 2007; 52 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W81XWH-06-1-0243
Report No.(s): AD-A465180; No Copyright; Avail.: CASI: A04, Hardcopy

The purpose of this proposal is to understand the molecular pathways regulating Bcr-Abl positive CML cells. We demonstrated that the transcription factor, CREB, is highly expressed in K562 cells and cells from patients with chronic phase CML. This led us to hypothesize that CREB may play a critical role in regulating proliferation of CML cells. To determine whether CREB and CREB-dependent pathways may be bonafide targets for CML therapy, we chose to downregulate CREB using RNA interference. There are two specific aims. In Aim 1, we will test the hypothesis that downregulation of CREB inhibits proliferation and survival of CML cells. In Aim 2, will test the hypothesis that downregulation of CREB inhibits leukemia progression in vivo and in primary CML cells. We have generated CREB shRNA lentivirus and infected primary mouse and human bone marrow stem cells. We have also infected Ba/F3 cells expressing the T315I mutation of Bcr-Abl with and without CREB shRNA and followed leukemia progression in vivo. Our results suggest that CREB is necessary for both normal stem cell proliferation and differentiation, and leukemic progression.
DTIC
Blood Cells; Hematopoietic System; Neurophysiology; Ribonucleic Acids

20070017059 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Modeling In Situ Bioremediation of Perchlorate-Contaminated Groundwater
Secody, Roland E; Mar 2007; 126 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465182; AFIT/GEM/ENV/07-M13; No Copyright; Avail.: CASI: A07, Hardcopy

Perchlorate-contaminated groundwater is a significant problem for the Department of Defense and the USA Air Force. An innovative technology was recently developed which uses dual-screened treatment wells to mix an electron donor into perchlorate-contaminated groundwater in order to effect in situ bioremediation of the perchlorate by indigenous perchlorate reducing bacteria without the need to extract the contaminated water from the subsurface. In this study, a model that simulates operation of the technology is calibrated and validated using 761 days of observational data obtained from a field-scale technology evaluation project. A genetic algorithm was used with the first 113 days of data to derive a set of best-fit parameters to describe perchlorate reduction kinetics for the electron donor, citrate, utilized in the evaluation study. The calibrated parameter values were then used to predict technology performance from day 114 through day 761. Measurements of goodness-of-fit statistics indicate the model appears to qualitatively reproduce the salient characteristics of the observed data when utilizing the new best-fit parameter values. Therefore, it appears the model may be a useful tool for designing and operating this technology at other perchlorate-contaminated sites.
DTIC
Biodegradation; Contamination; Ground Water; Perchlorates; Waste Treatment

20070017251 NASA Johnson Space Center, Houston, TX, USA

Plant Productivity and Characterization of Zeoponic Substrates after Three Successive Crops of Radish (Raphanus sativus L.)

Gruener, J. E.; Ming, Douglas W.; Galindo, C., Jr.; Henderson, K. E.; Golden, D. C.; [2007]; 26 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

The National Aeronautics and Space Administration (NASA) has developed a zeolite-based synthetic substrate, termed zeoponics. The zeoponic substrate (consisting of NH4(-) and K-exchanged clinoptilolite, synthetic apatite, and dolomite) provides all of the plant-essential nutrients through mineral dissolution and ion exchange, with only the addition of water. Previous studies have shown high productivity of wheat in zeoponic substrates; however, no experiments have been conducted on other crops. The objective of this study was to determine the productivity and nutrient uptake of radish (Raphanus sativus L.) grown in zeoponic substrates with three successive crops in the same substrate. Radish was chosen because of its sensitivities to NH4(+). Average fresh weights of edible roots were similar for radish grown in zeoponic substrates watered with deionized H2O (10.97 g/plant) and in potting mix control substrate irrigated with nutrient solution (10.92 g/plant). Average fresh weight production of edible roots for radish grown in same zeoponic substrate increased in yield over time with the lowest yield in the first crop (7.10 g/plant) and highest in the third crop (13.90 g/plant). The Ca plant tissue levels in radishes (1.8-2.9 wt. %) grown in zeoponic substrates are lower than the suggested sufficient range of 3.0-4.5 wt. % Ca; however, the Ca level is highest (2.9 wt. %) in radishes grown in the third crop in the same zeoponic substrates. The higher radish yield in the third crop was attributed to a reduction in an NH4(-) induced Ca deficiency that has been previously described for wheat grown in zeoponic substrates. The P levels in plant tissues of radish grown in the zeoponic substrates ranged from 0.94-1.15 wt. %; which is slightly higher than the sufficient levels of 0.3-0.7 wt. %. With the exception of Ca and P, other macronutrient and micronutrient levels in radish grown in zeoponic substrates were well within the recommended sufficient ranges. After three successive crops of radish growth, the zeoponic substrates had 52% of the original NH4(-)N and 78% of the original K remaining on zeolite exchange sites. Zeoponic substrates are capable of long-term productivity of radishes for space.

Author

Zeolites; Plants (Botany); Dolomite (Mineral); Calcium Phosphates; Crop Growth

20070017263 Executive Office of the President, Washington, DC USA

Coordination of Programs on Domestic Animal Genomics: A Federal Framework

Sep 2003; 20 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465005; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The Interagency Working Group (IWG) on Domestic Animal Genomics was chartered in March 2002 to enhance communication and awareness of the importance of domesticated animals, both livestock and companion, as a critical part of the Federal genomics programs. The U.S. Department of Agriculture, National Institutes of Health, National Science Foundation, and U.S. Department of Energy all support programs in genomics, from genome research tools and large-scale genome sequencing to bioinformatics and functional genomics. Domesticated animals play a central role in the food supply as well as biomedical research. With the high quality genome sequences of human, microbes, and plants, as well as other model organisms already available, obtaining similar scientific research resources for both livestock and companion animals will contribute significantly to improvements in the food supply, human health, and the economy. The increased diversity of genomes will allow comparative studies to identify new genes, understand the evolutionary relationships among species, and generate data central to understanding disease susceptibility and food production. Healthier and more efficient livestock impact the safety, security, and abundance of foods. Increased knowledge of domesticated animals commonly used to study human biology and diseases will benefit human health and the development of new pharmaceutical products. With significant input from Federal agencies currently investing in genomics, members of the scientific community, and industry, the IWG outlined a mission and developed a five year framework for Federal support of domestic animal genomics. The framework will facilitate coordination of several agencies to maximize use of resources to produce the genome sequences of the most important domesticated animal species, support data management, bioinformatics, and functional genomics specific for livestock and companion animals.

DTIC

Agriculture; Animals; Biomedical Data; Coordination; Genome; Livestock; Medical Science

20070017267 Geological Survey, Reston, VA USA

Dichloroethene and Vinyl Chloride Degradation Potential in Wetland Sediments at Twin Lakes and Pen Branch, Savannah River National Laboratory, South Carolina

Bradley, Paul M; Jan 2007; 22 pp.; In English

Report No.(s): AD-A464808; USGS-OF-2007-1028; No Copyright; Avail.: CASI: A03, Hardcopy

A series of 14C-radiotracer-based microcosm experiments was conducted to assess the mechanisms and products of degradation of dichloroethene (DCE) and vinyl chloride (VC) in wetland sediments at the Department of Energy (DOE) Savannah River National Laboratory. This project investigated the potential for biotic and abiotic DCE and VC degradation in wetland sediments from the Twin Lakes area of the C-BRP investigative unit and from the portion of Pen Branch located directly down gradient from the CMP investigative unit. Substantial degradation of [1,2-14C] DCE and [1,2-14C] VC to 14CO2 was observed in all viable sediment microcosms prepared under oxic conditions. These results indicate that microbial mineralization processes, involving direct oxidation or cometabolic oxidation, are the primary mechanisms of DCE and VC biodegradation in Twin Lake and Pen Branch sediments under oxic conditions. Substantial degradation of [1,2-14C] DCE and [1,2-14C] VC was observed in all viable sediment microcosms incubated under anoxic conditions. Production of 14CO2 was observed in all sediment microcosms under anoxic conditions. In general, the accumulation of mineralization products (14CO2 and 14CH4) was comparable to the accumulation of those reduced daughter products (14C-VC, 14C-ethene or 14C-ethane) traditionally identified with chloroethene reductive dechlorination. These results indicate that microbial mineralization processes can be an important component of DCE and VC degradation in Twin Lake and Pen Branch sediments under anoxic conditions. These results demonstrate that an evaluation of the efficiency of in situ DCE and VC biodegradation in Twin Lakes and Pen Branch that is based solely on the observed accumulation of reduced daughter products may underestimate substantially the total extent of contaminant biodegradation and, thus, the contribution of biodegradation to overall contaminant attenuation.

DTIC

Biodegradation; Chlorides; Degradation; Lakes; Oxidation; Sediments; Wetlands

20070017278 Executive Office of the President, Washington, DC USA

Coordination of Programs on Domestic Animal Genomics: The Federal Framework

Jun 2004; 38 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465004; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The Interagency Working Group (IWG) on Domestic Animal Genomics was chartered in 2002 with the charge of enhancing interagency communication and awareness of the importance of agricultural and companion animal species, increasing leverage of investments across government agencies, and positioning of agriculture as a critical element of the Federal genomics programs. The Committee on Science provides oversight over the IWG activities. The membership of the IWG consists of representatives from the Department of Agriculture (USDA), Department of Energy (DOE), Food and Drug Administration (FDA), National Institutes of Health (NIH), National Science Foundation (NSF), Office of Science and Technology Policy (OSTP), Office of Management and Budget (OMB), and U.S. Agency for International Development (USAID).

DTIC

Agriculture; Animals; Coordination; Genetic Engineering; Genome

20070017281 Naval Submarine Medical Research Lab., Groton, CT USA

Surface and 60 FSW Performance Testing of the Modified MBS 2000 Closed Circuit Oxygen Rebreather

Fothergill, David; Mar 5, 2007; 59 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465121; NSMRL/50505/TR-2007-1253; No Copyright; Avail.: CASI: A04, Hardcopy

The primary objective of the current study was to use the lessons learned from the FY05 testing to improve the design and efficiency of the current MBS 2000 unit. Specific design modifications chosen for testing were aimed at improving purge efficiency and reducing the oxygen volume requirements needed to accommodate purges and any leaks of ambient air into the system during a treatment. Since all previous testing had been performed at 1 ATA, a second major objective for the FY06 tests was to evaluate the modified MBS 2000 rebreather at 60 fsw in a hyperbaric chamber. In particular, data on purge frequency and oxygen consumption at depth was sought to provide more accurate calculations of the total volume of oxygen needed to support an operation.

DTIC

Breathing Apparatus; Circuits; Oxygen; Performance Tests

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*.

20070016705 NASA Johnson Space Center, Houston, TX, USA

Visual Acuity Using Head-fixed Displays During Passive Self and Surround Motion

Wood, Scott J.; Black, F. Owen; Stallings, Valerie; Peters, Brian; May 2007; 1 pp.; In English; 78th Annual Scientific Meeting of the Aerospace Medical Association, May 2007, New Orleans, LA, USA

Contract(s)/Grant(s): NCC9-58; Copyright; Avail.: CASI: A01, Hardcopy

The ability to read head-fixed displays on various motion platforms requires the suppression of vestibulo-ocular reflexes. This study examined dynamic visual acuity while viewing a head-fixed display during different self and surround rotation conditions. Twelve healthy subjects were asked to report the orientation of Landolt C optotypes presented on a micro-display fixed to a rotating chair at 50 cm distance. Acuity thresholds were determined by the lowest size at which the subjects correctly identified 3 of 5 optotype orientations at peak velocity. Visual acuity was compared across four different conditions, each tested at 0.05 and 0.4 Hz (peak amplitude of 57 deg/s). The four conditions included: subject rotated in semi-darkness (i.e., limited to background illumination of the display), subject stationary while visual scene rotated, subject rotated around a stationary visual background, and both subject and visual scene rotated together. Visual acuity performance was greatest when the subject rotated around a stationary visual background; i.e., when both vestibular and visual inputs provided concordant information about the motion. Visual acuity performance was most reduced when the subject and visual scene rotated together; i.e., when the visual scene provided discordant information about the motion. Ranges of 4-5 logMAR step sizes across the conditions indicated the acuity task was sufficient to discriminate visual performance levels. The background visual scene can influence the ability to read head-fixed displays during passive motion disturbances. Dynamic visual acuity using head-fixed displays can provide an operationally relevant screening tool for visual performance during exposure to novel acceleration environments.

Author

Visual Acuity; Head-Up Displays; Vestibular Tests; Eye (Anatomy); Motion; Acceleration (Physics)

20070016706 NASA Johnson Space Center, Houston, TX, USA

Comparison of Two Alternative Methods for Tracking Toe Trajectory

Miller, Chris; Peters, Brian; Brady, Rachel; Mulavara, Ajitkumar; Warren, Liz; Feiveson, Al; Bloomberg, Jacob; Aug. 25, 2007; 2 pp.; In English; American Society of Biomechanics, 23-25 Aug. 2007, Palo Alto, CA, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

Toe trajectory during the swing phase of locomotion has been identified as a precise motor control task (Karst, et al., 1999). The standard method for tracking toe trajectory is to place a marker on the superior aspect of the distal end of the 2nd toe itself (Karst, et al., 1999; Winter, 1992). However, others have based their toe trajectory results either on a marker positioned on the lateral aspect of the 5th metatarsal head (Dingwell, et al., 1999; Osaki, et al., 2007), or on a virtual toe marker computed at the anterior tip of the second toe based on the positions of other real foot markers (Miller, et al., 2006). While these methods for tracking the toe may seem similar, their results may not be directly comparable. The purpose of this study was to compute toe trajectory parameters using a 5th metatarsal marker and a virtual toe marker, and compare their results with those of the standard toe marker.

Author

Feet (Anatomy); Locomotion; Trajectories; Aerospace Medicine

20070016949 Texas Univ., San Antonio, TX USA

Characterization of Maze Performance in Adrenalectomized Sleep Disrupted Rats: A Comparison of Radial Arm Maze Performance between Adrenalectomized and Sham Adrenalectomized Sleep Disrupted Rats

Mery, Laura; Jan 2007; 36 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA86500-05-6644; Proj-7757

Report No.(s): AD-A464869; No Copyright; Avail.: CASI: A03, Hardcopy

Sleep disruption affects performance in rats in several behavioral paradigms. Elevation of plasma corticosterine is associated with stress, and with sleep disruption in rats. Elevated corticosterone may contribute to dendritic regression in the hippocampus, a brain region associated with spatial learning. The working hypothesis of this study was removing adrenal

glands in a rat will ameliorate the effects of sleep disruption on maze performance. Animals adrenalectomized and sham adrenalectomized were trained to criterion in the eight arm radial maze, and sleep disrupted for 12 hours during the light phase using a modified flowerpot in a cage with an inch of water. Removal of adrenal glands improved post sleep disruption performance slightly, but not significantly. However, the Barnes maze results showed an improvement of performance with a glucocorticoid receptor antagonist given 4 hours before the conclusion of 12 hours of sleep disruption on the flowerpot the post sleep disruption performances were compared. In addition, animals were implanted with a venous jugular catheter and sampled over a 36 hour period which included 12 hours of recovery. The results showed a significant elevation of corticosterone during the period of sleep disruption with recovery to cage control levels within 4 hours after return to home cage. In conclusion the sum of the performance impairments associated with sleep disruption may be the result of elevated corticosterone.
DTIC
Hippocampus; Maze Learning; Rats; Sense Organs; Sleep; Sleep Deprivation

20070017247 NASA Johnson Space Center, Houston, TX, USA
NASA-STD 3001 and the Human Integration Design Handbook (HIDH): Evolution of NASA-STD-3000
Pickett, Lynn; Connolly, Janis; Arch, M.; Tillman, Barry; Russo, Dane; [2007]; 1 pp.; In English; Department of Defense Human Factors Engineering meeting, 14-17 May 2007, Portsmouth, VA, USA; Copyright; Avail.: Other Sources; Abstract Only

The Habitability & Environmental Factors and Space Medicine Divisions have developed the Space Flight Human System Standard (SFHSS) (NASA-STD-3001) to replace NASA-STD-3000 as a new NASA standard for all human spaceflight programs. The SFHSS is composed of 2 volumes. Volume 1, Crew Health, contains medical levels of care, permissible exposure limits, and fitness for duty criteria, and permissible outcome limits as a means of defining successful operating criteria for the human system. Volume 2, Habitability and Environmental Health, contains environmental, habitability and human factors standards. Development of the Human Integration Design Handbook (HIDH), a companion to the standard, is currently under construction and entails the update and revision of NASA-STD-3000 data. This new handbook will, in the fashion of NASA STD-3000, assist engineers and designers in appropriately applying habitability, environmental and human factors principles to spacecraft design. Organized in a chapter-module-element structure, the HIDH will provide the guidance for the development of requirements, design considerations, lessons learned, example solutions, background research, and assist in the identification of gaps and research needs in the disciplines. Subject matter experts have been and continue to be solicited to participate in the update of the chapters. The purpose is to build the HIDH with the best and latest data, and provide a broad representation from experts in industry, academia, the military and the space program. The handbook and the two standards volumes work together in a unique way to achieve the required level of human-system interface. All new NASA programs will be required to meet Volumes 1 and 2. Volume 2 presents human interface goals in broad, non-verifiable standards. Volume 2 also requires that each new development program prepare a set of program-specific human factors requirements. These program-specific human and environmental factors requirements must be verifiable and tailored to assure the new system meets the Volume 2 standards. Programs will use the HIDH to write their verifiable program-specific requirements.
Author
Human Factors Engineering; Handbooks; NASA Programs; Aerospace Medicine; Health; Habitability; Spacecrews

20070017376 NASA Johnson Space Center, Houston, TX, USA
Effects of Daily Centrifugation on Segmental Fluid Distribution in Bed-rested Subjects
Diedrich, Andre; Moore, S. T.; Stenger, M.; Arya, T. M.; Newby, N.; Tucker, J. M.; Milstead, L.; Acock, K.; Knapp, C.; Jevans, J.; Paloski, W.; Apr. 13, 2007; 1 pp.; In English; 28th Annual International Gravitational Physiology Meeting, 8-13 Apr. 2007, San Antonio, TX, USA; Original contains black and white illustrations; Copyright; Avail.: CASI: A01, Hardcopy

The effect of daily centrifugation on segmental fluid distribution have been studied during 21 days of 6 degree head down bedrest. One group (N=7) underwent no countermeasure while the other (N=8) received a daily, one hour, dose (2.5 gz at the foot, decreasing to 1.0 gz at the heart) of artificial gravity (AG) training on the Johnson Space Center short radius centrifuge. Fluid shifts of thoracic(VTO), abdominal (VAB), thigh (VTH), and calf (VCA) regions were measured by the tetrapolar segmental body impedance technique. Untrained subjects reduced their total volume from 18.9 plus or minus 0.5L to 17.9 plus or minus 0.9L (MN plus or minus SE, P less than 0.05) while trained subjects maintained their total volume. In untrained, control, subjects after bed rest, there was a trend toward reduced volume in all segments, with significant reductions in thigh

and calf (fig, P less than 0.05). Trained subjects maintained volume in all segments. Our data indicate that artificial gravity treatment counteracts bed rest-induced hypovolemia.
Author
Artificial Gravity; Bed Rest; Centrifuging; Fluid Shifts (Biology); Aerospace Medicine

20070017835 NASA Johnson Space Center, Houston, TX, USA
The Headache of Carbon Dioxide Exposures
James, John T.; 2007; 7 pp.; In English; International Conference on Environmental Systems, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color and black and white illustrations
Report No.(s): Paper-No. 07ICES-47; Copyright; Avail.: Other Sources

Carbon dioxide (CO2), a natural product of human metabolism, accumulates quickly in sealed environments when humans are present, and can induce headaches, among other symptoms. Major resources are expended to control CO2 levels to concentrations that are tolerable to the crews of spacecraft and submersible craft. It is not practical to control CO2 levels to those found in the ambient environment on earth. As NASA looks ahead to long-duration missions conducted far from earth, difficult issues arise related to the management and effects of human exposure to CO2. One is the problem of pockets of CO2 in the habitat caused by excess generation of the gas in one location without a mechanism to purge the area with fresh air. This results in the crew rebreathing CO2 from their exhaled breath, exposing them to a much higher concentration of CO2 than whole-module measurements would suggest. Another issue is the potential increased sensitivity to CO2 in microgravity. For example, based on anecdotal information, it appears that space crews may be more susceptible than submarine crews to some of the subtle, yet adverse effects of CO2 exposure. Another issue, not unique to spaceflight, is the possibility of inter-individual differences in the susceptibility of crewmembers to CO2 exposure. Again, anecdotal reports from the International Space Station (ISS) crews suggest that certain individuals may experience a greater susceptibility. The implications associated with these issues are extremely important as NASA sets CO2 exposure limits that protect the crew from this compound s subtle adverse effects, without causing an unwarranted expenditure of resources to scrub CO2 from the habitat atmosphere.
Author
Headache; Aerospace Medicine; Carbon Dioxide; Exposure; Manned Space Flight; Carbon Dioxide Concentration; NASA Space Programs

20070017985 NASA Johnson Space Center, Houston, TX, USA
Human Factors Assessment and Redesign of the ISS Respiratory Support Pack (RSP) Cue Card
Byrne, Vicky; Hudy, Cynthia; Whitmore, Mihriban; Smith, Danielle; [2007]; 5 pp.; In English; Copyright; Avail.: CASI: A01, Hardcopy

The Respiratory Support Pack (RSP) is a medical pack onboard the International Space Station (ISS) that contains much of the necessary equipment for providing aid to a conscious or unconscious crewmember in respiratory distress. Inside the RSP lid pocket is a 5.5 by 11 inch paper procedural cue card, which is used by a Crew Medical Officer (CMO) to set up the equipment and deliver oxygen to a crewmember. In training, crewmembers expressed concerns about the readability and usability of the cue card; consequently, updating the cue card was prioritized as an activity to be completed. The Usability Testing and Analysis Facility at the Johnson Space Center (JSC) evaluated the original layout of the cue card, and proposed several new cue card designs based on human factors principles. The approach taken for the assessment was an iterative process. First, in order to completely understand the issues with the RSP cue card, crewmember post training comments regarding the RSP cue card were taken into consideration. Over the course of the iterative process, the procedural information was reorganized into a linear flow after the removal of irrelevant (non-emergency) content. Pictures, color coding, and borders were added to highlight key components in the RSP to aid in quickly identifying those components. There were minimal changes to the actual text content. Three studies were conducted using non-medically trained JSC personnel (total of 34 participants). Non-medically trained personnel participated in order to approximate a scenario of limited CMO exposure to the RSP equipment and training (which can occur six months prior to the mission). In each study, participants were asked to perform two respiratory distress scenarios using one of the cue card designs to simulate resuscitation (using a mannequin along with the hardware). Procedure completion time, errors, and subjective ratings were recorded. The last iteration of the cue card featured a schematic of the RSP, colors, borders, and simplification of the flow of information. The time to complete the RSP procedure was reduced by approximately three minutes with the new design. In an emergency situation, three minutes significantly increases the probability of saving a life. In addition, participants showed the highest preference for this design. The results of the studies and the new design were presented to a focus group of astronauts, flight surgeons, medical trainers,

and procedures personnel. The final cue card was presented to a medical control board and approved for flight. The revised RSP cue card is currently onboard ISS.
Author
Human Factors Engineering; Respiratory System; International Space Station; Resuscitation; Medical Personnel; Cards; Oxygen

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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*.

20070016696 NASA Johnson Space Center, Houston, TX, USA
Waste Collector System Technology Comparisons for Constellation Applications
Broyan, James Lee, Jr.; [2006]; 12 pp.; In English; 37th ICES Conference, 9-12 Jul. 2006, Chicago, IL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): 644423.06.31.03.12.10
Report No.(s): 07ICES-273; Copyright; Avail.: CASI: A03, Hardcopy

The Waste Collection Systems (WCS) for space vehicles have utilized a variety of hardware for collecting human metabolic wastes. It has typically required multiple missions to resolve crew usability and hardware performance issues that are difficult to duplicate on the ground. New space vehicles should leverage off past WCS systems. Past WCS hardware designs are substantially different and unique for each vehicle. However, each WCS can be analyzed and compared as a subset of technologies which encompass fecal collection, urine collection, air systems, pretreatment systems. Technology components from the WCS of various vehicles can then be combined to reduce hardware mass and volume while maximizing use of previous technology and proven human-equipment interfaces. Analysis of past US and Russian WCS are compared and extrapolated to Constellation missions.
Author
Human Wastes; Technology Utilization; Accumulators; Constellations; Closed Ecological Systems

20070016701 NASA Johnson Space Center, Houston, TX, USA
Metabolic Heat Regenerated Temperature Swing Adsorption for CO2 and Heat Removal/Rejection in a Martian PLSS
Iacomini, Christine; Powers, Aaron; Bower, Chad; Straub-Lopez, Kathrine; Anderson, Grant; MacCallum, Taber; Paul, Heather L.; July 12, 2007; 10 pp.; In English; ICES, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNJ06HA98C; 731384.06.04.01.05.10
Report No.(s): 07ICES-243; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070016701

Two of the fundamental problems facing the development of a Portable Life Support System (PLSS) for use on Mars, are (i) heat rejection (because traditional technologies use sublimation of water, which wastes a scarce resource and contaminates the premises), and (ii) rejection of carbon dioxide (CO2) in an environment with a CO2 partial pressure (ppCO2) of 0.4-0.9 kPa. Patent-pending Metabolic heat regenerated Temperature Swing Adsorption (MTSA) technology is being developed to address both these challenges. The technology utilizes an adsorbent that when cooled with liquid CO2 to near sublimation temperatures (~195K) removes metabolically-produced CO2 in the ventilation loop. Once fully loaded, the adsorbent is then warmed externally by the ventilation loop (~300K), rejecting the captured CO2 to Mars ambient. Two beds are used to provide a continuous cycle of CO2 removal/rejection as well as facilitate heat exchange out of the ventilation loop. Any cryogenic fluid can be used in the application; however, since CO2 is readily available on Mars and can be easily produced and stored on the Martian surface, the solution is rather elegant and less complicated when employing liquid CO2. As some metabolic heat will need to be rejected anyway, finding a practical use for metabolic heat is also an overall benefit to the PLSS. To investigate the feasibility of the technology, a series of experiments were conducted which lead to the selection and partial characterization of an appropriate adsorbent. The Molsiv Adsorbents 13X 8x12 (also known as NaX zeolite) successfully removed CO2 from a simulated ventilation loop at the prescribed temperature swing anticipated during PLSS operating conditions on Mars using a cryogenic fluid. Thermal conductivity of the adsorbent was also measured to eventually aid in a demonstrator design of the technology. These results provide no show stoppers to the development of MTSA technology and allow its development to

focus on other design challenges as listed in the conclusions section of this paper.
Author
Adsorption; Carbon Dioxide Removal; Heat Transfer; Life Support Systems; Portable Life Support Systems; Mars Environment; Mars Surface; Thermal Conductivity

20070016702 NASA Johnson Space Center, Houston, TX, USA
Development of a Rapid Cycling CO2 and H2O Removal Sorbent
Alptekin, Gokhan; Cates, Matthew; Bernal, Casey; Dubovik, Margarita; Paul, Heather L.; July 12, 2007; 8 pp.; In English; ICES, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): NNJ06JA35C; 731384.06.04.01.05.10; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070016702

The National Aeronautics and Space Administration (NASA) planned future missions set stringent demands on the design of the Portable Life Support System (PLSS), requiring dramatic reductions in weight, decreased reliance on supplies and greater flexibility on the types of missions. Use of regenerable systems that reduce weight and volume of the Extravehicular Mobility Unit (EMU) is of critical importance to NASA, both for low orbit operations and for long duration manned missions. The carbon dioxide and humidity control unit in the existing PLSS design is relatively large, since it has to remove and store eight hours worth of carbon dioxide (CO2). If the sorbent regeneration can be carried out during the Extravehicular Activity (EVA) with a relatively high regeneration frequency, the size of the sorbent canister and weight can be significantly reduced. TDA Research, Inc. is developing compact, regenerable sorbent materials to control CO2 and humidity in the space suit ventilation loop. The sorbent can be regenerated using space vacuum during the EVA, eliminating all CO2 and humidity duration-limiting elements in the life support system. The material also has applications in other areas of space exploration including long duration exploration missions requiring regenerable technologies and possibly the Crew Exploration Vehicle (CEV) spacecraft. This paper summarizes the results of the sorbent development, testing, and evaluation efforts to date.
Author
Carbon Dioxide Removal; Sorbents; Portable Life Support Systems; Extravehicular Mobility Units; Weight Reduction; Extravehicular Activity; NASA Programs; Manned Space Flight

20070016723 General Dynamics Advanced Information Systems, Dayton, OH USA
A Structural Reasoning Space for Design of Complex, Socio-Technical Systems
Lintern, Gavan; Oct 2006; 140 pp.; In English
Contract(s)/Grant(s): FA8650-04-C-6538; Proj-7184
Report No.(s): AD-A464641; No Copyright; Avail.: CASI: A07, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464641

This research project was undertaken to develop a concept for representing the products of a Cognitive Work Analysis (CWA) in a comprehensive, integrated fashion that would better support the application of Cognitive Systems Engineering practice within the traditional Systems Engineering process. CWA takes a more structured approach to representation than is common within Cognitive Systems Engineering. It is a multi-phase analytic process that develops representations for functional structure, tasks, strategies, collaboration and individual cognitive performance. Currently, its representations are difficult to interpret and do not serve well as design artifacts. The specific issue addressed is representation of the work domain and the activity within it in a form such that all involved in a developmental project can understand the domain well enough to design solutions for the cognitive challenges faced by the human operators of the envisioned system. The concept of an information environment to support system design is introduced, and leads into a vision for an information structure--'reasoning space.' A reasoning space supports the natural information-seeking strategies used in human problem resolution by encouraging an opportunistic trajectory through a comprehensive and global information space. The reasoning space described here lays out information at different levels of abstraction and degrees of decomposition in a structure that reveals the significance of interdependencies between specific details while taking account of global constraints. It uses a pictorially rich format that facilitates an intuitive grasp of subtle and complex concepts. The purpose of this reasoning space is to help a design team identify forms of functional reorganization or work support that may assist workflow in a complex, sociotechnical system.
DTIC
Cognition; Complex Systems; Man Machine Systems; Structural Design; Systems Engineering

20070016771 Roth Cognitive Engineering, Brookline, MA USA

Work-Centered Design and Evaluation of a C2 Visualization Aid

Roth, Emilie; Scott, Ronald; Kazmierczak, Tom; Whitaker, Randall; Stilson, Mona; Thomas-Meyers, Gina; Wampler, Jeffrey; Oct 2006; 7 pp.; In English

Contract(s)/Grant(s): F33601-03-F-0064; Proj-2830

Report No.(s): AD-A464754; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464754

Command and Control (C2) operators increasingly need to assimilate large amounts of near-real time data distributed across multiple sources to identify, interpret, and mentally fuse the information necessary to accomplish their work. We have been developing and applying work-centered design and evaluation methodologies to design advanced visualization and support tools intended to more effectively support C2 cognitive and collaborative work. This paper reports the results of a work-centered visualization aid (a graphic mission timeline display) we developed to support mission replanning during execution in a C2 airlift service. The evaluation compared performance with work-centered visualization to performance using the existing information technology system. The work-centered visualization produced statistically significant improvement in task completion time, errors, workload and situation awareness. The results point to the value of taking a work-centered analysis and design approach.

DTIC

Command and Control; Display Devices; Human Factors Engineering

20070016837 Army Communications-Electronics Command, Fort Monmouth, NJ USA

The Requirements and Applications of Speech Recognition Technology for Voice Activated Command and Control in the Tactical Military Environment

Reed, Lockwood; Jun 2004; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465047; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465047

The US Army Communications/Electronics Research, Development and Engineering Center (CERDEC) at Fort Monmouth, NJ has been at the forefront of the research and development of speech recognition technologies for the tactical military environment for over twenty years. This includes the development of specialized techniques and technology to provide reliable performance in high noise environments. Additionally, unique to this technology is the ability to recognize whispered speech that is barely audible at one meter. The whispered speech recognition capability permits voice activation of C2 equipment during covert operations, such as urban house-to-house and room-to-room fighting, which requires the soldiers to maintain both hands weapons and an eyes-alert posture. This paper will presents a discussion of the unique and specialized requirements for a militarized speech recognizer, as well as the tactical advantages of militarized speech recognition technology as it could be applied in several C2 applications and environments. Additionally, this paper will present the results of a comparison study, which was performed between a custom military speech recognition technology and various manual input modalities, including keyboard and trackball, for activating a selected C2 application. The results of this paper demonstrate a clear superiority of continuous speech recognition over discrete speech recognition in both metrics, and a tradeoff of task execution speed for error rate for continuous speech recognition verses manual input.

DTIC

Command and Control; Hearing; Human Factors Engineering; Speech Recognition; Voice Control

20070016920 Applied Research Associates, Inc., Tyndall AFB, FL USA

Performance of Nomex Military Uniforms in Attacks by Flame Field Expedient Weapons - A Literature Study

Sellers, Ramon D; Carr, Jr , Virgil J; Mar 2007; 23 pp.; In English

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

Report No.(s): AD-A464828; No Copyright; Avail.: CASI: A03, Hardcopy

The purpose of this final report is to highlight on the development and design of flame resistant uniforms such as Nomex brand uniforms and whether they provide greater protection from burns than Desert Camouflage Uniforms (DCUs). Assessments on the Nomex uniforms and DCUs have been made based on the research evaluations and tests conducted by government and industry. Various types of fabrics have also been evaluated to determine which provide insulating qualities that were most appropriate for thermal protection.

DTIC

Fabrics; Fires; Flames; Protective Clothing; Thermal Protection

20070017850 NASA Johnson Space Center, Houston, TX, USA

Concurrent CO2 Control and O2 Generation for Advanced Life Support

Paul, Heather L.; Duncan, Keith L.; Hagelin-Weaver, Helena E.; Bishop, Sean R.; Wachsman, Eric D.; January 2007; 14 pp.; In English; ICES, Chicago, IL, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 731384.06.04.01.05.10; Copyright; Avail.: CASI: A03, Hardcopy

The electrochemical reduction of carbon dioxide (CO2) using ceramic oxygen generators (COGs) is well known and widely studied, however, conventional devices using yttria-stabilized zirconia (YSZ) electrolytes operate at temperatures greater than 700 C. Operating at such high temperatures increases system mass compared to lower temperature systems because of increased energy overhead to get the COG up to operating temperature and the need for heavier insulation and/or heat exchangers to reduce the COG oxygen (O2) output temperature for comfortable inhalation. Recently, the University of Florida developed novel ceramic oxygen generators employing a bilayer electrolyte of gadolinia-doped ceria and erbia-stabilized bismuth for NASA's future exploration of Mars. To reduce landed mass and operation expenditures during the mission, in-situ resource utilization was proposed using these COGs to obtain both lifesupporting oxygen and oxidant/propellant fuel, by converting CO2 from the Mars atmosphere. The results showed that oxygen could be reliably produced from CO2 at temperatures as low as 400 C. These results indicate that this technology could be adapted to CO2 removal from a spacesuit and other applications in which CO2 removal was an issue. The strategy proposed for CO2 removal for advanced life support systems employs a catalytic layer combined with a COG so that it is reduced all the way to solid carbon and oxygen. Hence, a three-phased approach was used for the development of a viable low weight COG for CO2 removal. First, to reduce the COG operating temperature a high oxide ion conductivity electrolyte was developed. Second, to promote full CO2 reduction while avoiding the problem of carbon deposition on the COG cathode, novel cathodes and a removable catalytic carbon deposition layer were designed. Third, to improve efficiency, a pre-stage for CO2 absorption was used to concentrate CO2 from the exhalate before sending it to the COG. These subsystems were then integrated into a single CO2 removal system. This paper describes our progress to date on these tasks.

Author

Carbon Dioxide Removal; Oxides; Life Support Systems; Cerium Compounds; Yttria-Stabilized Zirconia; Low Weight; High Temperature; Ceramics; Heat Exchangers

20070017879 NASA Johnson Space Center, Houston, TX, USA

Development of a Test Facility for Air Revitalization Technology Evaluation

Lu, Sao-Dung; Lin, Amy; Campbell, Melissa; Smith, Frederick; Curley, Su; 2007; 8 pp.; In English; International Conference on Environmental Systems, 9-13 Jul. 2007, Chicago, IL, USA

Contract(s)/Grant(s): NNJ05HI05C

Report No.(s): 07ICES-295; Copyright; Avail.: CASI: A02, Hardcopy

Development of new air revitalization system (ARS) technology can initially be performed in a subscale laboratory environment, but in order to advance the maturity level, the technology must be tested in an end-to-end integrated environment. The Air Revitalization Technology Evaluation Facility (ARTEF) at the NASA Johnson Space Center serves as a ground test bed for evaluating emerging ARS technologies in an environment representative of spacecraft atmospheres. At the center of the ARTEF is a hypobaric chamber which serves as a sealed atmospheric chamber for closed loop testing. A Human Metabolic Simulator (HMS) was custom-built to simulate the consumption of oxygen, and production of carbon dioxide, moisture and heat of up to eight persons. A multitude of gas analyzers and dew point sensors are used to monitor the chamber atmosphere upstream and downstream of a test article. A robust vacuum system is needed to simulate the vacuum of space. A reliable data acquisition and control system is required to connect all the subsystems together. This paper presents the capabilities of the integrated test facility and some of the issues encountered during the integration.

Author

Air Purification; Technology Utilization; Test Facilities; Life Support Systems

20070017986 NASA Johnson Space Center, Houston, TX, USA

Integrating Human Factors into Crew Exploration Vehicle (CEV) Design

Whitmore, Mihriban; Holden, Kritina; Baggerman, Susan; Campbell, Paul; May 23, 2007; 15 pp.; In English; 16th IAA Humans in Space Symposium, 20-24 May 2007, Beijing, China; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

The purpose of this design process is to apply Human Engineering (HE) requirements and guidelines to hardware/software and to provide HE design, analysis and evaluation of crew interfaces. The topics include: 1) Background/Purpose; 2) HE Activities; 3) CASE STUDY: Net Habitable Volume (NHV) Study; 4) CASE STUDY: Human Modeling Approach; 5)

CASE STUDY: Human Modeling Results; 6) CASE STUDY: Human Modeling Conclusions; 7) CASE STUDY: Human-in-the-Loop Evaluation Approach; 8) CASE STUDY: Unsuited Evaluation Results; 9) CASE STUDY: Suited Evaluation Results; 10) CASE STUDY: Human-in-the-Loop Evaluation Conclusions; 11) Near-Term Plan; and 12) In Conclusion
CASI
Human Factors Engineering; Crew Exploration Vehicle; Systems Integration; Computer Programs

20070017991 NASA Johnson Space Center, Houston, TX, USA
Designing for Our Future in Space
Connolly, Janis; April 28, 2007; 17 pp.; In English; NASA Rhode Island Space Grant Consortium Spring Symposium: NASA in Rhode Island, 28 Apr. 2007, Providence, RI, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017991

Over the past several years, the disciplines of architecture and human factors have been increasingly recognized as specialties that have focused upon 'human-centered design' in the development of spacecraft and surface habitats. These specialties have been instrumental in the conceptual design of overall spacecraft configurations and layouts, as well as habitability outfitting hardware, such as the galley, hygiene facility, sleep quarters, or the layout of displays and controls. From the human-centered perspective, this approach to design assists in the mitigation of risk when designing for an extreme environment such as space. It takes into account the human s physical and cognitive capabilities and limitations, the human s performance in the context of human space flight, the human s interaction with machines that are both physically and cognitively complex, the activities required of the human to accomplish the goals of missions, and the use of design practices that promote products to enable human activity. It is this latter aspect - the use of design practices that promote products to enable human activity - that is the focus of the approach used by the Rhode Island School of Design (RISD) in collaboration with the Habitability and Human Factors Branch (HHFB) at the NASA Johnson Space Center (JSC). During the past few years, there has been a growing recognition of the value added by utilizing industrial designers to further the conceptual development of space hardware, that when used in conjunction with architecture and human factors, provides a robust solution to the design challenge. The 'Design for Extreme Environments' Studio at RISD has taken suggested design topics from the NASA JSC HHFB and asked the students to investigate solutions to these challenges. The topics have demanded that the student pay particular attention to a variety of aspects of the space environment and understand how the human responds to each. The student must then adapt the design to these responses. The studio environment has been one way to introduce these challenges, but providing for an 'in-residence' opportunity at JSC has given the students a broader vision and set of experiences. The accompanying presentation highlights the studio as well as in-residence work that has been accomplished. Author
Aerospace Environments; Habitability; Human Factors Engineering; Spacecraft Configurations; Manned Space Flight; Space Habitats; Habitats; Environmental Engineering; Long Duration Space Flight; Space Exploration

59
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see *categories 60 through 67*.

20070017872 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Quaternion Averaging
Markley, F. Landis; Cheng, Yang; Crassidis, John L.; Oshman, Yaakov; [2007]; 10 pp.; In English; Copyright; Avail.: CASI: A02, Hardcopy

Many applications require an algorithm that averages quaternions in an optimal manner. For example, when combining the quaternion outputs of multiple star trackers having this output capability, it is desirable to properly average the quaternions without recomputing the attitude from the the raw star tracker data. Other applications requiring some sort of optimal quaternion averaging include particle filtering and multiple-model adaptive estimation, where weighted quaternions are used to determine the quaternion estimate. For spacecraft attitude estimation applications, derives an optimal averaging scheme to compute the average of a set of weighted attitude matrices using the singular value decomposition method. Focusing on a 4-dimensional quaternion Gaussian distribution on the unit hypersphere, provides an approach to computing the average quaternion by minimizing a quaternion cost function that is equivalent to the attitude matrix cost function Motivated by and

extending its results, this Note derives an algorithm that deterniines an optimal average quaternion from a set of scalar- or matrix-weighted quaternions. Rirthermore, a sufficient condition for the uniqueness of the average quaternion, and the equivalence of the mininiization problem, stated herein, to maximum likelihood estimation, are shown.
Derived from text
Attitude (Inclination); Maximum Likelihood Estimates; Quaternions; Average; Algorithms

20070017948 NASA Goddard Space Flight Center, Greenbelt, MD, USA
On Representative Spaceflight Instrument and Associated Instrument Sensor Web Framework
Kizhner, Semion; Patel, Umeshkumar; Vootukuru, Meg; [2007]; 10 pp.; In English; IEEE 2007 Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains color illustrations; Copyright; Avail.: CASI: A02, Hardcopy

Sensor Web-based adaptation and sharing of space flight mission resources, including those of the Space-Ground and Control-User communication segment, could greatly benefit from utilization of heritage Internet Protocols and devices applied for Spaceflight (SpaceIP). This had been successfully demonstrated by a few recent spaceflight experiments. However, while terrestrial applications of Internet protocols are well developed and understood (mostly due to billions of dollars in investments by the military and industry), the spaceflight application of Internet protocols is still in its infancy. Progress in the developments of SpaceIP-enabled instrument components will largely determine the SpaceIP utilization of those investments and acceptance in years to come. Likewise SpaceIP, the development of commercial real-time and instrument colocated computational resources, data compression and storage, can be enabled on-board a spacecraft and, in turn, support a powerful application to Sensor Web-based design of a spaceflight instrument. Sensor Web-enabled reconfiguration and adaptation of structures for hardware resources and information systems will commence application of Field Programmable Arrays (FPGA) and other aerospace programmable logic devices for what this technology was intended. These are a few obvious potential benefits of Sensor Web technologies for spaceflight applications. However, they are still waiting to be explored. This is because there is a need for a new approach to spaceflight instrumentation in order to make these mature sensor web technologies applicable for spaceflight. In this paper we present an approach in developing related and enabling spaceflight instrument-level technologies based on the new concept of a representative spaceflight Instrument Sensor Web (ISW).
Author
Protocol (Computers); Internets; Field-Programmable Gate Arrays; Spaceborne Experiments; Information Systems; Ground Based Control

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*.

20070016810 Naval Research Lab., Washington, DC USA
Improving Inter-Enclave Information Flow for a Secure Strike Planning Application
Froscher, Judith N; Goldschlag, Daivd M; Kang, Myong H; Landwehr, Carl E; Moore, Andrew P; Moskowitz, Ira S; Payne, Charles N; Jan 1995; 11 pp.; In English
Report No.(s): AD-A464976; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464976

DoD operates many system high enclaves with limited information flow between enclaves at different security levels. Too often, the result is duplication of operations and inconsistent and untimely data at different sites, which reduces the effectiveness of DoD decision support systems. This paper describes our solution to this problem as it arises in installations of the Joint Maritime Command Information System (JMCIS), an integrated C4I system. Our approach views databases in more classified enclaves as potential replica sites for data from less classified enclaves. Replicated data flows from lower enclaves to higher ones via one-way connections, yielding a high assurance MLS (multi-level secure) distributed system. The one-way connections are the only trusted components. This approach is based on our work on SINTRA (Secure Information Through Replicated Architecture), and applies generally to any collection of systems each running a database at system high. It complements and exploits modern system design methods, which separate data management from data processing, and enables effective, low-cost MLS operation within that paradigm. In addition to describing current JMCIS installations and our

architectural approach, the paper presents our approach for justifying a system's security and our use of formal methods to increase assurance that security requirements are met.
DTIC
Command and Control; Decision Support Systems; Information Flow; Relational Data Bases; Security

20070016835 Naval Research Lab., Washington, DC USA
Towards a Strand Semantics for Authentication Logic
Syverson, Paul; Jan 1999; 16 pp.; In English
Report No.(s): AD-A465045; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465045

The logic BAN was developed in the late eighties to reason about authenticated key establishment protocols. It uncovered many flaws and properties of protocols, thus generating lots of attention in protocol analysis. BAN itself was also subject of much attention, and work was done examining its properties and limitations, developing extensions and alternatives, and giving it a semantics. More recently, the strand space approach was developed. This approach gave a graph theoretic characterization of the causally possible interactions between local histories (strands) along with a term algebra to express sent and received messages. This model was designed and has been used by its authors for direct application to authentication protocol analysis. However, it has also quickly attracted the attention of many other researchers in the field as useful in connection to related work, such as model checking approaches. Here we discuss the idea of using strand spaces as the model of computation underlying a semantics for BAN-style expressions. This will help to integrate some of the approaches to security protocol analysis and to hopefully provide BAN logics with a clearer, more useful underlying model than they have had to date.
DTIC
Computer Information Security; Computers; Logic Design; Protocol (Computers); Semantics; Strands

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.

20070016737 Naval Research Lab., Washington, DC USA
Variable Data Rate Voice Encoder to Narrowband and Wideband Speech
Moran, Thomas M; Heide, David A; Lee, Yvette T; Kang, George S; Mar 2, 2007; 30 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464664; NRL/FR/5555--07-10145; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464664

Past designs for many military communications systems were based upon specific radio links with fixed and limited channel capacities. Accordingly, many different voice compression algorithms, operating at various fixed rates, were implemented. While still being used today, these incompatible systems are an obstacle to interoperable communications. Emerging net-centric communications promise to provide connectivity to all military users but voice interoperability will still require compatible voice encoding as well as encryption for secure communications. This report details a Variable Data Rate (VDR) voice encoder that is designed to provide interoperable secure voice communications for net-centric users. While being backwards compatible with the Federal standard voice encoder (MELP) at 2400 bits per second (bps), it operates at a range of data rates up to 26,000 bps. Because the rate setting can be changed dynamically, the VDR encoder can provide efficient use of network bandwidth yet be interoperable at any and all rates simultaneously, and, with the proper encryption, even when secure.
DTIC
Broadband; Coders; Coding; Cryptography; Interoperability; Narrowband; Rates (Per Time); Voice Communication

20070016741 Computational Tools, Inc., Gurnee, IL USA
Case Study for New Feature Extraction Algorithms, Automated Data Classification, and Model-Assisted Probability of Detection Evaluation (Preprint)
Aldrin, J C; Knopp, J S; Sep 2006; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-03-D-5204; Proj-4349
Report No.(s): AD-A464672; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464672

This paper explores feature extraction algorithms for crack characterization in eddy current inspection of fastener sites. A novel feature extraction method fitting approximate models to data associated with geometric part features addressing adjacent fastener sites and panel edges are developed. Data classification methods in the circumferential direction around fastener sites are developed to better characterize fatigue cracks with improved noise invariance. Model-assisted probability of detection results are presented highlighting the benefit of automation in NDE.
DTIC
Algorithms; Classifications; Coders; Detection; Eddy Currents; Pattern Recognition; Pods (External Stores); Probability Theory; Signal Processing

20070016762 General Dynamics Advanced Information Systems, Dayton, OH USA
Vertical-Sensing Effectiveness and CONOPS Tool for Operational Requirements (VECTOR)
Catantzarite, James; Green, Gary; Jacobs, Denice; Sep 2006; 8 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8650-04-D-1600-0003; Proj-5034
Report No.(s): AD-A464715; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464715

The ability to attain information superiority over an enemy and to quickly exploit it will be the core of the continued success of U.S. forces. Speed of command and decision-making will not only 'affect' the outcome of future battles but 'drive' the outcome of future battles. The Military Transformation Vision for the Department of Defense allows for an increased competitive advantage by creating future concepts of operation that will aid in the speed and effectiveness of defeating future enemy threats. At the core of the transformation vision is the Network Centric Warfare (NCW) concept of high quality shared awareness. NCW will better facilitate both the allocation and application of forces.
DTIC
Decision Making; Detection; Software Development Tools; System Effectiveness

20070016791 Intelligent Automation Systems, Inc., Rockville, MD USA
Sensor Validation Using Nonlinear Minor Component Analysis (Preprint)
Xu, Roger; Zhang, Guangfan; Zhang, Xiadong; Haynes, Leonard; Kwan, Chiman; Semega, Kenneth; May 2006; 12 pp.; In English
Contract(s)/Grant(s): FA8650-05-M-2582; Proj-3005
Report No.(s): AD-A464788; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464788

In this paper, we present a unified framework for sensor validation, which is an extremely important module in the engine health management system. Our approach consists of several key ideas. First, we applied nonlinear minor component analysis (NLMCA) to capture the analytical redundancy between sensors. The obtained NLMCA model is data driven, does not require faulty data, and only utilizes sensor measurements during normal operations. Second, practical fault detection and isolation indices based on Squared Weighted Residuals (SWR) are employed to detect and classify the sensor failures. The SWR yields more accurate and robust detection and isolation results as compared to the conventional Squared Prediction Error (SPE). Third, an accurate fault size estimation method based on reverse scanning of the residuals is proposed. Extensive simulations based on a nonlinear prototype non-augmented turbofan engine model have been performed to validate the excellent performance of our approach.
DTIC
Fault Detection; Models; Nonlinearity; Turbofan Engines

20070016807 Naval Research Lab., Washington, DC USA
Reliable Multicast Transport and Integrated Erasure-Based Forward Error Correction
Macker, Joseph P; Jan 1997; 6 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464965; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464965

Multicast networking is an important emerging technology area for both commercial and military group-based data dissemination. In addition, a number of emerging applications can benefit from a reliable multicast transport service. A variety of approaches have been developed regarding the general application of Automatic Repeat Request (ARQ) techniques over Internet Protocol (IP) multicasting to achieve reliable delivery. In this paper, we investigate the application of erasure-based processing and parity-based recovery to a reliable multicast protocol framework. The integrated design approach described is

shown to have improved efficiency and scalability features over reliable multicasting techniques based solely on ARQ. These bandwidth utilization improvements are expected to be substantial when applied across future multipoint communication infrastructures, especially over bandwidth-constrained and/or asymmetric networks.
DTIC
Error Analysis; Error Correcting Codes; Protocol (Computers)

20070016825 Naval Research Lab., Washington, DC USA
Using the SCR* Toolset to Specify Software Requirements
Heitmeyer, Constance; Oct 19, 1998; 4 pp.; In English
Report No.(s): AD-A465026; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465026

Formulated in the late 1970s to specify the requirements of the Operational Flight Program (OFP) of the A-7 aircraft [8], the SCR (Software Cost Reduction) requirements method is a method based on tables for specifying the requirements of software systems. During the 1980s and the early 1990s, many companies, including Bell Laboratories, Grumman, Ontario Hydro, and Lockheed, applied the SCR requirements method to practical systems. Each of these applications of SCR had, at most, weak tool support. To provide powerful, robust tool support customized for the SCR method, we have developed the SCR* toolset. To provide formal underpinnings for the method, we have also developed a formal model which defines the semantics of SCR requirements specifications.
DTIC
Computer Programming; Kits; Requirements; Software Development Tools; Software Engineering

20070016832 Naval Research Lab., Washington, DC USA
Randomly Roving Agents for Intrusion Detection
Moskowitz, Ira S; Kang, Myong H; Chang, LiWu; Longdon, Garth E; Mar 2001; 17 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465041; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465041

Agent based intrusion detection systems (IDS) have advantages such as scalability, reconfigurability, and survivability. In this paper, we introduce a mobile-agent based IDS, called ABIDE (Agent Based Intrusion Detection Environment). ABIDE is comprised of various types of agents, all of which are mobile, lightweight, and specialized. The most common form of agent is the DMA (Data Mining Agent), which randomly moves around the network and collects information. The DMA then relays the information it has gathered to a DFA (Data Fusion Agent) which assesses the likelihood of intrusion. As we show in this paper, there is a quantifiable relationship between the number of DMA and the probability of detecting an intrusion. We study this relationship and its implications.
DTIC
Detection; Probability Theory; Warning Systems

20070016838 Naval Research Lab., Washington, DC USA
The Specification and Verified Decomposition of System Requirements Using CSP
Moore, Andrew P; Sep 1990; 30 pp.; In English
Report No.(s): AD-A465049; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465049

An important principle of building trustworthy systems is to rigorously analyze the critical requirements early in the development process, even before starting system design. Existing proof methods for systems of communicating processes focus on the bottom-up composition of component-level specifications into system-level specifications. Trustworthy system development requires, instead, the top-down derivation of component requirements from the critical system requirements. This paper describes a formal method for decomposing the requirements of a system into requirements of its component processes and a minimal, possibly empty, set of synchronization requirements. The Trace Model of Hoare's Communicating Sequential Processes (CSP) is the basis for the formal method. We apply the method to an abstract voice transmitter and describe the role that the EHDM verification system plays in the transmitter's decomposition. In combination with other verification techniques, we expect that the method defined here will promote the development of more trustworthy systems.
DTIC
Decomposition; Program Verification (Computers); Specifications

20070016860 Icosystem Corp., Cambridge, MA USA

Agent-Based Modeling as a Tool for Manpower and Personnel Management

Trifonov, Iavor; Bandte, Oliver; Bonabeau, Eric; Gaudiano, Paolo; Jun 2005; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-04-M-0167

Report No.(s): AD-A465091; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465091

We have developed an agent-based model of the US Navy's Manpower and Personnel (M&P) systems, and used the model as a tool to analyze and design M&P policies. The model captures the dynamics of sailor recruitment, training and retention, as well as their performance during missions. Our model makes it possible to gain a deep understanding of the dynamics of the entire M&P systems. We expect our tool to offer several benefits to the Navy, including the ability to design new policies for existing ships or new ships; the ability to understand the impact of shipboard technologies to increase automation; and the ability to study the impact of various interventions on sailor retention. The model also promises to be useful for personnel management in the commercial sector.

DTIC

Manpower; Models; Navy; Personnel; Personnel Management

20070016871 Naval Research Lab., Washington, DC USA

Hardware/Software Co-Design and Co-Validation Using the SCR Method

Bharadwaj, Ramesh; Heitmeyer, Constance; Nov 1999; 7 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465157; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465157

To date, the SCR (Software Cost Reduction) method has been used to specify system requirements. This paper extends the SCR method to hardware/software co-design and co-validation. Our approach consists of three steps. First, the SCR method is used to specify the required system behavior, i.e., the required relation between environmental quantities (called monitored quantities) that the system monitors and environmental quantities (called controlled quantities) that the system controls. Next, the system designers specify the I/O devices required to compute estimates of the monitored quantities and to set values of the controlled quantities. Finally, the required software behavior is specified as three modules: a device-independent module, specifying how the (estimated) monitored quantities are to be used to compute estimates of the controlled quantities, and two device-dependent modules: an input device interface module, specifying how data from the input devices are to be used to compute estimates of the monitored quantities, and an output device interface module, specifying how the values of controlled variables are written to output devices. To illustrate the approach, we use SCR to specify a simple light control system.

DTIC

Computer Programs; Computers; Cost Reduction; Software Development Tools

20070016872 Naval Research Lab., Washington, DC USA

Applying Formal Methods to an Information Security Device: An Experience Report

Kirby, Jr, James; Archer, Myla; Heitmeyer, Constance; Nov 1999; 9 pp.; In English

Report No.(s): AD-A465158; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465158

SCR (Software Cost Reduction) is a formal method for specifying and analyzing system requirements that has previously been applied to control systems. This paper describes a case study in which the SCR method was used to specify and analyze a different class of system, a cryptographic system called CD, which must satisfy a large set of security properties. The paper describes how a suite of tools supporting SCR a consistency checker, simulator, model checker, invariant generator, theorem prover, and validity checker were used to detect errors in the SCR specification of CD and to verify that the specification satisfies seven security properties. The paper also describes issues of concern to software developers about formal methods e.g., ease of use, cost-effectiveness, scalability, how to translate a prose specification into a formal notation, and what process to follow in applying a formal methodland discusses these issues based on our experience with CD. Also described are some unexpected results of our case study.

DTIC

Computer Programming; Computer Programs; Cost Reduction; Cryptography; Security; Software Engineering

20070016873 Naval Research Lab., Washington, DC USA

Software Cost Reduction

Heitmeyer, Constance L; Jan 2002; 15 pp.; In English

Report No.(s): AD-A465161; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465161

Software Cost Reduction (SCR) is a set of techniques for designing software systems developed by David Parnas and researchers from the U.S. Naval Research Laboratory (NRL) beginning in the late 1970s. A major goal of the original SCR research team was to evaluate the utility and scalability of software engineering principles by applying the principles to the reconstruction of software for a practical system, the Operational Flight Program (OFP) for the U.S. Navy's A-7 aircraft. The process of applying the principles produced a number of new techniques for software design, which were demonstrated in a requirements document [18] and several software design documents (e.g., a module guide [6]) for the A-7. Further research during the 1990s produced two formal models, the Four Variable Model [37] and the SCR requirements model [15], and a set of software tools for analyzing SCR-style requirements documents [16].

DTIC

Computer Programs; Cost Reduction

20070016874 Auburn Univ., AL USA

An Experimental Investigation of Improving Human Problem-Solving Performance by Guiding Attention and Adaptively Proving Details on Information Displays

Narayanan, N H; Apr 4, 2007; 12 pp.; In English

Contract(s)/Grant(s): N00014-03-1-0324

Report No.(s): AD-A465162; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465162

This report presents a summary of the research activities, major accomplishments, publications and presentations resulting from the project supported by ONR grant NOOOl4O31O324 to Auburn University. Key contribution of this project was the development and experimental testing of a variety of information displays, called 'reactive information displays,' that could modify the presented information in real-time in response to the viewer's gaze patterns. Designs of these displays were based on a cognitive model of multimodal information comprehension developed in a previous ONR project (N000149611187). Reactive information displays were tested in the domains of mechanics and computer science. Results showed that various display strategies for augmenting information presented based on knowledge about both the viewer's gaze patterns and the problem solving procedure he or she is employing could indeed improve problem-solving performance.

DTIC

Cognition; Computer Programming; Display Devices; Eye (Anatomy); Human-Computer Interface; Information Systems; Mental Performance; Models; Problem Solving; Software Engineering

20070016929 Naval Research Lab., Washington, DC USA

Applying Practical Formal Methods to the Specifications and Analysis of Security Properties

Heitmeyer, Constance; Jan 2001; 7 pp.; In English

Report No.(s): AD-A464842; No Copyright; Avail.: CASI: A02, Hardcopy

The SCR (Software Cost Reduction) toolset contains tools for specifying, debugging, and verifying system and software requirements. The utility of the SCR tools in detecting specification errors, many involving safety properties, has been demonstrated recently in projects involving practical systems, such as the International Space Station, a flight guidance system, and a U.S. weapons system. This paper briefly describes our experience in applying the tools in the development of two secure systems: a communications device and a biometrics standard for user authentication.

DTIC

Computer Programs; Security; Software Development Tools

20070016953 Naval Research Lab., Washington, DC USA

Applying a Formal Requirements Method to Three NASA Systems: Lessons Learned

Heitmeyer, Constance L; Jeffords, Ralph D; Jan 2007; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464876; No Copyright; Avail.: CASI: A03, Hardcopy

Recently, a formal requirements method called SCR (Software Cost Reduction) was used to specify software requirements of mission-critical components of three NASA systems. The components included a fault protection engine, which determines

how a spacecraft should respond to a detected fault; a fault detection, isolation and recovery component, which, in response to an undesirable event, outputs a failure notification and raises one or more alarms; and a display system, which allows a space crew to monitor and control on-orbit scientific experiments. This paper demonstrates how significant and complex requirements of one of the components can be translated into an SCR specification and describes the errors detected when the authors formulated the requirements in SCR. It also discusses lessons learned in using formal methods to document the software requirements of the three components. Based on the authors experiences, the paper presents several recommendations for improving the quality of requirements specifications of safety-critical aerospace software.
DTIC
Computer Programming; Requirements; Software Engineering

20070017007 Naval Research Lab., Washington, DC USA
The Multicast Dissemination Protocol (MDP) Toolkit
Macker, Joseph P; Adamson, R B; Jan 1999; 6 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464981; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A02, Hardcopy

The Multicast Dissemination Protocol (MDP) provides reliable multicast file and data delivery on top of the generic UDP/IP multicast transport. Early work on MDP was deployed across the global Internet Multicast Backbone (Mbone) as part of the publicly available Image Multicaster (IMM) application. This paper describes more recent work on MDP resulting in the MDP version 2 (MDPv2) toolkit. This recent effort has significantly modified and generalized the MDP protocol and the associated software interface. Enhancements made to the protocol are suitable for a wide range of network environments. Additionally, integrated erasure-based repairing improves reliable multicast efficiency and robustness. We briefly discuss the protocol design, general performance characteristics, and ongoing MDP work including: initial rate-based congestion control design and results, network simulation and modeling, and asymmetric satellite operation.
DTIC
Internets; Networks; Protocol (Computers)

20070017016 Naval Research Lab., Washington, DC USA
Merging Paradigms of Survivability and Security: Stochastic Faults and Designed Faults
McDermott, J; Kim, A; Froscher, J; Aug 18, 2003; 13 pp.; In English
Report No.(s): AD-A465039; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Faults are examined by both the security and fault tolerance communities. These communities have strikingly different views of the types of faults that exist, the way they are modeled, and how they are addressed. One community can pronounce a system survivable but the other community would not find this to be so. This leaves us with two approaches that both fail to be comprehensive, depending on which community is looking at the system. While intrusion-tolerance and security researchers look at faults in terms of statistically dependent events caused by the hard intruder, the fault tolerance literature assumes that faults are statistically independent and can be described as random variables with probability distributions. When considering the survivability of a system, we cannot assume that the system is susceptible to only one type of fault or the other, but this is common practice in both communities. A new paradigm is needed.
DTIC
Fault Tolerance; Stochastic Processes

20070017023 Reliable Software Technologies Corp., Sterling, VA USA
Simulating Specification Errors and Ambiguities in Systems Employing Design Diversity
Voas, Jeffrey; Kassab, Lora; Jan 1997; 13 pp.; In English
Contract(s)/Grant(s): F30602-95-C-0282; 70NANB5H1160
Report No.(s): AD-A465103; No Copyright; Avail.: CASI: A03, Hardcopy

This paper looks at methods for predicting how likely it is that an n-version software system will suffer from common-mode failures. Common-mode failures are frequently caused by specification errors, specification ambiguities, and programmer faults. Since common-mode failures are detrimental to n-version systems, we have developed a method and a tool that observes the impact of simulated specification errors and specification ambiguities. These observations are made possible by a new family of fault injection algorithms designed to simulate specification anomalies. As a side benefit, this analysis also provides clues concerning which portions of the specification, if even slightly wrong or misinterpreted, will lead to identical

failures by two or more versions. This suggests which specification directives have the most impact on the system's functionality.
DTIC
Algorithms; Ambiguity; Computer Programming; Errors; Failure; Injection; Simulation; Software Engineering; Systems Engineering

20070017024 Naval Research Lab., Washington, DC USA
SINS: A Middleware for Autonomous Agents and Secure Code Mobility
Bharadwaj, Ramesh; Jul 16, 2002; 4 pp.; In English
Report No.(s): AD-A465104; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A01, Hardcopy

Building trusted applications is hard, especially in a distributed or mobile setting. Existing methods and tools are inadequate to deal with the multitude of challenges posed by distributed application development. The problem is exacerbated in a hostile environment such as the Internet where, in addition, applications are vulnerable to malicious attacks. It is widely acknowledged that intelligent software agents provide the right paradigm for developing agile, re-configurable, and efficient distributed applications. Distributed processing in general carries with it risks such as denial of service, Trojan horses, information leaks, and malicious code. Agent technology, by introducing autonomy and code mobility, may exacerbate some of these problems. In particular, a malicious agent could do serious damage to an unprotected host, and malicious hosts could damage agents or corrupt agent data. Secure Infrastructure for Networked Systems (SINS) being developed at the Naval Research Laboratory is a middleware for secure agents intended to provide the required degree of trust for mobile agents, in addition to ensuring their compliance with a set of enforceable security policies. An infrastructure such as SINS is central to the successful deployment and transfer of distributed agent technology to Industry because security is a necessary prerequisite for distributed computing.
DTIC
Applications Programs (Computers); Autonomy; Computer Information Security; Distributed Processing; Mobility

20070017029 Naval Research Lab., Washington, DC USA
The Role of HCI in CASE Tools Supporting Formal Methods
Heitmeyer, Connie; Jan 1994; 6 pp.; In English
Report No.(s): AD-A465116; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy

From 1988 through 1992, I led two research groups: the advanced interfaces section of NRL's Human-Computer Interaction (HCI) laboratory, which is developing advanced user interface techniques, and a software engineering group, which is designing formal methods for real-time systems. In 1989, a multidisciplinary team of HCI experts and software engineers, drawn from the two groups, began a new research task whose purpose was two-fold: to evaluate existing formal methods for representing and reasoning about a system's timing behavior and to build a prototype CASE toolset supporting the most promising methods. From the beginning, we recognized that the success of the CASE tools depended not only on powerful analysis methods but also on the quality of the toolset's user interface and its software design [4]. A high-quality user interface would allow developers to create, edit, and analyze specifications easily and effectively. A high-quality software design would enforce a clean separation between the user interface software and the software encoding the formal methods. A clean separation would facilitate software changes.
DTIC
Computer Programming; Human-Computer Interface; Software Development Tools; Software Engineering

20070017031 Naval Research Lab., Washington, DC USA
MT: A Toolset for Specifying and Analyzing Real-Time Systems
Clements, P C; Heitmeyer, C L; Labaw, B G; Rose, A T; Jan 1993; 12 pp.; In English
Report No.(s): AD-A465119; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy

This paper introduces MT, a collection of integrated tools for specifying and analyzing real-time systems using the Mode chart language. The toolset includes facilities for creating and editing Modechart specifications. Users may symbolically execute the specifications with an automatic simulation too! to make sure that the specified behavior is what was intended. They may also invoke a verifier that uses model-checking to determine whether the specifications imply (satisfy) any of a broad class of safety assertions. To illustrate the toolset's capabilities as well as several issues that arise when formal methods

are applied to real-world systems, the paper includes specifications and analysis procedures for a software component taken from an actual Navy real-time system.
DTIC
Real Time Operation; Software Development Tools

20070017060 Virginia Univ., Charlottesville, VA USA
Comparing Java and .NET Security: Lessons Learned and Missed
Paul, Nathanael; Evans, David; Jan 2006; 14 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8750-04-2-0246
Report No.(s): AD-A465183; No Copyright; Avail.: CASI: A03, Hardcopy

Many systems execute untrusted programs in virtual machines (VMs) to mediate their access to system resources. Sun introduced the Java VM in 1995, primarily intended as a lightweight platform for executing untrusted code inside web pages. More recently, Microsoft developed the .NET platform with similar goals. Both platforms share many design and implementation properties, but there are key differences between Java and .NET that have an impact on their security. This paper examines how .NET's design avoids vulnerabilities and limitations discovered in Java and discusses lessons learned (and missed) from experience with Java security.
DTIC
Computer Programs; Security

20070017283 Columbia Univ., New York, NY USA
A Lightweight Intelligent Virtual Cinematography System for Machinima Production
Elson, David K; Riedl, Mark O; Jan 2007; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464770; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464770

Machinima is a low-cost alternative to full production filmmaking. However, creating quality cinematic visualizations with existing machinima techniques still requires a high degree of talent and effort. We introduce a lightweight artificial intelligence system, Cambot, that can be used to assist in machinima production. Cambot takes a script as input and produces a cinematic visualization. Unlike other virtual cinematography systems, Cambot favors an offline algorithm coupled with an extensible library of specific modular and reusable facets of cinematic knowledge. One of the advantages of this approach to virtual cinematography is a tight coordination between the positions and movements of the camera and the actors.
DTIC
Artificial Intelligence; Cinematography; Coding; Decision Making

20070017408 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Protograph LDPC Codes Over Burst Erasure Channels
Divsalar, Dariush; Dolinar, Sam; Jones, Christopher; October 23, 2006; 7 pp.; In English; IEEE Military Communications Conference, 23-25 Oct. 2006, Washington, D.C., USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39931

In this paper we design high rate protograph based LDPC codes suitable for binary erasure channels. To simplify the encoder and decoder implementation for high data rate transmission, the structure of codes are based on protographs and circulants. These LDPC codes can improve data link and network layer protocols in support of communication networks. Two classes of codes were designed. One class is designed for large block sizes with an iterative decoding threshold that approaches capacity of binary erasure channels. The other class is designed for short block sizes based on maximizing minimum stopping set size. For high code rates and short blocks the second class outperforms the first class.
Author
Parity; Density; Decoding; Protocol (Computers); Communication Networks; Graphs (Charts)

20070017428 NASA Johnson Space Center, Houston, TX, USA
Extravehicular Activity System Sizing Analysis Tool (EVAS_SAT)
Brown, Cheryl B.; Conger, Bruce C.; Miranda, Bruno M.; Bue, Grant C.; Rouen, Michael N.; [2007]; 16 pp.; In English; 37th International Congressional Environmental Systems Meeting, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color and black and white illustrations
Report No.(s): 07ICES-27; Copyright; Avail.: Other Sources

An effort was initiated by NASA/JSC in 2001 to develop an Extravehicular Activity System Sizing Analysis Tool (EVAS_SAT) for the sizing of Extravehicular Activity System (EVAS) architecture and studies. Its intent was to support space suit development efforts and to aid in conceptual designs for future human exploration missions. Its basis was the Life Support Options Performance Program (LSOPP), a spacesuit and portable life support system (PLSS) sizing program developed for NASA/JSC circa 1990. EVAS_SAT estimates the mass, power, and volume characteristics for user-defined EVAS architectures, including Suit Systems, Airlock Systems, Tools and Translation Aids, and Vehicle Support equipment. The tool has undergone annual changes and has been updated as new data have become available. Certain sizing algorithms have been developed based on industry standards, while others are based on the LSOPP sizing routines. The sizing algorithms used by EVAS_SAT are preliminary. Because EVAS_SAT was designed for use by members of the EVA community, subsystem familiarity on the part of the intended user group and in the analysis of results is assumed. The current EVAS_SAT is operated within Microsoft Excel 2003 using a Visual Basic interface system.
Author
Extravehicular Activity; Systems Analysis; Life Support Systems; Space Suits; Portable Life Support Systems

20070017438 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Security Verification Techniques Applied to PatchLink COTS Software
Gilliam, David P.; Powell, John D.; Bishop, Matt; Andrew, Chris; Jog, Sameer; June 26, 2006; 6 pp.; In English; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/40029

Verification of the security of software artifacts is a challenging task. An integrated approach that combines verification techniques can increase the confidence in the security of software artifacts. Such an approach has been developed by the Jet Propulsion Laboratory (JPL) and the University of California at Davis (UC Davis). Two security verification instruments were developed and then piloted on PatchLink's UNIX Agent, a Commercial-Off-The-Shelf (COTS) software product, to assess the value of the instruments and the approach. The two instruments are the Flexible Modeling Framework (FMF) -- a model-based verification instrument (JPL), and a Property-Based Tester (UC Davis). Security properties were formally specified for the COTS artifact and then verified using these instruments. The results were then reviewed to determine the effectiveness of the approach and the security of the COTS product.
Author
Commercial Off-the-Shelf Products; Program Verification (Computers); Computer Programs; Computer Information Security

20070017454 NASA Langley Research Center, Hampton, VA, USA
The Roles of Verification, Validation and Uncertainty Quantification in the NASA Standard for Models and Simulations
Zang, Thomas A.; Luckring, James M.; Morrison, Joseph H.; Blattnig, Steve R.; Green, Lawrence L.; Tripathi, Ram K.; [2007]; 1 pp.; In English; 14th International Conference on Finite Elements in Flow Problems, 26-28 Mar. 2007, Sante Fe, NM, USA
Contract(s)/Grant(s): WBS 843515.02.01.07.05.02.01; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017454

The National Aeronautics and Space Administration (NASA) recently issued an interim version of the Standard for Models and Simulations (M&S Standard) [1]. The action to develop the M&S Standard was identified in an internal assessment [2] of agency-wide changes needed in the wake of the Columbia Accident [3]. The primary goal of this standard is to ensure that the credibility of M&S results is properly conveyed to those making decisions affecting human safety or mission success criteria. The secondary goal is to assure that the credibility of the results from models and simulations meets the project requirements (for credibility). This presentation explains the motivation and key aspects of the M&S Standard, with a special focus on the requirements for verification, validation and uncertainty quantification. Some pilot applications of this standard to computational fluid dynamics applications will be provided as illustrations. The authors of this paper are the members of the team that developed the initial three drafts of the standard, the last of which benefited from extensive comments from most of the NASA Centers. The current version (number 4) incorporates modifications made by a team representing 9 of the 10 NASA Centers. A permanent version of the M&S Standard is expected by December 2007. The scope of the M&S Standard is confined to those uses of M&S that support program and project decisions that may affect human safety or mission success criteria. Such decisions occur, in decreasing order of importance, in the operations, the test & evaluation, and the design & analysis phases. Requirements are placed on (1) program and project management, (2) models, (3) simulations and analyses, (4) verification, validation and uncertainty quantification (VV&UQ), (5) recommended practices, (6) training, (7) credibility assessment, and (8) reporting results to decision makers. A key component of (7) and (8) is the use

of a Credibility Assessment Scale, some of the details of which were developed in consultation with William Oberkampf, David Peercy and Timothy Trocano of Sandia National Laboratories. The focus of most of the requirements, including those for VV&UQ, is on the documentation of what was done and the reporting, using the Credibility Assessment Scale, of the level of rigor that was followed. The aspects of one option for the Credibilty Assessment Scale are (1) code verification, (2) solution verification, (3) validation, (4) predictive capability, (5) technical review, (6) process control, and (7) operator and analyst qualification.
Author
Computerized Simulation; Models; Program Verification (Computers); NASA Programs; Computational Fluid Dynamics; Standards

20070017961 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
New Challenges in Model Checking
Holzmann, Gerard J.; Joshi, Rajeev; Groce, Alex; August 16, 2006; 14 pp.; In English; Proceedings of the Conference on Computer-Aided Verification, 16-20 Aug. 2006, Seattle, WA, USA; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39859

In the last 25 years, the notion of performing software verification with logic model checking techniques has evolved from intellectual curiosity to accepted technology with significant potential for broad practical application. In this paper we look back at the main steps in this evolution and illustrate how the challenges have changed over the years, as we sharpened our theories and tools. Next we discuss a typical challenge in software verification that we face today - and that perhaps we can look back on in another 25 years as having inspired the next logical step towards a broader integration of model checking into the software development process.
Author
Program Verification (Computers); Software Engineering; Mathematical Models; Logic Programming

20070017963 NASA Ames Research Center, Moffett Field, CA, USA, NASA Langley Research Center, Hampton, VA, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA
Infusing Software Engineering Technology into Practice at NASA
Pressburger, Thomas; Feather, Martin S.; Hinchey, Michael; Markosia, Lawrence; July 17, 2006; 9 pp.; In English; 2nd International Conference on Space Mission Challenges for Information Technology, 17-21 Jul. 2006, Pasadena, CA, USA; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39861

We present an ongoing effort of the NASA Software Engineering Initiative to encourage the use of advanced software engineering technology on NASA projects. Technology infusion is in general a difficult process yet this effort seems to have found a modest approach that is successful for some types of technologies. We outline the process and describe the experience of the technology infusions that occurred over a two year period. We also present some lessons from the experiences.
Author
Computer Programming; NASA Programs; Software Engineering; Aerospace Technology Transfer

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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.

20070016817 Maryland Univ., College Park, MD USA
Internet-Based Mobile Ad Hoc Networking (Preprint)
Corson, M S; Macker, Joseph P; Cirincione, Gregory H; Jul 1999; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAL01-96-2-0002
Report No.(s): AD-A465016; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465016

Internet-based Mobile Ad Hoc Networking is an emerging technology that supports self-organizing, mobile networking infrastructures, and is one which appears well-suited for use in future commercial and military applications. This article presents an overview of Mobile Ad Hoc Networking technology and current Internet Engineering Task Force standardization

efforts in this regard. It gives long-term rationale for following an Internet Protocol-based networking approach in these mobile wireless systems. It also discusses some current limitations of the technology and gives several areas for future work.
DTIC
Communication Networks; Internets; Radiotelephones

20070016819 Naval Research Lab., Washington, DC USA
Integrated Erasure-Based Coding for Reliable Multicast Retransmission
Macker, Joseph P; Apr 1997; 7 pp.; In English
Report No.(s): AD-A465019; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465019

Single parity packet can repair multiple packets across receiver set. We can integrate this into NACK (negative acknowledgement) processing to improve scaling when uncorrelated loss is anticipated.
DTIC
Coding; Protocol (Computers)

20070016820 Naval Research Lab., Washington, DC USA
A TCP Friendly, Rate-Based Mechanism for NACK-Oriented Reliable Multicast Congestion Control (Preprint)
Macker, Joseph P; Adamson, R B; Jan 2001; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465020; XB-NRL/ITD/5500; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465020

In this paper, we describe ongoing work in adding congestion control extensions to an existing negative acknowledgement (NACK) oriented reliable multicast protocol. Our previous work adopted and used the concept of a dynamic worst path representative for equation-based rate adaptation at the multicast source and we have further refined this approach and present results here. We present an overview of these extensions implemented within a working reliable multicast protocol (mdp-cc) and we present simulation results. Our analysis of interflow fairness with TCP unicast sessions demonstrates friendly behavior across a set of scenarios and results with more dynamic flows show that the worst path representative approach adapts rapidly to changing congestion conditions.
DTIC
Congestion; Protocol (Computers)

20070016821 Naval Research Lab., Washington, DC USA
Application of Optimization Techniques to a Nonlinear Problem of Communication Network Design With Nonlinear Constraints
Wieselthier, Jeffrey E; Nguyen, Gam D; Ephremides, Anthony; Barnhart, Craig M; Jun 2002; 7 pp.; In English
Report No.(s): AD-A465021; XB-NRL/ITD/5500; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465021

Nonlinear optimization under nonlinear constraints is usually difficult. However, standard ad-hoc search techniques may work successfully in some cases. Here, we consider an augmented Lagrangian formulation, and we develop a projection heuristic that guides the iterative search toward the optimum. We demonstrate the effectiveness of this approach by applying it to the problem of maximizing a circuit-switched communication network's throughput under quality-of-service (QoS) constraints by means of choosing the input offered load. This problem is useful for sizing the network capacity. Performance results using several versions of the algorithm demonstrate its robustness, in terms of its accuracy and convergence properties.
DTIC
Communication Networks; Nonlinearity

20070016843 Naval Research Lab., Washington, DC USA
Simple Timing Channels
Moskowitz, Ira S; Miller, Allen R; May 1994; 11 pp.; In English
Report No.(s): AD-A465059; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465059

We discuss the different ways of defining channel capacity for certain types of illicit communication channels. We also

correct some errors from the literature, offer new proofs of some historical results, and give bounds for channel capacity. Special function techniques are employed to express the results in closed form. We conclude with examples.
DTIC
Channels (Data Transmission); Computers; Security

20070016849 Naval Research Lab., Washington, DC USA
A Pump for Rapid, Reliable, Secure Communication
Kang, Myong H; Moskowitz, Ira S; Nov 1993; 13 pp.; In English
Report No.(s): AD-A465065; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465065

Communication from a low- to a high-level system without acknowledgements will be unreliable; with acknowledgements, it can be insecure. We propose to provide quantifiable security, acceptable reliability, and minimal performance penalties by interposing a device (called the Pump) to push messages to the high system and provide a controlled stream of acknowledgements to the low system. This paper describes how the Pump supports the transmission of messages upward and limits the capacity of the covert timing channel in the acknowledgement stream without a affecting the average acknowledgement delay seen by the low system or the message delivery delay seen by the high system in the absence of actual Trojan horses. By adding random delays to the acknowledgment stream, we show how to further reduce the covert channel capacity even in the presence of cooperating Trojan horses in both the high and low systems. We also discuss engineering tradeoffs relevant to practical use of the Pump.
DTIC
Data Transmission; Interprocessor Communication; Security

20070016857 Naval Research Lab., Washington, DC USA
Onion Routing for Anonymous and Private Internet Connections
Goldschlag, David; Reed, Michael; Syverson, Paul; Jan 28, 1999; 6 pp.; In English
Report No.(s): AD-A465075; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465075

Preserving privacy means not only hiding the content of messages, but also hiding who is talking to whom (traffic analysis). Much like a physical envelope, the simple application of cryptography within a packet-switched network hides the messages being sent, but can reveal who is talking to whom, and how often. Onion Routing is a general purpose infrastructure for private communication over a public network [8, 9, 4]. It provides anonymous connections that are strongly resistant to both eavesdropping and traffic analysis. The connections are bidirectional, near real-time, and can be used for both connection-based and connectionless traffic. Onion Routing interfaces with off the shelf software and systems through specialized proxies, making it easy to integrate into existing systems. Prototypes have been running since July 1997. As of this article's publication, the prototype network is processing more than 1 million Web connections per month from more than six thousand IP addresses in twenty countries and in all six main top level domains. [7]
DTIC
Cryptography; Data Transmission; Internets; Security

20070016865 Naval Research Lab., Washington, DC USA
Secure Middleware for Situation-Aware Naval C2 and Combat Systems
Bharadwaj, Ramesh; May 2003; 8 pp.; In English
Report No.(s): AD-A465151; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465151

There is an increasing need within the Navy and Marine Corps for building distributed situation-aware applications that are rapidly reconfigurable and survivable in the face of attacks and changing mission needs. For the Navy's vision of Network Centric Warfare and the Total Ship Computing Environment to succeed, there is an urgent need for a secure, robust, and survivable network infrastructure for disseminating mission-critical information in a timely manner. It is widely believed that intelligent software agents provide the ability to build robust, agile, and efficient distributed applications. We outline how Secure Infrastructure for Networked Systems (SINS) being developed at the Naval Research Laboratory will provide commanders and warfighters the necessary middleware for constructing situation-aware Command and Control (C2) and combat applications. We pay particular attention to the correctness, survivability, and efficiency of the underlying middleware

architecture, and develop a middleware definition language Secure Operations Language (SOL) that enables C2 and Combat applications to use this infrastructure in a seamless and scalable manner.
DTIC
Applications Programs (Computers); Combat; Security

20070016967 Naval Research Lab., Washington, DC USA
A Low-Cost, IP-Based Mobile Network Emulator (MNE)
Macker, Joseph P; Chao, William; Weston, Jeffrey W; Jan 2003; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464904; No Copyright; Avail.: CASI: A02, Hardcopy

The Naval Research Laboratory (NRL) Mobile Network Emulator (MNE) is a low-cost, flexible wireless mobile internetwork protocol (IP) test environment that provides flexible, dynamic topology control and manipulation for testing of both IPv4 and IPv6 dynamic network scenarios. Direct and indirect software support for network node motion modeling is supported. We describe the emulation design and various software and hardware support components. We also provide a case example of how the mobile emulation system has been applied with a set of ancillary visualization tools, motion generators, and network analysis tools. Finally, we discuss how such an emulation environment provides a valuable engineering tool supplementing more abstract simulation studies and costly, time-consuming field trials of mobile network systems and software.
DTIC
Low Cost; Wide Area Networks

20070016979 Naval Research Lab., Washington, DC USA
Internetwork Traffic Management Enhancements: Evaluation and Experimental Results
Macker, Joseph; Park, Vincent; Jan 1998; 6 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464920; XB-NRL/ITD/5500; No Copyright; Avail.: Defense Technical Information Center (DTIC)

In recent years, there has been an increasing reliance on internetworking technology for military communication networks. As more diverse and mission critical applications begin to coexist within this shared infrastructure the need for improved network traffic and bandwidth management becomes apparent. Recent developments within the research community and within commercial products provide numerous candidate technologies that may be applied as solutions. This paper explores a set of such techniques while evaluating their relative merits and performance tradeoffs. A subset of empirical results from an actual testbed environment is also provided and discussed.
DTIC
Internets; Protocol (Computers); Traffic

20070016984 Naval Research Lab., Washington, DC USA
Dolev-Yao is no better than Machiavelli
Syverson, Paul; Meadows, Catherine; Cervesato, Iliano; Jan 2000; 7 pp.; In English
Contract(s)/Grant(s): N0014-96-D2024
Report No.(s): AD-A464936; No Copyright; Avail.: CASI: A02, Hardcopy

We show that all attacks that can be mounted by a traditional Dolev-Yao intruder against common cryptographic protocols can be enacted by an apparently weaker 'Machiavellian' adversary in which compromised principals will not share long-term secrets and will not send arbitrary messages. We also show that a Dolev-Yao adversary composed of multiple compromised principals is attack-equivalent to an adversary consisting of a single dishonest principal who is only willing to produce messages in valid protocol form.
DTIC
Cryptography; Protocol (Computers)

20070016993 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Recommendations for a Standardized Program Management Office (PMO) Time Compliance Network Order (TCNO) Patching Process
Czumak, III, Michael; Mar 2007; 135 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464947; AFIT/GIR/ENV/07-M8; XC-AFNO/DT/1; No Copyright; Avail.: CASI: A07, Hardcopy

Network security is a paramount concern for organizations utilizing computer technology, and the Air Force is no exception. Network software vulnerability patching is a critical determinant of network security. The Air Force deploys these

patches as Time Compliance Network Orders (TCNOs), which together with associated processes and enforced timelines ensure network compliance. While the majority of the network assets affected by this process are Air Force owned and operated, a large number are maintained by external entities known as Program Management Offices (PMOs). Although these externally controlled systems provide a service to the Air Force and reside on its network, the TCNO processes for these assets are dictated and managed, to a large extent, by the PMOs. There is no current or planned, standardized method to release TCNOs to PMOs within the AF. While AFI mandates that PMOs are responsible for establishing procedures to evaluate applicability to their systems, there are no quality checks, standardization requirements or oversight to ensure the results of such evaluations are sound. Nonetheless, these PMO systems directly impact the security of the Air Force Network and the Department of Defense at large. By examining existing PMO patch management processes, this study should provide a better understanding of the TCNO processes used by PMOs with the intent of exploiting strengths and addressing weaknesses in an effort to move towards a standardized TCNO patching process.
DTIC
Networks; Project Management; Security; Standardization

20070017015 Naval Research Lab., Washington, DC USA
Anycast Routing for Mobile Services
Park, Vincent D; Macker, Joseph P; Mar 1999; 7 pp.; In English
Contract(s)/Grant(s): N00014-99-WR2-0017
Report No.(s): AD-A465028; No Copyright; Avail.: CASI: A02, Hardcopy

This paper considers the problem of locating and forwarding network traffic to any one of a set of distributed servers or service points primarily in the context of mobile ad hoc networks. The advantages of providing such a capability through the use of anycast routing techniques at the network layer are discussed. We then illustrate how several different classes of unicast routing protocols can be extended to provide efficient construction and maintenance of anycast routes. Extensions to link-state, distance-vector and link reversal unicast routing protocols are all conceptually realized through the representation of an anycast service as a virtual node in a graph based on the network topology. The initial results of a simulation study, which demonstrate how anycast routing techniques can provide a one-to-any communication capability with greater efficiency than traditional unicast based techniques, are presented and discussed. The simulation results further indicate that anycast routing can ease the configuration and management required to achieve a given level of robustness and can reduce connection setup latency and message packet delay.
DTIC
Computer Networks; Topology

20070017039 Naval Research Lab., Washington, DC USA
Identifying Potential Type Confusion in Authenticated Messages
Meadows, Catherine; Jan 2002; 12 pp.; In English
Report No.(s): AD-A465134; No Copyright; Avail.: CASI: A03, Hardcopy

A type confusion attack is one in which a principal accepts data of one type as data of another. Although it has been shown by Heather et al. that there are simple formatting conventions that will guarantee that protocols are free from simple type confusions in which fields of one type are substituted for fields of another, it is not clear how well they defend against more complex attacks, or against attacks arising from interaction with protocols that are formatted according to different conventions. In this paper we show how type confusion attacks can arise in realistic situations even when the types are explicitly defined in at least some of the messages, using examples from our recent analysis of the Group Domain of Interpretation Protocol. We then develop a formal model of types that can capture potential ambiguity of type notation, and outline a procedure for determining whether or not the types of two messages can be confused. We also discuss some open issues.
DTIC
Cryptography; Identifying; Messages

20070017044 Naval Research Lab., Washington, DC USA
The Modulated-Input Modulated-Output Model
Moskowitz, Ira S; Kang, Myong H; Jan 1995; 20 pp.; In English
Report No.(s): AD-A465147; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper, we discuss why message acknowledgements are an appropriate engineering approach to meet system

functionality. The data replication problem in database systems is our motivation. We introduce a new queueing theoretic model, the MIMO model, that incorporates burstiness in the sending side and busy periods in the receiving side. Based on simulation results derived from this model, we show that the buffer requirements from M/M/1/N queues are too optimistic.
DTIC
Interprocessor Communication; Message Processing

20070017045 Naval Research Lab., Washington, DC USA
Towards Formalizing the Java Security Architecture of JDK 1.2
Kassab, Lora L; Greenwald, Steven J; Jan 1998; 18 pp.; In English
Report No.(s): AD-A465148; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy

The Java security architecture in the Java Development Kit 1.2 expands the current Java sandbox model, allowing finer-grained, configurable access control for Java code. This new security architecture permits more precise, yet flexible, protection for both remote code (loaded across a network connection) and local code (residing on the same machine running the Java Virtual Machine) developed using the Java programming language. Our formal model and analysis is intended to: (1) allow designers and implementors to understand and correctly use the protection provided by these security controls, and (2) provide guidance to a JVM implementor wishing to support these security controls. Access control decisions in Java are made based on the current execution context using stack introspection. To model this, we employ a state-based model that uses multiple access control matrices to model the security controls in JDK 1.2. We also present a safety analysis and discuss the effects of static and dynamic security policies for a given Java Virtual Machine.
DTIC
Architecture (Computers); Computer Information Security; Security

20070017047 Naval Research Lab., Washington, DC USA
An Experience Modeling Critical Requirements
Payne, Jr , Charles N; Moore, Andrew P; Mihelcic, David M; Jun 1994; 12 pp.; In English
Report No.(s): AD-A465150; No Copyright; Avail.: CASI: A03, Hardcopy

Previous work at NRL demonstrated the benefits of a security modeling approach for building high assurance systems for particular application domains. This paper introduces an application domain called selective bypass that is prominent in certain network security solutions. We present a parameterized modeling framework for the domain and then instantiate a confidentiality model for a particular application, called the External COMSEC Adaptor (ECA), within the framework. We conclude with lessons we learned from modeling, implementing and verifying the ECA. Our experience supports the use of the application based security modeling approach for high assurance systems.
DTIC
Models; Requirements; Security

20070017336 Naval Research Lab., Washington, DC USA
Quasi-Anonymous Channels
Moskowitz, Ira S; Newman, Richard E; Syverson, Paul F; Jan 2003; 7 pp.; In English
Report No.(s): AD-A465128; No Copyright; Avail.: CASI: A02, Hardcopy

Although both anonymity and covert channels are part of the larger topic of information hiding, there also exists an intrinsic linkage between anonymity and covert channels. This linkage was illustrated in [1]; however, [1] just scratched the surface of the interplay between covert channels and anonymity, without a formal analysis of the related issues. This paper begins the process of formalizing the linkage between anonymity and covert channels via the study of quasi-anonymous channels. We also discuss and contrast some of the existing formal mathematical models of anonymity.
DTIC
Computer Information Security; Mathematical Models; Information Theory

20070017419 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
A Reference Architecture for Space Information Management
Mattmann, Chris A.; Crichton, Daniel J.; Hughes, J. Steven; Ramirez, Paul M.; Berrios, Daniel C.; June 19, 2006; 15 pp.; In English; AIAA SpaceOps Conference, 19-24 Jun. 2006, Rome, Italy; Original contains black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39895

We describe a reference architecture for space information management systems that elegantly overcomes the rigid design of common information systems in many domains. The reference architecture consists of a set of flexible, reusable, independent models and software components that function in unison, but remain separately managed entities. The main guiding principle of the reference architecture is to separate the various models of information (e.g., data, metadata, etc.) from implemented system code, allowing each to evolve independently. System modularity, systems interoperability, and dynamic evolution of information system components are the primary benefits of the design of the architecture. The architecture requires the use of information models that are substantially more advanced than those used by the vast majority of information systems. These models are more expressive and can be more easily modularized, distributed and maintained than simpler models e.g., configuration files and data dictionaries. Our current work focuses on formalizing the architecture within a CCSDS Green Book and evaluating the architecture within the context of the C3I initiative.
Author
Aerospace Systems; Information Management; Computer Systems Design; Data Systems; Architecture (Computers)

20070017439 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Autonomous Congestion Control in Delay-Tolerant Networks
Burleigh, Scott; Jennings, Esther; Schoolcraft, Joshua; June 19, 2006; 10 pp.; In English; AIAA 9th International Conference on Space Operations (SpaceOps, 19-24 Jun. 2006, Rome, Italy; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39835

Congestion control is an important feature that directly affects network performance. Network congestion may cause loss of data or long delays. Although this problem has been studied extensively in the Internet, the solutions for Internet congestion control do not apply readily to challenged network environments such as Delay Tolerant Networks (DTN) where end-to-end connectivity may not exist continuously and latency can be high. In DTN, end-to-end rate control is not feasible. This calls for congestion control mechanisms where the decisions can be made autonomously with local information only. We use an economic pricing model and propose a rule-based congestion control mechanism where each router can autonomously decide on whether to accept a bundle (data) based on local information such as available storage and the value and risk of accepting the bundle (derived from historical statistics). Preliminary experimental results show that this congestion control mechanism can protect routers from resource depletion without loss of data.
Author
Autonomy; Computer Networks; Control Theory; Delay; Algorithms

20070017441 Naval Research Lab., Washington, DC USA
Techniques and Issues in Multicast Security
Kruus, Peter S; Macker, Joseph P; Jan 1998; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464922; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A02, Hardcopy

Multicast networking support is becoming an increasingly important future technology area for both commercial and military distributed and group-based applications. Integrating a multicast security solution involves numerous engineering tradeoffs. The end goal of effective operational performance and scalability over a heterogeneous internetwork is of primary interest for widescale adoption and application of such a capability. Various techniques that have been proposed to support multicast security are discussed and their relative merits are explored.
DTIC
Internets; Computer Information Security; Multichannel Communication

20070017465 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
SALT: The Simulator for the Analysis of LWP Timing
Springer, Paul L.; Rodrigues, Arun; Brockman, Jay; March 13, 2006; 15 pp.; In English; Summer Simulation Multiconference, 31 Jul. 2006, Calgary, Canada; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS7-03001; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39894

With the emergence of new processor architectures that are highly multithreaded, and support features such as full/empty memory semantics and split-phase memory transactions, the need for a processor simulator to handle these features becomes apparent. This paper describes such a simulator, called SALT.
Author
Architecture (Computers); Simulators; Memory (Computers); Central Processing Units

20070017836 NASA Stennis Space Center, Stennis Space Center, MS, USA

ISHM Anomaly Lexicon for Rocket Test

Schmalzel, John L.; Buchanan, Aubri; Hensarling, Paula L.; Morris, Jonathan; Turowski, Mark; Figueroa, Jorge F.; [2007]; 2 pp.; In English; Integrated Systems Health Management Conference, 6-9 Aug. 2007, Cincinnati, OH, USA

Contract(s)/Grant(s): NNS04AB67T

Report No.(s): SSTI-2200-0084; Copyright; Avail.: Other Sources; Abstract Only

Integrated Systems Health Management (ISHM) is a comprehensive capability. An ISHM system must detect anomalies, identify causes of such anomalies, predict future anomalies, help identify consequences of anomalies for example, suggested mitigation steps. The system should also provide users with appropriate navigation tools to facilitate the flow of information into and out of the ISHM system. Central to the ability of the ISHM to detect anomalies is a clearly defined catalog of anomalies. Further, this lexicon of anomalies must be organized in ways that make it accessible to a suite of tools used to manage the data, information and knowledge (DIaK) associated with a system. In particular, it is critical to ensure that there is optimal mapping between target anomalies and the algorithms associated with their detection. During the early development of our ISHM architecture and approach, it became clear that a lexicon of anomalies would be important to the development of critical anomaly detection algorithms. In our work in the rocket engine test environment at John C. Stennis Space Center, we have access to a repository of discrepancy reports (DRs) that are generated in response to squawks identified during post-test data analysis. The DR is the tool used to document anomalies and the methods used to resolve the issue. These DRs have been generated for many different tests and for all test stands. The result is that they represent a comprehensive summary of the anomalies associated with rocket engine testing. Fig. 1 illustrates some of the data that can be extracted from a DR. Such information includes affected transducer channels, narrative description of the observed anomaly, and the steps used to correct the problem. The primary goal of the anomaly lexicon development efforts we have undertaken is to create a lexicon that could be used in support of an associated health assessment database system (HADS) co-development effort. There are a number of significant byproducts of the anomaly lexicon compilation effort. For example, (1) Allows determination of the frequency distribution of anomalies to help identify those with the potential for high return on investment if included in automated detection as part of an ISHM system, (2) Availability of a regular lexicon could provide the base anomaly name choices to help maintain consistency in the DR collection process, and (3) Although developed for the rocket engine test environment, most of the anomalies are not specific to rocket testing, and thus can be reused in other applications.

Author

Systems Health Monitoring; Systems Integration; Anomalies; Rocket Engines; Engine Tests

20070017837 NASA Stennis Space Center, Stennis Space Center, MS, USA

An IEEE 1451.1 Architecture for ISHM Applications

Morris, Jon A.; Turowski, Mark; Schmalzel, John L.; Figueroa, Jorge F.; [2007]; 2 pp.; In English; Integrated Systesm Health Management/AFRL, 6-9 Aug. 2007, Cinsinnati, OH, USA

Contract(s)/Grant(s): NNS04AB67T

Report No.(s): SSTI-2200-0087; Copyright; Avail.: Other Sources; Abstract Only

The IEEE 1451.1 Standard for a Smart Transducer Interface defines a common network information model for connecting and managing smart elements in control and data acquisition networks using network-capable application processors (NCAPs). The Standard is a network-neutral design model that is easily ported across operating systems and physical networks for implementing complex acquisition and control applications by simply plugging in the appropriate network level drivers. To simplify configuration and tracking of transducer and actuator details, the family of 1451 standards defines a Transducer Electronic Data Sheet (TEDS) that is associated with each physical element. The TEDS contains all of the pertinent information about the physical operations of a transducer (such as operating regions, calibration tables, and manufacturer information), which the NCAP uses to configure the system to support a specific transducer. The Integrated Systems Health Management (ISHM) group at NASA's John C. Stennis Space Center (SSC) has been developing an ISHM architecture that utilizes IEEE 1451.1 as the primary configuration and data acquisition mechanism for managing and collecting information from a network of distributed intelligent sensing elements. This work has involved collaboration with other NASA centers, universities and aerospace industries to develop IEEE 1451.1 compliant sensors and interfaces tailored to support health assessment of complex systems. This paper and presentation describe the development and implementation of an interface for the configuration, management and communication of data, information and knowledge generated by a distributed system of IEEE 1451.1 intelligent elements monitoring a rocket engine test system. In this context, an intelligent element is defined as one incorporating support for the IEEE 1451.x standards and additional ISHM functions. Our implementation supports real-time collection of both measurement data (raw ADC counts and converted engineering units) and health statistics produced by each intelligent element. The handling of configuration, calibration and health information is automated by using

the TEDS in combination with other electronic data sheets extensions to convey health parameters. By integrating the IEEE 1451.1 Standard for a Smart Transducer Interface with ISHM technologies, each element within a complex system becomes a highly flexible computation engine capable of self-validation and performing other measures of the quality of information it is producing.
Author
Systems Integration; Systems Health Monitoring; Data Acquisition; Architecture (Computers); Transducers

20070017995 National Inst. of Aerospace, Hampton, VA, USA, NASA Langley Research Center, Hampton, VA, USA
Distributed Saturation
Chung, Ming-Ying; Ciardo, Gianfranco; Siminiceanu, Radu I.; April 2007; 21 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NCC1-02043; WBS 706801.04.13.01.02
Report No.(s): NASA/CR-2007-214862; NIA Report No. 2007-05; Copyright; Avail.: CASI: A03, Hardcopy

The Saturation algorithm for symbolic state-space generation, has been a recent break-through in the exhaustive veri cation of complex systems, in particular globally-asyn- chronous/locally-synchronous systems. The algorithm uses a very compact Multiway Decision Diagram (MDD) encoding for states and the fastest symbolic exploration algo- rithm to date. The distributed version of Saturation uses the overall memory available on a network of workstations (NOW) to efficiently spread the memory load during the highly irregular exploration. A crucial factor in limiting the memory consumption during the symbolic state-space generation is the ability to perform garbage collection to free up the memory occupied by dead nodes. However, garbage collection over a NOW requires a nontrivial communication overhead. In addition, operation cache policies become critical while analyzing large-scale systems using the symbolic approach. In this technical report, we develop a garbage collection scheme and several operation cache policies to help on solving extremely complex systems. Experiments show that our schemes improve the performance of the original distributed implementation, SmArTNow, in terms of time and memory efficiency.
Author
Algorithms; Complex Systems; Workstations; Mathematical Models; Saturation; Distributed Processing

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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*.

20070016733 Pennsylvania State Univ., University Park, PA USA
Semantic Source Coding for Flexible Lossy Image Compression
Phoha, Shashi; Schmiedekamp, Mendel; Mar 29, 2007; 5 pp.; In English
Contract(s)/Grant(s): N00014-03-1-0231
Report No.(s): AD-A464658; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464658

Semantic Source Coding for Lossy Video Compression investigates methods for Mission-oriented lossy image compression, by developing methods to use different compression levels for different portions of an image based on their utility in understanding the scene depicted. We have used semantic methods, including pattern discovery, wavelet-based segmentation and texture segmentation to extract the essential predictive information in the image. Described are mission oriented approaches to image pre-processing, image and video segmentation, quality comparison, compression, and two complete systems for lossy video compression.
DTIC
Coding; Data Compression; Image Processing; Imaging Techniques; Video Compression

20070016765 Army Cold Regions Research and Engineering Lab., Hanover, NH USA
A Generalized Approach to Soil Strength Prediction With Machine Learning Methods
Semen, Peter M; Jul 2006; 151 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464726; ERDC/CRREL-TR-06-15; No Copyright; Avail.: CASI: A08, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464726

Current methods for evaluating the suitability of potential landing sites for fixed-wing aircraft require a direct

measurement of soil bearing capacity. In contingency military operations, the commitment of ground troops to carry out this mission prior to landing poses problems in hostile territory, including logistics, safety, and operational security. Developments in remote sensing technology provide an opportunity to make indirect measurements that may prove useful for inferring basic soil properties. However, methods to accurately predict strength from other fundamental geotechnical parameters are lacking, especially for a broad range of soil types under widely-varying environmental conditions. To support the development of new procedures, a dataset of in situ soil pit test results was gathered from airfield pavement evaluations at forty-six locations worldwide that encompass a broad variety of soil types. Many features associated with soil strength including gradation, moisture content, density, specific gravity and plasticity were collected along with California bearing ratio (CBR), a critical strength index used to determine the traffic loading that the ground can support.
DTIC
Machine Learning; Soil Mechanics; Soils

20070016808 Naval Research Lab., Washington, DC USA
A Unified Cryptographic Protocol Logic
Syverson, Paul F; van Oorschot, Paul C; Jan 1996; 32 pp.; In English
Report No.(s): AD-A464967; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464967

We present a logic for analyzing cryptographic protocols. This logic is based on a unification of four of its predecessors in the BAN family of logics, namely those given in [GNY90], [AT91], [vO93b], and BAN itself [BAN89]. The logic herein captures the desirable features of its predecessors and more; nonetheless, as a logic it is relatively simple and simple to use. We also present a model-theoretic semantics, and we prove soundness for the logic with respect to that semantics. We illustrate the logic by applying it to the Needham- Schroeder protocol, revealing that BAN analysis of it may lead to inappropriate conclusions in some settings. We also use the logic to analyze two key agreement protocols, examining an attack on one of them.
DTIC
Cryptography; Protocol (Computers)

20070016834 Hong Kong Univ. of Science and Technology, Kowloon, Hong Kong
Using Temporal Logic to Specify and Verify Cryptographic Protocols (Progress Report)
Gray, III, James W; McLean, John; Jan 1995; 18 pp.; In English
Report No.(s): AD-A465044; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465044

We use standard linear-time temporal logic to specify cryptographic protocols, model the system penetrator, and specify correctness requirements. The requirements are specified as standard safety properties, for which standard proof techniques apply. In particular, we are able to prove that the system penetrator cannot obtain a session key by any logical or algebraic techniques. We compare our work to Meadows' method. We argue that using standard temporal logic provides greater flexibility and generality, firmer foundations, easier integration with other formal methods, and greater confidence in the verification results.
DTIC
Cryptography; Protocol (Computers); Temporal Logic

20070016841 Naval Research Lab., Washington, DC USA
Developing User Strategies in PVS: A Tutorial
Archer, Myla; Di Vito, Ben; Munoz, Cesar; Sep 8, 2003; 28 pp.; In English
Report No.(s): AD-A465056; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465056

This tutorial provides an overview of the PVS strategy language, and explains how to define new PVS strategies and load them into PVS, and how to create a strategy package. It then discusses several useful techniques that can be used in developing user strategies, and provides examples that illustrate many of these techniques.
DTIC
Manuals; Programming Languages; Prototypes

20070016842 Massachusetts Inst. of Tech., Cambridge, MA USA
Developing Strategies for Specialized Theorem Proving about Untimed, Timed, and Hybrid I/O Automata
Mitra, Sayan; Archer, Myla; Sep 8, 2003; 8 pp.; In English
Report No.(s): AD-A465057; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465057

In this paper we discuss how we intend to develop a specialized theorem proving environment for the Hybrid I/O Automata (HIOA) framework over the PVS theorem prover, and some of the issues involved. In particular, we describe approaches to using PVS that allow and encourage the development of useful proof strategies, and note some desired PVS features that would further help us to do so for our HIOA environment.
DTIC
Automata Theory; Prototypes; Theorem Proving; Theorems

20070016856 Naval Research Lab., Washington, DC USA
TAME: A PVS Interface to Simplify Proofs for Automata Models
Archer, Myla; Heitmeyer, Constance; Sims, Steve; Jan 1998; 9 pp.; In English
Report No.(s): AD-A465074; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465074

Although a number of mechanical provers have been introduced and applied widely by academic researchers, these provers are rarely used in the practical development of software. For mechanical provers to be used more widely in practice, two major barriers must be overcome. First, the languages provided by the mechanical provers for expressing the required system behavior must be more natural for software developers. Second, the reasoning steps supported by mechanical provers are usually at too low and detailed a level and therefore discourage use of the prover. To help remove these barriers, we are developing a system called TAME, a high-level user interface to PVS for specifying and proving properties of automata models. TAME provides both a standard specification format for automata models and numerous high-level proof steps appropriate for reasoning about automata models. In previous work, we have shown how TAME can be useful in proving properties about systems described as Lynch-Vaandrager Timed Automata models. TAME has the potential to be used as a PVS interface for other specification methods that are specialized to define automata models. This paper first describes recent improvements to TAME, and then presents our initial results in using TAME to provide theorem proving support for the SCR (Software Cost Reduction) requirements method, a method with a wide range of other mechanized support.
DTIC
Automata Theory; Graphical User Interface; Programming Languages; Prototypes; Proving

20070016868 Naval Research Lab., Washington, DC USA
An Agent-Based Approach to Inference Prevention Distributed Database Systems
Tracy, James; Chang, LiWu; Moskowitz, Ira S; Jan 2003; 17 pp.; In English
Report No.(s): AD-A465154; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465154

We propose an inference prevention agent as a tool that enables each of the databases in a distributed system to keep track of probabilistic dependencies with other databases and then use that information to help preserve the confidentiality of sensitive data. This is accomplished with minimal sacrifice of the performance and survivability gains that are associated with distributed database systems.
DTIC
Artificial Intelligence; Data Bases; Inference; Prevention

20070017001 Catholic Univ. of America, Washington, DC USA
Correlation-Based Watermarking Method for Image Authentication Applications
Ahmed, Farid; Moskowitz, Ira S; Aug 2004; 7 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464969; No Copyright; Avail.: Defense Technical Information Center (DTIC)

We propose a correlation-based digital watermarking technique for robust image pattern authentication. We hide a phase-based signature of the image back into its Fourier magnitude spectrum in the embedding stage. The detector computes the Fourier transform of the watermarked image and extracts the embedded signature. Authentication performance is measured by a correlation test of the extracted signature and the signature computed from the watermarked image. The quality of the watermarked image is obtained from the peak signal-to-noise ratio metric. We also furnish simulation results to show the

robustness of our approach to typical image processing as found in JPEG compression.
DTIC
Computer Information Security; Correlation; Digital Systems; Embedding; Image Processing

20070017004 Kentucky Univ., Lexington, KY USA
DEPSCOR: Research on ARL's Intelligent Control Architecture: Hierarchical Hybrid-Model Based Design, Verification, Simulation, and Synthesis of Mission Control for Autonomous Underwater Vehicles
Kumar, Ratnesh; Holloway, Lawrence E; Feb 2007; 99 pp.; In English
Contract(s)/Grant(s): N00014-01-1-0621
Report No.(s): AD-A464977; No Copyright; Avail.: CASI: A05, Hardcopy

In this research, our goal has been to develop hierarchical hybrid mission control architecture for autonomous systems illustrating its application to autonomous underwater vehicle (AUV), verify the logical correctness of the controller designed, look into the feasibility of simulating the operations executed by the AUV, and automate controller synthesis. The correct operation of a system we design is a requirement. The challenge to develop a hierarchical hybrid mission controller for underwater vehicle which facilitates modeling, verification, simulation and automated synthesis of coordinators has lead to research in this area. We have worked and are working on these issues with Applied Research Laboratory (ARL) at Pennsylvania State University (PSU) who have designed autonomous underwater vehicles for over 50 years primarily under the support of the U.S. Navy through the Office of Naval Research (ONR).
DTIC
Autonomy; Controllers; Proving; Simulation; Underwater Vehicles

20070017005 Army Tank-Automotive Research and Development Command, Warren, MI USA
Pedestrian Detection
Del Rose, Michael; Frederick, Philip; Jun 2005; 6 pp.; In English
Report No.(s): AD-A464978; No Copyright; Avail.: CASI: A02, Hardcopy

Pedestrian detection has been an active topic for several years. Many types of sensors and algorithms have been explored to improve pedestrian detection with varying levels of success. Currently, the pedestrian detection program within the Intelligent Systems Directorate at the U.S. Army Tank Automotive Research Development and Engineering Center (TARDEC), Warren, MI, concentrates on stereo vision systems, including stereo gray scale, stereo color, and stereo infrared. Both human detection from a single framed, stereo-paired image and tracking using a sequence of stereo-paired images are investigated. This paper discusses the current and future state of these activities.
DTIC
Artificial Intelligence; Computer Vision; Detection; Robotics; Stereophotography

20070017012 State Univ. of New York, Binghamton, NY USA
Estimation of Information Hiding Algorithms and Parameters
Craver, Scott A; Feb 21, 2007; 25 pp.; In English
Contract(s)/Grant(s): FA9550-05-1-0440
Report No.(s): AD-A464991; 1; No Copyright; Avail.: CASI: A03, Hardcopy

The goal of this project is the development of a system of useful tools for reverse-engineering covert channels and information hiding systems. This includes new algorithms for detection and estimation of certain hiding systems and the statistical artifacts they leave behind. One of our main observations is that severe false alarms leak a great deal of information about a watermark detector algorithm. The tendency to admit certain extreme false alarms a property we call superrobustness is an exploitable weakness in a detector. Using the techniques developed in this project, we participated in and won an international contest to defeat an unknown watermarking system. We did this by reverse-engineering the algorithm through the yes/no output of the watermark detector. Likewise, the participation in the contest spurred new research, in particular the 'noise caliper' technique of plumbing a detection region by growing false positives.
DTIC
Algorithms; Reverse Engineering

20070017014 Florida Univ., Gainesville, FL USA
A Steganographic Embedding Undetectable by JPEG Compatibility Steganalysis
Newman, Richard E; Moskowitz, Ira S; Chang, LiWu; Brahmadesam, Murali M; Jan 2002; 20 pp.; In English
Report No.(s): AD-A464998; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Steganography and steganalysis of digital images is a cat-and-mouse game. In recent work, Fridrich, Goljan and Du introduced a method that is surprisingly accurate at determining if bitmap images that originated as JPEG files have been altered (and even specifying where and how they were altered), even if only a single bit has been changed. However, steganographic embeddings that encode embedded data in the JPEG coefficients are not detectable by their JPEG compatibility steganalysis. This paper describes a steganographic method that encodes the embedded data in the spatial domain, yet cannot be detected by their steganalysis mechanism. Furthermore, we claim that our method can also be used as a steganographic method on files stored in JPEG format. The method described herein uses a novel, topological approach to embedding. The paper also outlines some extensions to the proposed embedding method.
DTIC
Compatibility; Computer Storage Devices; Embedding; Images; Steganography

20070017032 Naval Research Lab., Washington, DC USA
Capacity is the Wrong Paradigm
Moskowitz, Ira S; Chang, LiWu; Newman, Richard E; Jan 2002; 14 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465120; No Copyright; Avail.: CASI: A03, Hardcopy

At present, 'capacity' is the prevailing paradigm for covert channels. With respect to steganography, however, capacity is at best insufficient, and at worst, is incorrect. In this paper, we propose a new paradigm called 'capability' which gauges the effectiveness of a steganographic method. It includes payload carrying ability, detectability, and robustness components. We also discuss the use of zero-error capacity for channel analysis and demonstrate that a JPEG compressed image always has the potential to carry hidden information.
DTIC
Cryptography; Steganography

20070017269 University of Southern California, Marina del Rey, CA USA
Teaching Negotiation Skills through Practice and Reflection with Virtual Humans
Core, Mark; Traum, David; Lane, H C; Swartout, William; Gratch, Jonathan; van Lent, Michael; Marsella, Stacy; Nov 2006; 19 pp.; In English
Report No.(s): AD-A464801; No Copyright; Avail.: CASI: A03, Hardcopy

Although the representation of physical environments and behaviors will continue to play an important role in simulation-based training, an emerging challenge is the representation of virtual humans with rich mental models (e.g., including emotions, trust) that interact through conversational as well as physical behaviors. The motivation for such simulations is training soft skills such as leadership, cultural awareness, and negotiation, where the majority of actions are conversational, and the problem solving involves consideration of the emotions, attitudes, and desires of others. The educational power of such simulations can be enhanced by the integration of an intelligent tutoring system to support learners understanding of the effect of their actions on virtual humans and how they might improve their performance. In this paper, we discuss our efforts to build such virtual humans, along with an accompanying intelligent tutor, for the domain of negotiation and cultural awareness.
DTIC
Artificial Intelligence; Computerized Simulation; Education

20070017319 Southern Univ., Baton Rouge, LA USA
Advanced Image Processing Techniques for Maximum Information Recovery
Cross, James E; Luo, Jiecai; Nov 2006; 72 pp.; In English
Contract(s)/Grant(s): FA8650-05-1-6645; Proj-7184
Report No.(s): AD-A464688; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464688

The objective of this project was to investigate methods to recover the maximum amount of available information from an image. Some radio frequency and optical sensors collect large-scale sets of spatial imagery data whose content is often obscured by fog, clouds, foliage and other intervening structures. Often, the obstruction is such as to render unreliable the definition of underlying images. Various mathematical operations used in image processing to remove obstructions from images and to recover reliable information were investigated, to include Spatial Domain Processing, Frequency Domain Processing, and non-Abelian group operations. These imaging techniques were researched and their effectiveness determined. Some of the most effective techniques were selected, refined, extended and customized for this project. Several examples are

presented showing applications of such techniques with the MATLAB code included. A new advanced image processing technique was developed, tested, and is being proposed for the removal of clouds from an image. This technique has been applied to certain images to demonstrate its effectiveness. The MATLAB code has been developed, tested and appended to this report.
DTIC
Image Processing; Image Enhancement; Optical Measuring Instruments

20070017333 ITT Industries, Inc., Alexandria, VA USA
A Calculus of Macro-Events: Progress Report
Cervesato, Iliano; Montanari, Angelo; Jan 2000; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-96-D-2024
Report No.(s): AD-A465072; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465072

The need of constraining the temporal relationships among sets of related events arises in several temporal reasoning tasks, including monitoring, plan validation, planning, and diagnosis. Process constructors provide an effective way of packaging up related events into individual conceptual chunks, called macro-events. In this paper, we present a first attempt at defining a Calculus of Macro-Events that extends Kowalski and Sergot's Event Calculus with process constructors to express effects triggered by complex combinations of event occurrences. We apply this language to model the operations of a simple gas heater, and present a Prolog implementation.
DTIC
Architecture (Computers); Programming Languages

20070017925 NASA Ames Research Center, Moffett Field, CA, USA
Aerobots as a Ubiquitous Part of Society
Young, Larry A.; Jan. 20, 2006; 30 pp.; In English; AHS Vertical Lift Aircraft Design Conference, 18-20 Jan. 2006, San Francisco, CA, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 56158102.07.01.02; Copyright; Avail.: Other Sources

Small autonomous aerial robots (aerobots) have the potential to make significant positive contributions to modern society. Aerobots of various vehicle-types - CTOL, STOL, VTOL, and even possibly LTA - will be a part of a new paradigm for the distribution of goods and services. Aerobots as a class of vehicles may test the boundaries of aircraft design. New system analysis and design tools will be required in order to account for the new technologies and design parameters/constraints for such vehicles. The analysis tools also provide new approaches to defining/assessing technology goals and objectives and the technology portfolio necessary to accomplish those goals and objectives. Using the aerobot concept as an illustrative test case, key attributes of these analysis tools are discussed.
Author
Vertical Takeoff Aircraft; Design Analysis; Robots; Short Takeoff Aircraft; Systems Analysis

20070017938 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Agent Based Intelligence in a Tetrahedral Rover
Phelps, Peter; Truszkowski, Walt; [2007]; 11 pp.; In English; IEEE Aerospace Conference, 3-10 Mar. 2007, Big Sky, MT, USA; Original contains color illustrations
Report No.(s): IEEEAC Paper 1182; Copyright; Avail.: Other Sources

A tetrahedron is a 4-node 6-strut pyramid structure which is being used by the NASA - Goddard Space Flight Center as the basic building block for a new approach to robotic motion. The struts are extendable; it is by the sequence of activities: strut-extension, changing the center of gravity and falling that the tetrahedron 'moves'. Currently, strut-extension is handled by human remote control. There is an effort underway to make the movement of the tetrahedron autonomous, driven by an attempt to achieve a goal. The approach being taken is to associate an intelligent agent with each node. Thus, the autonomous tetrahedron is realized as a constrained multi-agent system, where the constraints arise from the fact that between any two agents there is an extendible strut. The hypothesis of this work is that, by proper composition of such automated tetrahedra, robotic structures of various levels of complexity can be developed which will support more complex dynamic motions. This is the basis of the new approach to robotic motion which is under investigation. A Java-based simulator for the single

tetrahedron, realized as a constrained multi-agent system, has been developed and evaluated. This paper reports on this project and presents a discussion of the structure and dynamics of the simulator.
Author
Robot Dynamics; Remote Control; Tetrahedrons; Autonomy; Intelligence; Java (Programming Language); Hypotheses

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NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

20070016719 California Inst. of Tech., Pasadena, CA USA
Attenuation of Persistant Laplace Transform (infinity)-Bounded Disturbances for Nonlinear Systems
Lu, Wei-Min; Doyle, John; Jan 1995; 33 pp.; In English
Report No.(s): AD-A464629; CIT-CDS-95-002; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464629

A version of nonlinear generalization of the Laplace transform(exp 1)-control problem, which deals with the attenuation of persistent bounded disturbances in Laplace transform(infinity)-sense, is investigated in this paper. The methods used in this paper are motivated by Shamma(1994). The main idea in the Laplace transform (exp 1)-performance analysis and synthesis is to construct a certain invariant subset of the state-space such that achieving disturbance rejection is equivalent to restricting the state-dynamics to this set. The concepts from viability theory, nonsmooth analysis, and set-valued analysis play important roles. In addition, the relation between the Laplace transform (exp 1)-control of a continuous-time system and the Laplace transform (exp 1)-control of its Euler approximated discrete-time systems is established.
DTIC
Laplace Transformation; Nonlinear Systems

20070016770 California Inst. of Tech., Pasadena, CA USA
Robust H2 Performance: Guaranteeing Margins for LQG Regulators
Paganini, Fernando; Dec 1995; 36 pp.; In English
Report No.(s): AD-A464752; CIT-CDS-95-031; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464752

This paper shows that H2 (LQG) performance specifications can be combined with structured uncertainty in the system yielding robustness analysis conditions of the same nature and computational complexity as the corresponding conditions for H infinity performance. These conditions are convex feasibility tests in terms of Linear Matrix inequalities and can be proven to be necessary and sufficient under the same conditions as in the H infinity case. With these results the tools of robust control can be viewed as coming full circle to treat the problem where it all began: guaranteeing margins for LQG regulators.
DTIC
Hydrogen; Linear Quadratic Gaussian Control; Linear Systems

20070016773 California Inst. of Tech., Pasadena, CA USA
Analysis of Implicit Uncertain Systems. Part 1: Theoretical Framework
Paganini, Fernando; Doyle, John; Dec 7, 1994; 31 pp.; In English
Report No.(s): AD-A464757; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464757

This paper introduces a general and powerful framework for the analysis of uncertain systems, encompassing linear fractional transformations, the behavioral approach for system theory and the integral quadratic constraint formulation. In this approach, a system is defined by implicit equations, and the central analysis question is to test for solutions of these equations. In Part 1, the general properties of this formulation are developed, and computable necessary and sufficient conditions are derived for a robust performance problem posed in this framework.
DTIC
Differential Equations; Linear Equations; Systems Analysis; Uncertain Systems

20070016776 California Inst. of Tech., Pasadena, CA USA
Observability/Identifiability of Rigid Motion under Perspective Projection
Soatto, Stefano; Perona, Pietro; Mar 8, 1994; 22 pp.; In English
Contract(s)/Grant(s): N00014-93-1-0990
Report No.(s): AD-A464761; CIT-CDS-94-001; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464761

The 'visual motion' problem consists of estimating the motion of an object viewed under projection. In this paper we address the feasibility of such a problem. We will show that the model which defines the visual motion problem for feature points in the euclidean 3D space lacks of both linear and local (weak) observability. The locally observable manifold is covered with three levels of lie differentiations. Indeed, by imposing metric constraints on the state-space, it is possible to reduce the set of indistinguishable states. We will then analyze a model for visual motion estimation in terms of identification of an Exterior Differential System, with the parameters living on a topological manifold, called the 'essential manifold', which includes explicitly in its definition the forementioned metric constraints. We will show that rigid motion is globally observable/identifiable under perspective projection with zero level of lie differentiation under some general position conditions. Such conditions hold when the viewer does not move on a quadric surface containing all the visible points.
DTIC
Differential Geometry; Motion

20070016780 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Modeling, Simulation, and Estimation of Optical Turbulence
Formwalt, Byron P; Dec 2006; 94 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464766; AFIT/GE/ENG/DSG-06S; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464766

This dissertation documents three new contributions to simulation and modeling of optical turbulence. The first contribution is the formalization, optimization, and validation of a modeling technique called successively conditioned rendering (SCR). The SCR technique is empirically validated by comparing the statistical error of random phase screens generated with the technique. The second contribution is the derivation of the covariance delineation theorem, which provides theoretical bounds on the error associated with SCR. It is shown empirically that the theoretical bound may be used to predict relative algorithm performance. Therefore, the covariance delineation theorem is a powerful tool for optimizing SCR algorithms. For the third contribution, we introduce a new method for passively estimating optical turbulence parameters, and demonstrate the method using experimental data.
DTIC
Algorithms; Optical Properties; Simulation; Turbulence

20070016796 California Inst. of Tech., Pasadena, CA USA
Robust Stability Under Mixed Time Varying, Time Invariant and Parametric Uncertainty
Paganini, Fernando; Sep 1995; 35 pp.; In English
Report No.(s): AD-A464794; CIT-CDS-95-024; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464794

Robustness analysis is considered for systems with structured uncertainty involving a combination of linear time-invariant and linear time-varying perturbations, and parametric uncertainty. A necessary and sufficient condition for robust stability in terms of the structured singular value p is obtained, based on a finite augmentation of the original problem. The augmentation corresponds to considering the system at a fixed number of frequencies. Sufficient conditions based on scaled small-gain are also considered and characterized. A substantial amount of research in recent years has been devoted to analysis and synthesis of control systems o achieve robust stability and performance in the presence of structured uncertainty. This implies a decentralized nature of the uncertain perturbation, which is a reasonable modeling choice for complex systems, where uncertainty may be introduced at the subsystem level (see Safonov [17] and Doyle [5] for early treatments of this). In addition t o this 'spatial' structure, different assumptions can be made on the dynamic properties of the uncertainty: real parametric, linear time invariant (LTI), linear time varying (LTV) or nonlinear perturbations. All these uncertainty classes arise naturally in modeling. Parametric uncertainty appears frequently in first principles models; LTI perturbations are well suited when
DTIC
Nonlinear Systems; Spatial Distribution; Stability

20070016806 Naval Research Lab., Washington, DC USA

A Variable Rate Voice Coder using LPC-10E

Macker, J P; Adamson, R B; Jul 12, 1994; 3 pp.; In English

Report No.(s): AD-A464963; NRL/5520-92; XB-NRL/MR/5520; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA464963

This paper describes the current status of an ongoing research and development effort whose objective is a variable rate voice coder with a high degree of speech intelligibility and natural voice quality with an average throughput rate near 1200 b/s. The voice coder described here is based on the DoD FS 1015 LPC-10 2400 b/s vocoder. A method of silence detection and the use of variable size data frame formats to distinguish voiced and unvoiced frames are discussed. This voice coding technology is a critical component in supporting efficient integrated services over bandwidth constricted radio networks, satellite systems, and handheld portable communications devices.

DTIC

Algorithms; Coders; Intelligibility

20070016848 Naval Research Lab., Washington, DC USA

Applying the SCR Requirements Specification Method to Practical Systems: A Case Study

Bharadwaj, Ramesh; Heitmeyer, Connie; Dec 1996; 16 pp.; In English

Report No.(s): AD-A465064; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465064

Studies have shown that the majority of errors in software systems are due to incorrect requirements specifications. The root cause of many requirements errors is the imprecision and ambiguity that arise because the software requirements are expressed in natural language. An effective way to reduce such errors is to express requirements in a formal notation. For a number of years, researchers at the Naval Research Laboratory (NRL) have been working on a formal method based on tables to specify the requirements of practical systems [2, 11]. Known as the Software Cost Reduction (SCR) method, this approach was originally formulated to document the requirements of the Operational Flight Program (OFP) for the U.S. Navy's A-7 aircraft [2]. Since SCR's introduction more than a decade ago, many industrial organizations, including Lockheed, Grumman, and Ontario Hydro, have used SCR to specify requirements. Recently, NRL has developed both a formal state machine model [12, 14] to define the SCR semantics and a set of software tools to support analysis and validation of SCR requirements specifications [10]. The tools support consistency and completeness checking, simulation, and model checking.

DTIC

Computer Programs; Cost Reduction; Natural Language (Computers); Semantics; Software Development Tools; Specifications

20070016912 University of Southern California, Marina del Rey, CA USA

A Host-Based Real-Time Multichannel Immersive Sound Playback and Processing System

Sadek, Ramy; Oct 31, 2004; 7 pp.; In English

Contract(s)/Grant(s): DAAD19-99-D-0046

Report No.(s): AD-A464814; No Copyright; Avail.: CASI: A02, Hardcopy

This paper presents ARIA (Application Rendering Immersive Audio). This system provides a means for the research community to easily test and integrate algorithms into a multichannel playback/recording system. ARIA uses a host-based architecture, meaning that programs can be developed and debugged in standard C++ without the need for expensive, specialized DSP programming and testing tools. ARIA allows developers to exploit the speed and low cost of modern CPUs, provides cross-platform portability, and simplifies the modification and sharing of codes. This system is designed for real-time playback and processing, thus closing the gap between research testbed and delivery systems.

DTIC

Algorithms; Playbacks; Real Time Operation

20070016922 Naval Postgraduate School, Monterey, CA USA
Multi-Agent Simulations for Assessing Massive Sensor Deployment (Briefing Charts)
Hynes, Sean; Rowe, Neil; Jun 2004; 23 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464831; No Copyright; Avail.: CASI: A03, Hardcopy

These briefing charts concern problem space, sensor coverage and sensor deployment.

DTIC
Charts; Deployment; Detectors; Networks; Simulation

20070016939 Army Research Lab., Aberdeen Proving Ground, MD USA
Data Translations to Support the Battlespace Terrain Ownership Project
O'May, Janet F; Vu, Tan; Neiderer, Andrew M; Mar 2007; 20 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464858; ARL-MR-660; No Copyright; Avail.: CASI: A03, Hardcopy

The U S. Army Research Laboratory's Battlespace Decision Support Team is exploring methods of portraying control or power influence in the battlespace. The Battlespace Terrain Ownership project uses resultant data from the successive application of three computer programs to present a graphical display of areas of influence in the battlespace: combat simulation, the data translation process, and the control algorithm and associated display. The first step involves the creation of a combat scenario in One Semi-Automated Forces (OneSAF) Testbed Baseline (OTB) v2.0; OTB provides data on all entities in the battlespace and both direct- and indirect-fire events. The second step is converting this data into a format for the control algorithm. The control algorithm then interprets different factors in the battlespace and provides a visual display. This report addresses the second step, the data translation process.

DTIC
Algorithms; Combat; Computer Programming; Display Devices; Java (Programming Language); Simulation; Terrain; Translating

20070016941 Johns Hopkins Univ., Baltimore, MD USA
The Cohesive Element Approach to Dynamic Fragmentation: The Question of Energy Convergence
Molinari, J F; Gazonas, G; Raghupathy, R; Rusinek, A; Zhou, F; Feb 2007; 32 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): 48389-MS; 2511050005200
Report No.(s): AD-A464860; ARL-RP-162; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The cohesive element approach is getting increasingly popular for simulations in which a large amount of cracking occurs. Naturally, a robust representation of fragmentation mechanics is contingent to an accurate description of dissipative mechanisms in form of cracking and branching. A number of cohesive law models have been proposed over the years and these can be divided into two categories: cohesive laws that are initially rigid and cohesive laws that have an initial elastic slope. This report focuses on the initially rigid cohesive law, which is shown to successfully capture crack branching mechanisms in simulations. The report addresses the issue of energy convergence of the finite-element solution for high-loading rate fragmentation problems, within the context of small strain linear elasticity. These results are obtained in an idealized one dimensional setting, and they provide new insight for determining proper cohesive zone spacing as function of loading rate. The findings provide a useful roadmap for choosing mesh sizes and mesh size distributions in two and three-dimensional fragmentation problems. Remarkably, introducing a slight degree of mesh randomness is shown to improve by up to two orders of magnitude the convergence of the fragmentation problem.

DTIC
Cohesion; Convergence; Crack Propagation; Elastic Properties; Finite Element Method; Fragmentation

20070016952 Universiteit Twente, Enschede, Netherlands
A Local Discontinuous Galerkin Method for the Camassa-Holm Equation
Xu, Yan; Shu, Chi-Wang; Jan 10, 2007; 30 pp.; In English
Contract(s)/Grant(s): W911NF-04-1-0291; DMS-0510345
Report No.(s): AD-A464872; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper, we develop, analyze and test a local discontinuous Galerkin (LDG) method for solving the Camassa-Holm equation which contains nonlinear high order derivatives. The LDG method has the flexibility for arbitrary h and p adaptivity. We prove the L2 stability for general solutions and give a detailed error estimate for smooth solutions, and provide numerical

simulation results for different types of solutions of the nonlinear Camassa-Holm equation to illustrate the accuracy and capability of the LDG method.
DTIC
Galerkin Method; Mathematical Models

20070016960 Pennsylvania State Univ., University Park, PA USA
Numerical Predictions for the Demo Enclosure Comparison to Experiment
Fahnline, J B; Campbell, R L; Hambric, S A; May 2004; 49 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464892; TR-04-007; No Copyright; Avail.: CASI: A03, Hardcopy

Numerical methods for modeling the surface vibrations and sound radiation from a small enclosure are investigated, with special emphasis on simple methods for representing the connections. Finite element methods are used for the structural vibrations and the accompanying sound radiation is computed using the boundary element method. It is shown that good results can be obtained by simply adjusting the resonance frequencies for the modes to agree with experimental measurements. This assumes that the modes are fairly similar and that a one-to-one correspondence can be established between the numerical and experimental results. It is also shown that the technique of analyzing the components separately and combining them together using adding stiffnesses performed as well or better than trying to model the connections directly. The technique is also well-suited to optimization problems because numerous cases can be analyzed much more quickly than the more direct technique. Comparisons to experimental measurements show that the strategies for combining the components worked better for the more rigid connections than they did for the softer configurations.
DTIC
Enclosure; Finite Element Method; Numerical Analysis; Predictions; Vibration

20070017003 Naval Research Lab., Washington, DC USA
The Channel Capacity of a Certain Noisy Timing Channel
Moskowitz, Ira S; Miller, Allen R; Jul 1992; 7 pp.; In English
Report No.(s): AD-A464974; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The effect of noise upon a simple covert timing channel is investigated. Shannon's information theory is used to quantify the resulting information flow across the channel. In particular, how a probabilistic response time to a query by the receiver affects the mutual information and channel capacity is studied. The channel capacity is expressed in terms of the critical probability for the mutual information function which is given in closed for in terms of Wright's hypergeometric function.
DTIC
Channel Capacity; Information Theory

20070017026 California Inst. of Tech., Pasadena, CA USA
Flocking with Obstacle Avoidance
Saber, Reza O; Feb 15, 2003; 29 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F49620-01-1-0361; F33615-98-C-3613
Report No.(s): AD-A465112; CIT-CDS-03-006; No Copyright; Avail.: Defense Technical Information Center (DTIC)

In this paper, we provide a dynamic graph theoretical framework for flocking in presence of multiple obstacles. In particular, we give formal definitions of nets and flocks as spatially induced graphs. We provide models of nets and flocks and discuss the realization/embedding issues related to structural nets and flocks. This allows task representation and execution for a network of agents called -agents. We also consider flocking in the presence of multiple obstacles. This task is achieved by introducing two other types of agents called -agents and -agents. This framework enables us to address split/rejoin and squeezing maneuvers for nets/flocks of dynamic agents that communicate with each other. The problems arising from switching topology of these networks of mobile agents make the analysis and design of the decision-making protocols for such networks rather challenging. We provide simulation results that demonstrate the e ectiveness of our theoretical and computational tools.
DTIC
Avoidance; Computerized Simulation; Distributed Interactive Simulation; Locking; Obstacle Avoidance; Protocol (Computers)

20070017027 California Inst. of Tech., Pasadena, CA USA

Agreement Problems in Networks with Directed Graphs and Switching Topology

Saber, Reza O; Murray, Richard M; Feb 15, 2003; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-01-1-0361; F33615-98-C-3613

Report No.(s): AD-A465113; CIT-CDS-03-005; No Copyright; Avail.: Defense Technical Information Center (DTIC)

In this paper, we provide tools for convergence and performance analysis of an agreement protocol for a network of integrator agents with directed information flow. Moreover, we analyze algorithmic robustness of this consensus protocol for the case of a network with mobile nodes and switching topology. We establish a connection between the Fiedler eigenvalue of the graph Laplacian and the performance of this agreement protocol. We demostrate that a class of directed graphs, called balanced graphs, have a crucial role in solving average-consensus problems. Based on the properties of balanced graphs, a group disagreement function (i.e. Lyapunov function) is proposed for convergence analysis of this agreement protocol for networks with directed graphs. This group disagreement function is later used for convergence analysis for the agreement problem in networks with switching topology. We provide simulation results that are consistent with our theoretical results and demonstrate the e ectiveness of the proposed analytical tools.

DTIC

Algorithms; Graph Theory; Networks; Switching; Topology

20070017028 California Inst. of Tech., Pasadena, CA USA

LMI Approach to Mixed Performance Objective Controllers: Application to Robust H2 Synthesis

D'Andrea, Raffaello; Jul 1995; 20 pp.; In English

Report No.(s): AD-A465115; CIT-CDS-95-020; No Copyright; Avail.: CASI: A03, Hardcopy

The problem of synthesizing a controller for plants subject to arbitrary, finite en ergy disturbances and white noise disturbances via Linear Matrix Inequalities (LMIs) is presented. This is achieved by considering white noise disturbances as belonging to a constrained set in l2. In the case of where oniy white noise disturbances are present, the procedure reduces to standard H2 synthesis. When arbitrarv, finite energy dis turbances are also present, the procedure may be used to synthesize general hiixed performance objective controllers, and for certain cases, Robust H2 controllers.

DTIC

Finite Element Method; Hydrogen; Inequalities; Linear Systems; Matrix Theory

20070017034 California Inst. of Tech., Pasadena, CA USA

Stabilization of Linear Systems with Structured Perturbations

Lu, Wei-Min; Zhou, Kemin; Doyle, John C; Apr 11, 1993; 40 pp.; In English

Report No.(s): AD-A465127; CIT-CDS-93-014; No Copyright; Avail.: CASI: A03, Hardcopy

The problem of stabilization of linear systems with bounded structured uncertainties are considered in this paper. Two notions of stability, denoted quadratic stability (Q-stability) and stability, are considered, and corresponding notions of stabilizability and detectability are defined. In both cases, the output feedback stabilization problem is reduced via a separation argument to two simpler problems: full information (I) and full control (FC). The set of all stabilizing controllers can be parametrized as a linear fractional transformation (LFT) on a free stable parameter. For Q-stability, stabilizability and detectability can in turn be characterized by Linear Matrix Inequalities (LMIs), and the FI and FC Q-stabilization problems can be solved using the corresponding LMIs. In the standard one-dimensional case the results in this paper reduce to well-known results on controller parametrization using state-space methods, although the development here relies more heavily on elegant LFT machinery and avoids the need for coprime factorizations.

DTIC

Linear Systems; Perturbation; Structural Analysis

20070017051 Massachusetts Inst. of Tech., Lexington, MA USA

Coverage Maximization Using Dynamic Taint Tracing

Leek, T R; Baker, G Z; Brown, R E; Zhivich, M A; Lippmann, R P; Mar 28, 2007; 33 pp.; In English

Contract(s)/Grant(s): FA8721-05-C-0002

Report No.(s): AD-A465167; TR-1112; No Copyright; Avail.: CASI: A03, Hardcopy

We present COMET, a system that automatically assembles a test suite for a C program to improve line coverage, and give initial results for a prototype implementation. COMET works dynamically, running the program under a variety of instrumentations in a feedback loop that adds new inputs to an initial corpus with each iteration. One instrumentation in

particular is crucial to the success of this approach: dynamic taint tracing. Inputs are labeled as tainted at the byte level and all read/write pairs in the program are augmented to track the flow of taint between memory objects. This allows COMET to determine from which bytes of which inputs the variables in conditions derive, thereby dramatically narrowing the search over inputs necessary to expose new code. On a test set of 13 example programs, COMET improves upon the level of coverage reached in random testing by an average of 23% relative, takes only about twice the time, and requires a tiny fraction of the number of inputs to do so.
DTIC
Charts; Computer Programs; Feedback

20070017066 Virginia Univ., Charlottesville, VA USA
StarDust: A Flexible Architecture for Passive Localization in Wireless Sensor Networks
Stoleru, Radu; Vicaire, Pascal; He, Tian; Stankovic, John A; Jan 2006; 15 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-01-C-1905; W911NF-06-1-0204
Report No.(s): AD-A465193; No Copyright; Avail.: CASI: A03, Hardcopy

The problem of localization in wireless sensor networks where nodes do not use ranging hardware, remains a challenging problem, when considering the required location accuracy, energy expenditure and the duration of the localization phase. In this paper we propose a framework, called StarDust, for wireless sensor network localization based on passive optical components. In the StarDust framework, sensor nodes are equipped with optical retro-reflectors. An aerial device projects light towards the deployed sensor network, and records an image of the reflected light. An image processing algorithms developed for obtaining the locations of sensor nodes. For matching a node ID to a location we propose a constraint-based label relaxation algorithm. We propose and develop localization techniques based on four types of constraints: node color, neighbor information, deployment time for a node and deployment location for a node. We evaluate the performance of a localization system based on our framework by localizing a network of 26 sensor nodes deployed in a 120 60 ft squared area. The localization accuracy ranges from 2 ft to 5 ft while the localization time ranges from 10 milliseconds to 2 minutes.
DTIC
Communication Networks; Image Processing; Position (Location)

20070017322 China Scientific and Technical Univ., Hofei, China
Local Discontinuous Galerkin Methods for the Cahn-Hilliard Type Equations
Xia, Yinhua; Xu, Yan; Shu, Chi-Wang; Jan 2007; 29 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): W911NF-04-1-0291
Report No.(s): AD-A464873; No Copyright; Avail.: CASI: A03, Hardcopy

In this paper we develop local discontinuous Galerkin (LDG) methods for the fourth-order nonlinear Cahn-Hilliard equation and system. The energy stability of the LDG methods is proved for the general nonlinear case. Numerical examples for the Cahn-Hilliard equation and the Cahn-Hilliard system in one and two dimensions are presented and the numerical results illustrate the accuracy and capability of the methods.
DTIC
Galerkin Method; Discontinuity; Nonlinear Systems

20070017335 Virginia Univ., Charlottesville, VA USA
t-kernel: Providing Reliable OS Support to Wireless Sensor Networks
Gu, Lin; Stankovic, John A; Jan 2006; 15 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-01-1-0576; F33615-01-C-1905
Report No.(s): AD-A465189; No Copyright; Avail.: CASI: A03, Hardcopy

The development of a reliable large-scale wireless sensor network (WSN) is very difficult because of resource constraints, energy budget, and demanding application requirements. Three OS features OS protection, virtual memory, and preemptive scheduling can significantly improve the reliability of WSN systems and facilitate developing complex WSN software. However, due to the lack of hardware support for privileged execution and address translation, it is impossible to implement these features with traditional OS design techniques. To solve this problem, we design a new OS kernel, the t-kernel, to perform extensive code modification at load time. The modified code and the OS work in a collaborative way supporting the aforementioned features. Having implemented the t-kernel on MICA2 motes, we evaluate its performance by measuring the overhead and execution speed. We analyze the CPU utilization of sensor network applications, and verify that, though CPU-bound tasks execute 1.5 3 times as long as in native mode, application performance under typical workloads does not

noticeably degrade. The t-kernel significantly enhances developers ability to design reliable and sophisticated sensor networks, and includes several new design techniques, such as efficient binary translation on highly constrained sensor nodes, differentiated virtual memory without repeatedly writable swapping devices, and the protection of the OS from application errors without privileged execution hardware.
DTIC
Kernel Functions; Wireless Communication; Detectors; Communication Networks

20070017338 California Inst. of Tech., Pasadena, CA USA
The Rank One Mixed mu Problem and 'Kharitonov-Type' Analysis
Young, Peter M; Aug 30, 1993; 25 pp.; In English
Report No.(s): AD-A465118; CIT-CDS-93-015; No Copyright; Avail.: CASI: A03, Hardcopy

The general mixed mu problem has been shown to be NP hard, so that the exact solution of the general problem is computationally intractable, except for small problems. In this paper we consider not the general problem, but a particular special case of this problem, the rank one mixed mu problem. We show that for this case the mixed mu problem is equivalent to its upper bound (which is convex), and it can in fact be computed easily (and exactly). This special case is shown to be equivalent to the so called affine parameter variation' problem (for a polynomial with perturbed coefficients) which has been examined in detail in the literature, and for which several celebrated 'Kharitonov-type' results have been proven.
DTIC
Numerical Analysis; Parameterization

20070017339 California Inst. of Tech., Pasadena, CA USA
Hoo Optimization with Spatial Constraints
D'Andrea, Raffaello; Sep 1995; 19 pp.; In English
Report No.(s): AD-A465114; CIT-CDS-95-026; No Copyright; Avail.: CASI: A03, Hardcopy

A generalized H infinity synthesis problem where non-euclidian spatial norms on the disturbances and output error are used is posed and solved. The solution takes the form of a linear matrix inequality. Some problems which fall into this class are presented. In particular, solutions are presented to two problems: a variant of H infinity synthesis where norm constraints on each component of the disturbance can be imposed, and synthesis for a certain class of robust performance problems.
DTIC
Spatial Distribution; Synthesis

20070017407 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
When is Constrained Clustering Beneficial, and Why?
Wagstaff, Kiri L.; Basu, Sugato; Davidson, Ian; July 16, 2006; 2 pp.; In English; National Conference on Aritficial Intelligence, 16-20 Jul. 2006, Boston, MA, USA
Contract(s)/Grant(s): NBCHD030010; NSF ITR-03-25329; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39933

Several researchers have shown that constraints can improve the results of a variety of clustering algorithms. However, there can be a large variation in this improvement, even for a fixed number of constraints for a given data set. We present the first attempt to provide insight into this phenomenon by characterizing two constraint set properties: informativeness and coherence. We show that these measures can help explain why some constraint sets are more beneficial to clustering algorithms than others. Since they can be computed prior to clustering, these measures can aid in deciding which constraints to use in practice.
Author
Algorithms; Cluster Analysis; Artificial Intelligence; Constraints

20070017958 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Measuring Constraint-Set Utility for Partitional Clustering Algorithms
Davidson, Ian; Wagstaff, Kiri L.; Basu, Sugato; September 18, 2006; 12 pp.; In English; 10th European Conference on Principles and Practice of Knowledge Discovery in Databases, 18-22 Sep. 2006, Berlin, Germany; Original contains color and black and white illustrations
Contract(s)/Grant(s): NBCHD030010; NSF ITR-03-25329; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39891

Clustering with constraints is an active area of machine learning and data mining research. Previous empirical work has convincingly shown that adding constraints to clustering improves the performance of a variety of algorithms. However, in most of these experiments, results are averaged over different randomly chosen constraint sets from a given set of labels, thereby masking interesting properties of individual sets. We demonstrate that constraint sets vary significantly in how useful they are for constrained clustering; some constraint sets can actually decrease algorithm performance. We create two quantitative measures, informativeness and coherence, that can be used to identify useful constraint sets. We show that these measures can also help explain differences in performance for four particular constrained clustering algorithms.
Author
Algorithms; Cluster Analysis; Data Mining; Machine Learning

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STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

20070016756 Statistical Engineering, Palm Beach Gardens, FL USA
Comparing The Effectiveness of a90/95 Calculations (Preprint)
Annis, Charles; Knopp, Jeremy; Sep 2006; 10 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-03-D-5204; Proj-4349
Report No.(s): AD-A464705; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464705

Most practitioners see a90/95 as a static, single-point summary of an entire inspection's capability. It purports to be the size of the target having at least 90% probability of detection in 95 of 100 probability of detection (POD) experiments under nominally identical conditions. But in some situations the actual coverage is closer to 80%, rather than 95%, with 50% coverage being the median POD(a) curve itself. This paper discusses the two philosophies, the Wald Method, and the Loglikelihood Ratio Method, for constructing lower bounds on POD(a) curves (and therefore determining a90/95) and compares the effectiveness of each as functions of other experimental realities such as sample size and balance.
DTIC
Probability Theory; Statistical Tests

20070016759 Southwest Research Inst., San Antonio, TX USA
A New Approach to Fatigue Life Prediction Based on Nucleation and Growth (Preprint)
McClung, R C; Francis, W L; Hudak, S J; Feb 2006; 11 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F33615-03-2-5203; Proj-4347
Report No.(s): AD-A464708; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464708

Prediction of total fatigue life in components is often performed by summing 'initiation' and 'propagation' life phases, where initiation life is based on stress-life or strain-life methods calibrated to smooth specimen fatigue tests. An 'engineering' size crack (e.g., 0.030' or 1 mm) is often used as the transition between initiation and propagation analyses. However, these methods commonly fail to give accurate predictions for problems with significant stress gradients. A new approach to fatigue life prediction has been developed to address this shortcoming. The approach employs traditional smooth specimen and fatigue crack growth data but applies them in novel ways. The first step is to generate 'nucleation' curves to a designated small crack size from smooth specimen data by subtracting calculated crack growth life (including small-crack corrections) in the smooth specimen from the total smooth specimen life. The second step is to apply these nucleation curves to predict the nucleation life to the same initial crack size in a feature of interest, equating the stress at the nucleation length in the feature geometry with the uniform stress in a corresponding virtual smooth specimen. The feature crack growth life is calculated from this crack size to failure, and then nucleation and growth lives are summed to obtain the total fatigue life. The approach has been demonstrated for Ti-6Al-4V using available data from smooth specimen and fatigue crack growth tests to predict total fatigue lives in double-edge notched fatigue specimens at three different stress ratios.
DTIC
Cracks; Fatigue Life; Nucleation; Predictions

20070016786 Massachusetts Univ., Amherst, MA USA
Multi-Document Relationship Fusion via Constraints on Probabilistic Databases
Mann, Gideon; Jan 2007; 9 pp.; In English
Contract(s)/Grant(s): HM1582-06-1-2013
Report No.(s): AD-A464777; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464777

Previous multi-document relationship extraction and fusion research has focused on single relationships. Shifting the focus to multiple relationships allows for the use of mutual constraints to aid extraction. This paper presents a fusion method which uses a probabilistic database model to pick relationships which violate few constraints. This model allows improved performance on constructing corporate succession timelines from multiple documents with respect to a multi-document fusion baseline.
DTIC
Data Bases; Extraction; Multisensor Fusion; Probability Theory

20070016798 Advanced Technical Concepts, Berkshire, NY USA
High Order Non-Stationary Markov Models and Anomaly Propagation Analysis in Intrusion Detection System (IDS)
Skormin, Victor A; Feb 2007; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA8750-06-1-0176; Proj-558B
Report No.(s): AD-A464796; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464796

A new concept targeted to decrease false positive rates of anomaly based intrusion detection operating in the system call domain is proposed. To mitigate false positives, network based correlation of collected anomalies from different hosts is suggested, as well as a new means of host-based anomaly detection. The concept of anomaly propagation is based on the premise that false alarms do not propagate within the network. Unless anomaly propagation is observed, alarms are to be treated as false positives. The rationale behind the concept lies in the fact that the most common feature of worms and viruses is self-replication. As replication takes place, a malicious code propagating through the network would carry out the same activity resulting in almost identical system call sequences and triggering the same alarm at different hosts. The alarm propagation effect can be used to distinguish true alarms from false positives . At the host-level, a new anomaly detection mechanism operating that employs non-stationary Markov models is proposed.
DTIC
Anomalies; Detection; Markov Processes; Warning Systems

20070016831 Hong Kong Univ. of Science and Technology, Kowloon, Hong Kong
A Logical Approach to Multilevel Security of Probabilistic Systems
Gray, III, James W; Syverson, Paul F; Jan 1998; 50 pp.; In English
Report No.(s): AD-A465040; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465040

We set out a modal logic for reasoning about multilevel security of probabilistic systems. This logic contains expressions for time, probability, and knowledge. Making use of the Halpern-Tuttle framework for reasoning about knowledge and probability, we give a semantics for our logic and prove it is sound. We give two syntactic definitions of perfect multilevel security and show that their semantic interpretations are equivalent to earlier, independently motivated characterizations. We also discuss the relation between these characterizations of security and between their usefulness in security analysis.
DTIC
Probability Theory; Security; Warning Systems

20070016846 Naval Research Lab., Washington, DC USA
Difference of Sums Containing Products of Binomial Coefficients and Their Logarithms
Miller, Allen R; Moskowitz, Ira S; Jan 2005; 9 pp.; In English
Report No.(s): AD-A465062; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465062

Properties of the difference of two sums containing products of binomial coefficients and their logarithms which arise in

the application of Shannon's information theory to a certain class of covert channels are deduced. Some allied consequences of the latter are also recorded.
DTIC
Binomial Coefficients; Binomials; Coefficients; Information Theory; Logarithms; Mathematical Models; Sums

20070017983 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Non-Parametric Collision Probability for Low-Velocity Encounters
Carpenter, J. Russell; [2007]; 17 pp.; In English; 2007 AAS/AIAA Space Flight Mechanics Meeting, 28 Jan. - 1 Feb. 2007, Sedona, AZ, USA; Original contains color illustrations
Report No.(s): AAS-07-201; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017983

An implicit, but not necessarily obvious, assumption in all of the current techniques for assessing satellite collision probability is that the relative position uncertainty is perfectly correlated in time. If there is any mis-modeling of the dynamics in the propagation of the relative position error covariance matrix, time-wise de-correlation of the uncertainty will increase the probability of collision over a given time interval. The paper gives some examples that illustrate this point. This paper argues that, for the present, Monte Carlo analysis is the best available tool for handling low-velocity encounters, and suggests some techniques for addressing the issues just described. One proposal is for the use of a non-parametric technique that is widely used in actuarial and medical studies. The other suggestion is that accurate process noise models be used in the Monte Carlo trials to which the non-parametric estimate is applied. A further contribution of this paper is a description of how the time-wise decorrelation of uncertainty increases the probability of collision.
Author
Collisions; Low Speed; Probability Theory; Position Errors; Monte Carlo Method; Satellites; Error Analysis

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SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

20070016725 Air Force Research Lab., Wright-Patterson AFB, OH USA
Distributed Cognition (DCOG): Foundations for a Computational Associative Memory Model
Eggleston, Robert G; McCreight, Katherine L; Aug 2006; 129 pp.; In English
Contract(s)/Grant(s): Proj-2313
Report No.(s): AD-A464646; AFRL-HE-WP-TR-2006-0160; No Copyright; Avail.: CASI: A07, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464646

Computational models of human behavior and performance continue to gain in importance for the development and use of tools to support Air Force personnel in warfighting operations. In this report, we describe the foundations of a different type of computational architecture; one that we believe will be less susceptible to cognitive brittleness and can better scale to complex and ill-structured work domains. More specifically, it describes an investigation into the design and software implementation of an associative style memory model. The memory model expresses knowledge at three fundamental levels of granularity as opposed to one found in other machine representations of cognition. The report describes the theoretical constructs used in the memory model; illustrates how they can be used to account for certain cognitive phenomena such as over generalization of categories by children and base rate neglect in decision making; develops these concepts mathematically and algorithmically; and illustrates how they capture cognition in a concept leaning task. It concludes with a software implementation plan that embeds the memory model into a software actor Distributed Cognition (DCOG) that employs a distributive software agent architecture.
DTIC
Associative Memory; Cognition; Decision Making; Mathematical Models

20070016827 Massachusetts Inst. of Tech., Cambridge, MA USA
Reusable PVS Proof Strategies for Proving Abstraction Properties of I/O Automata
Mitra, Sayan; Archer, Myla; Jul 4, 2004; 15 pp.; In English
Report No.(s): AD-A465029; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465029

Recent modifications to PVS Support a new technique for defining abstraction properties relating automata in a clean and

uniform way. This definition technique employs specification templates that can support development of generic high level PVS strategies that set up the standard subgoals of these abstraction proofs and then execute the standard initial proof steps for these subgoals. In this paper, we describe an abstraction specification technique and associated abstraction proof strategies we are developing for I/O automata. The new strategies can be used together with existing strategies in the TAME (Timed Automata Modeling Environment) interface to PVS; thus, our new templates and strategies provide an extension to TAME for proofs of abstraction. We illustrate how the extended set of TAME templates and strategies can be used to prove example I/O automata abstraction properties taken from the literature.
DTIC
Automata Theory; Prototypes; Proving

20070016853 Naval Research Lab., Washington, DC USA
How to Fake a Rational Design Process using the SCR Method
Bharadwaj, Ramesh; May 10, 2003; 3 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465070; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465070

We explore the idea of faking a rational design process, a la Parnas and Clements by the application of the extended SCR Method of Heitmeyer and Bharadwaj. We argue that the formal artifacts created as a result serve as the basis for determining the work products associated with each step of the process, and whose quality assessment is aided by the application of tools in the SCR Toolset. Further, since the products associated with each step have a consistent formal denotation, the approach opens the possibility of significantly automating many process steps.
DTIC
Computer Programming; Software Engineering; Specifications

20070016869 Naval Research Lab., Washington, DC USA
Interpreting Strands in Linear Logic
Cervesato, I; Durgin, N; Kanovich, M; Scedrov, A; Jan 2000; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-97-1-0505; N00014-96-D-2024
Report No.(s): AD-A465155; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465155

The adoption of the Dolev-Yao model, an abstraction of security protocols that supports symbolic reasoning, is responsible for many successes in protocol analysis. In particular, it has enabled using logic effectively to reason about protocols. One recent framework for expressing the basic assumptions of the Dolev-Yao model is given by strand spaces, certain directed graphs whose structure reflects causal inter- actions among protocol participants. We represent strand constructions as relatively simple formulas in first-order linear logic, a refinement of traditional logic known for an intrinsic and natural accounting of process states, events, and resources. The proposed encoding is shown to be sound and complete. Interestingly, this encoding differs from the multiset rewriting definition of the Dolev-Yao model, which is also based on linear logic. This raises the possibility that the multiset rewriting framework may differ from strand spaces in some subtle way, although the two settings are known to agree on the basic secrecy property.
DTIC
Computer Information Security; Protocol (Computers); Strands

20070016870 Naval Research Lab., Washington, DC USA
Multi-Dimensional Inference and Confidential Data Protection with Decision Tree Methods
Chang, LiWu; Tracy, James; Jan 2002; 7 pp.; In English
Report No.(s): AD-A465156; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465156

We present a novel approach to the challenging issue of database confidential data protection. We adopt the decision tree framework as our baseline and extend it to cope with databases where the class label attribute is not specified. We are interested in confidential data that are randomly distributed over different attributes (referred to as multi-dimensional inference). For confidential data protection, our method (referred to as adaptive modification) mitigates inference by evaluating and modifying some, not all, relevant data records. We localize data modification in a decision tree and, instead of exhaustively evaluating all modification possibilities, we select informative data to modify. Our proposed method is

effective in protection of confidential data and scalable for handling large databases.
DTIC
Classifications; Computer Information Security; Decision Theory; Errors; Inference

20070016914 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Anisotropy in the South Atlantic Anomaly
Easley, Shaun M; Jan 2007; 97 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464816; AFIT/GAP/ENP/07-02; No Copyright; Avail.: CASI: A05, Hardcopy

From June 2000 through July 2006, the TSX-5 satellite measured proton fluxes in the Earth?s magnetosphere using its CEASE instrument. A review of the satellite data by scientists at AFRL/VSBX revealed an unanticipated, recurring bi-modal structure in histograms of the proton counts. This research identified the bi-modal behavior as anisotropic in nature, and the result of two separate processes. At low altitudes the anisotropy was well described by the classic ?East-West Effect.? Comparisons of the satellite data to simple analytical models are presented. At high altitudes, the anisotropy was the result of the detector measuring protons at different pitch angles when looking east vs. west. The sampled pitch angles were also found to be function of location, leading to a latitudinal variation to this anisotropy. Finally, we also examined a series of unusually high readings that affected some of the statistics in this study. These anomalous counts were found to have a possible solar cycle dependence leading to questions about the suitability of the current timeindependent scheme used to sort the satellite?s data set. Other possible explanations for the anomalous counts are also presented.
DTIC
Anisotropy; Anomalies; Atlantic Ocean; Telemetry

20070016978 University of Southern California, Marina del Rey, CA USA
Artemis: Integrating Scientific Data on the Grid (Preprint)
Tuchinda, Rattapoom; Thakkar, Snehal; Gil, Yolanda; Deelman, Ewa; Jul 2004; 9 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F49620-01-1-0053
Report No.(s): AD-A464918; No Copyright; Avail.: CASI: A02, Hardcopy

Grid technologies provide a robust infrastructure for distributed computing, and are widely used in large-scale scientific applications that generate terabytes (soon petabytes) of data. This data is described with metadata attributes about the data properties and provenance, and is organized in a variety of metadata catalogs distributed over the grid. In order to find a collection of data that share certain properties, these metadata catalogs need to be identified and queried on an individual basis. This paper introduces Artemis, a system developed to integrate distributed metadata catalogs on the grid. Artemis exploits several AI techniques including a query mediator, a query planning and execution system, ontologies and semantic web tools to model metadata attributes, and an intelligent user interface that guides users through these ontologies to formulate queries. We describe our experiences using Artemis with large metadata catalogs from two projects in the physics domain.
DTIC
Artificial Intelligence; Information Retrieval; Metadata

20070016983 Georgia Inst. of Tech., Atlanta, GA USA
Tracking Deforming Objects using Particle Filtering for Geometric Active Contours
Rathi, Yogesh; Vaswani, Namrata; Tannenbaum, Allen; Yezzi, Anthony; Jan 2007; 16 pp.; In English
Contract(s)/Grant(s): U54-EB005149; NAC-P41-RR-13218
Report No.(s): AD-A464927; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Tracking deforming objects involves estimating the global motion of the object and its local deformations as a function of time. Tracking algorithms using Kalman filters or particle filters have been proposed for finite dimensional representations of shape, but these are dependent on the chosen parametrization and cannot handle changes in curve topology. Geometric active contours provide a framework which is parametrization independent and allow for changes in topology. In the present work, we formulate a particle filtering algorithm in the geometric active contour framework that can be used for tracking moving and deforming objects. To the best of our knowledge, this is the first attempt to implement an approximate particle filtering algorithm for tracking on a (theoretically) infinite dimensional state
DTIC
Contours; Deformation

20070017323 NASA Stennis Space Center, Stennis Space Center, MS, USA, ATK Launch Systems, Brigham City, UT, USA
Smart Sensor Node Development, Testing and Implementation for ISHM
Mengers, Timothy; Shipley, John; Merrill, Richard; Eggett, Mark; Lemon, Leon; Johnson, Mont; Morris, Jonathan; Figueroa, Fernando; Schmalzel, John; Turowski, Mark; Nov. 12, 2007; 1 pp.; In English; 2007 Annual ITEA International Symposium, 12-15 Nov. 2007, Kauai, HI, USA
Contract(s)/Grant(s): NNS06AB89A
Report No.(s): SSTI-2200-0081; Copyright; Avail.: Other Sources; Abstract Only

A main design criterion for a robust Integrated Systems Health Management (ISHM) system is summed up best by the statement 'No data is better than bad data'. Traditional data acquisition systems are calibrated in a controlled environment and guaranteed to perform bounded by their tested conditions. To successfully design and implement a real world ISHM system, the data acquisition and signal conditioning needs to function in an uncontrolled environment. Development and testing 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 in a system that is flexible, requiring little redesign to be deployed on a wide variety of systems. Development progress and testing results will be reported.
Author
Systems Integration; Management Systems; Data Acquisition; Deployment; Signal Detection; Calibrating; Signal Processing; Systems Management

20070017849 NASA Langley Research Center, Hampton, VA, USA
High Altitude Long Endurance UAV Analysis of Alternatives and Technology Requirements Development
Nickol, Craig L.; Guynn, Mark D.; Kohout, Lisa L.; Ozoroski, Thomas A.; March 2007; 111 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 561581.02.08.07
Report No.(s): NASA/TP-2007-214861; L-19300; Copyright; Avail.: CASI: A06, Hardcopy

An Analysis of Alternatives and a Technology Requirements Study were conducted for two mission areas utilizing various types of High Altitude Long Endurance (HALE) Unmanned Aerial Vehicles (UAV). A hurricane science mission and a communications relay mission provided air vehicle requirements which were used to derive sixteen potential HALE UAV configurations, including heavier-than-air (HTA) and lighter-than-air (LTA) concepts with both consumable fuel and solar regenerative propulsion systems. A HTA diesel-fueled wing-body-tail configuration emerged as the preferred concept given near-term technology constraints. The cost effectiveness analysis showed that simply maximizing vehicle endurance can be a sub-optimum system solution. In addition, the HTA solar regenerative configuration was utilized to perform both a mission requirements study and a technology development study. Given near-term technology constraints, the solar regenerative powered vehicle was limited to operations during the long days and short nights at higher latitudes during the summer months. Technology improvements are required in energy storage system specific energy and solar cell efficiency, along with airframe drag and mass reductions to enable the solar regenerative vehicle to meet the full mission requirements.
Author
Pilotless Aircraft; Body-Wing and Tail Configurations; Solar Propulsion; Airframes; Propulsion System Configurations; High Altitude; Cost Effectiveness

20070017862 NASA Glenn Research Center, Cleveland, OH, USA
Probabilistic Analysis of Space Shuttle Body Flap Actuator Ball Bearings
Oswald, Fred B.; Jett, Timothy R.; Predmore, Roamer E.; Zaretsky, Erin V.; [2007]; 36 pp.; In English; STLE's 62nd Annual Meeting and Exhibition, 6-10 May 2007, Philadelphia, PA, USA; Original contains black and white illustrations
Contract(s)/Grant(s): 049788.04.06.03.05; Copyright; Avail.: CASI: A03, Hardcopy

A probabilistic analysis, using the 2-parameter Weibull-Johnson method, was performed on experimental life test data from space shuttle actuator bearings. Experiments were performed on a test rig under simulated conditions to determine the life and failure mechanism of the grease lubricated bearings that support the input shaft of the space shuttle body flap actuators. The failure mechanism was wear that can cause loss of bearing preload. These tests established life and reliability data for both shuttle flight and ground operation. Test data were used to estimate the failure rate and reliability as a function of the number of shuttle missions flown. The Weibull analysis of the test data for a 2-bearing shaft assembly in each body flap actuator established a reliability level of 99.6 percent for a life of 12 missions. A probabilistic system analysis for four shuttles, each of which has four actuators, predicts a single bearing failure in one actuator of one shuttle after 22 missions (a total of 88

missions for a 4-shuttle fleet). This prediction is comparable with actual shuttle flight history in which a single actuator bearing was found to have failed by wear at 20 missions.
Author
Ball Bearings; Shafts (Machine Elements); Weibull Density Functions; Systems Analysis; Wear; Actuators

67
THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology, set theory, group theory and number theory.

20070016777 Massachusetts Univ., Amherst, MA USA
Efficient Computation of Entropy Gradient for Semi-Supervised Conditional Random Fields
Mann, Gideon S; McCallum, Andrew; Jan 2007; 5 pp.; In English
Contract(s)/Grant(s): HM1582-06-1-2013; IIS-0427594
Report No.(s): AD-A464763; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464763

Entropy regularization is a straightforward and successful method of semi-supervised learning that augments the traditional conditional likelihood objective function with an additional term that aims to minimize the predicted label entropy on unlabeled data. It has previously been demonstrated to provide positive results in linear-chain CRFs, but the published method for calculating the entropy gradient requires significantly more computation than supervised CRF training. This paper presents a new derivation and dynamic program for calculating the entropy gradient that is significantly more efficient having the same asymptotic time complexity as supervised CRF training. We also present efficient generalizations of this method for calculating the label entropy of all sub-sequences, which is useful for active learning, among other applications.
DTIC
Entropy; Gradients; Machine Learning; Random Variables

20070016781 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Sampled-Data Kalman Filtering and Multiple Model Adaptive Estimation for Infinite-Dimensional Continuous-Time Systems
Sallberg, Scott A; Mar 2007; 494 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464767; AFIT/DS/ENG/07-08; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464767

Kalman filtering and multiple model adaptive estimation (MMAE) methods have been applied by researchers in several engineering disciplines to a multitude of problems featuring a linear (or mildly nonlinear) model based on finite-dimensional differential (or difference) equations perturbed by random inputs. However, many real-world systems are more naturally modeled using an infinite-dimensional continuous-time linear systems model, such as those most naturally modeled as partial differential equations or time-delayed differential equations along with a possibly infinite-dimensional measurement model. The Kalman filtering technique was extended to encompass infinite-dimensional continuous-time systems with sampled-data measurements and a technique to approximate an infinite-dimensional continuous-time system model with an essentially equivalent finite-dimensional discrete-time model upon which a filtering algorithm could be based was developed. The tools developed during this research were demonstrated using an estimation problem based on a stochastic partial differential equation with an unknown noise environment.
DTIC
Kalman Filters; Partial Differential Equations; Sampled Data Systems

20070016785 Air Force Research Lab., Wright-Patterson AFB, OH USA
Basis Construction for the Design of Boundary Feedback Controls From Reduced Order Models (Preprint)
Camphouse, R C; Nov 2006; 20 pp.; In English
Contract(s)/Grant(s): Proj-2304
Report No.(s): AD-A464776; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464776

We develop a reduced basis construction method that allows for separate consideration of baseline and actuated dynamics in the reduced modeling process. A prototype initial boundary value problem, governed by the two-dimensional Burgers equation, is formulated to demonstrate the utility of the method in a boundary control setting. A weak formulation approach,

in combination with proper orthogonal decomposition and Galerkin projection, is used to develop a reduced model of the distributed parameter system. Comparisons are done between reduced and full order solutions under open-loop boundary actuation to illustrate advantages gained by separate consideration of actuated dynamics in the reduced modeling process. A tracking control problem is specified for the full order system using a linear quadratic regulator formulation. Comparisons of feedback control effectiveness are done to demonstrate benefits in control effectiveness obtained from separate consideration of actuated dynamics during model reduction.
DTIC
Boundaries; Boundary Value Problems; Burger Equation; Feedback Control; Linear Systems; Models; Orthogonality; Structural Design

20070016795 California Inst. of Tech., Pasadena, CA USA
Analysis of Implicit Uncertain Systems. Part 2: Constant Matrix Problems and Application to Robust H2 Analysis
Paganini, Fernando; Dec 8, 1994; 32 pp.; In English
Report No.(s): AD-A464793; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464793

This paper introduces an implicit framework for the analysis of uncertain systems of which the general properties were described in Part 1. In Part 2 the theory is specialized to problems which admit a finite dimensional formulation. A constant matrix version of implicit analysis is presented, leading to a generalization of the structured singular value microns as the stability measure; upper bounds are developed and analyzed in detail. An application of this framework results in a practical method for robust H2 analysis: computing robust performance in the presence of norm-bounded perturbations and white- noise disturbances.
DTIC
Differential Equations; Hydrogen; Integral Equations; Linear Equations; Linear Transformations; Matrices (Mathematics); Measurement; Uncertain Systems

20070016847 Ottawa Univ., Ontario Canada
Privacy-Preserving Collaborative Sequential Pattern Mining
Zhan, Justin Z; Chang, LiWu; Matwin, Stan; Jan 2004; 13 pp.; In English
Report No.(s): AD-A465063; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465063

In the modern business world, collaborative data mining becomes especially important because of the mutual benefit it brings to the collaborators. During the collaboration, each party of the collaboration needs to share its data with other parties. If the parties don't care about their data privacy, the collaboration can be easily achieved. However, if the parties don't want to disclose their private data to each other, can they still achieve the collaboration? To use the existing data mining algorithms, all parties need to send their data to a trusted central place to conduct the mining. However in situations with privacy concerns, parties may not trust anyone, including a third party. Generic solutions for any kind of secure collaborative computing exist in the literature. However, none of the proposed generic solutions is practical in handling large-scale data sets because of the prohibitive extra cost in protecting data privacy. Therefore, practical solutions need to be developed. This need underlies the rationale for our research.
DTIC
Algorithms; Data Mining; Pattern Recognition; Privacy; Protocol (Computers)

20070016933 Abdelmalek Essaadi Univ., Tetuan, Morocco
Global Modeling of Microwave Three Terminal Active Devices Using the FDTD Method
Mrabet, O E; Essaaidi, M; Drissi, M'hamed; Jan 25, 2005; 7 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N62558-02-M-5113
Report No.(s): AD-A464848; No Copyright; Avail.: CASI: A02, Hardcopy

This paper presents a new approach for the global electromagnetic analysis of the three-Terminal active linear and nonlinear microwave circuits using the Finite-Difference Time Domain (FDTD) Method. Here, we have updated the both electric field components on the three - terminal active device by correlating the voltage and current with its impedance. This approach is applied to the analysis of a linear amplifier which includes a three-terminal active MESFET device. Simulations results are in good agreement with those of the commercial tool.
DTIC
Differential Equations; Electromagnetism; Finite Difference Theory; Finite Difference Time Domain Method; Microwave Equipment; Nonlinear Equations

20070017017 Naval Research Lab., Washington, DC USA

Analysis of a Point-Source Integrating-Cavity Absorption Meter

Leathers, Robert A; Downes, T V; Davis, Curtiss O; Nov 20, 2000; 11 pp.; In English

Report No.(s): AD-A465051; No Copyright; Avail.: CASI: A03, Hardcopy

We evaluate the theoretical performance of a point-source integrating-cavity absorption meter (PSICAM) with Monte Carlo simulations and a sensitivity analysis. We quantify the scattering errors, verifying that they are negligible for most ocean optics applications. Although the PSICAM detector response is highly sensitive to the value of the wall reflectivity, the absorption of an unknown fluid can be accurately determined with a PSICAM if appropriate reference solution(s) are chosen. We also quantify the error that results if the source is not perfectly isotropic, finding that moderate amounts of source anisotropy can be tolerated provided that the detector is properly located with respect to the source.

DTIC

Absorption; Cavities; Optical Measuring Instruments; Sea Water

20070017025 California Inst. of Tech., Pasadena, CA USA

Controller Design with Real Parametric Uncertainty

Young, Peter M; Aug 30, 1993; 35 pp.; In English

Report No.(s): AD-A465111; CIT-CDS-93-016; No Copyright; Avail.: CASI: A03, Hardcopy

A number of techniques have been developed in recent years for the analysis and design of controllers which are robust with respect to structured complex uncertainty. In particular the complex mu synthesis procedure has been successfully applied to a number of engineering problems. However the presence of real parametric uncertainty in the problem description substantially complicates matters, so that standard complex mu synthesis techniques are no longer adequate. In this paper we develop a procedure to tackle the mixed (real and complex) micro synthesis problem. This procedure involves a 'D,G-K iteration' between computing the mixed mu upper bound and solving an H infinity, optimal control problem, and has guaranteed convergence to a local minimum of the (nonconvex) problem. The procedure has been implemented in software, and several controller designs are compared with the corresponding complex mu synthesis designs.

DTIC

Controllers

20070017037 Naval Research Lab., Washington, DC USA

Difference of Sums Containing Products of Binomial Coefficients and their Logarithms

Miller, Allen R; Moskowitz, Ira S; Jan 2004; 13 pp.; In English

Report No.(s): AD-A465131; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy

Properties of the difference of two sums containing products of binomial coefficients and their logarithms which arise in the application of Shannon's information theory to a certain class of covert channels are deduced. Some allied consequences of the latter are also recorded.

DTIC

Binomial Coefficients; Binomials; Coefficients; Logarithms; Mathematical Models; Sums

20070017041 Naval Research Lab., Washington, DC USA

An Analysis of the Timed Z-channel

Moskowitz, Ira S; Greenwald, Steven J; Kang, Myong H; Jan 1996; 11 pp.; In English

Report No.(s): AD-A465140; XB-NRL/MR/5540; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Our timed Z-channel (a general case of the Z-channel) appears as the basis for a large class of covert channels. Golomb analyzed the Z-channel, a memoryless channel with two input symbols and two output symbols, where one of the input symbols is transmitted with noise while the other is transmitted without noise, and the output symbol transmission times are equal. We introduce the timed Z-channel, where the output symbol transmission times are different. Specifically, we show how the timed Z-channel applies to two examples of covert timing channel scenarios: a CPU scheduler, and a token ring network. We then give a detailed analysis of our timed Z-channel. We report a new result expressing the capacity of the timed Z-channel as the log of the root of a trinomial equation. This changes the capacity calculation from an optimization problem into a simpler algebraic problem and illustrates the relationship between the noise and time factors. Further, it generalizes Shannon's work on noiseless channels for this special case. We also report a new result bounding the timed Z-channel's capacity from

below. Finally, we show how an interesting observation that Golomb reported for the Z-channel also holds for the timed Z-channel.
DTIC
Channel Capacity; Computer Networks; Microwave Landing Systems; Security

20070017046 Naval Research Lab., Washington, DC USA
Salsa: Beyond Model Checking
Bharadwaj, Ramesh; Jan 2001; 16 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465149; No Copyright; Avail.: CASI: A03, Hardcopy

The Verification Problem: Given the following: * A system description * A set of environmental assumptions * A set of required properties (one-state or two-state) -- Verification is the process of: * Extracting models from the system description. Sufficient to establish the properties of interest. * Applying a verification tool to the model to verify/refute properties. Very likely that a property is not provable (or wrong).
DTIC
Models; Theorem Proving

20070017424 Naval Research Lab., Washington, DC USA
A Classical Automata Approach to Noninterference Type Problems
Moskowitz, Ira S; Costich, Oliver L; Jun 1992; 9 pp.; In English
Contract(s)/Grant(s): N00014-89-C-2389
Report No.(s): AD-A465050; No Copyright; Avail.: CASI: A02, Hardcopy

Using classical automata theory we show how noninterference can be viewed as a relatively simple phenomenon. We also give direction for future work concerning probabilistic security problems using classical automata theory.
DTIC
Automata Theory; Security; Mathematical Models

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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*.

20070016715 Osaka Univ., Osaka, Japan
Periodic Magnetoresistance Oscillations in Side-Gated Quantum Dots
Suzuki, T; Momose, H; Morifuji, M; Mori, N; Kondow, M; Jan 2006; 5 pp.; In English
Report No.(s): AD-A464528; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464528

We fabricated side-gated quantum-dot structures on a GaAs/AlGaAs single heterostructure and measured their magnetoresistance at low temperature. We observed that oscillations appear almost periodic in B for a lower magnetic field region. We find that the oscillation period is fairly independent of the structure width. The experimental magnetoconductance are compared with numerical results.
DTIC
Magnetoresistivity; Oscillations; Quantum Dots

20070016731 Naval Research Lab., Bay Saint Louis, MS USA
Doppler Frequency Shift in Ocean Wave Measurements: Frequency Downshift of a Fixed Spectral Wave Number Component by Advection of Wave Orbital Velocity
Hwang, Paul; Jan 2006; 5 pp.; In English
Report No.(s): AD-A464656; NRL/JA/7330-05-5252; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464656

Because the Jacobian connecting wave number to frequency conversion is nonlinear, in the presence of background waves even without a mean current a wave number spectral component does not appear at he expected intrinsic frequency in the frequency spectrum measured by a stationary probe. The advection of the wave number component by the orbital current of

background waves produces a net downshift in the encounter frequency. Comparison with laboratory measurements shows that the effect is important in low-wind conditions. As wind speed increases, the frequency downshift due to orbital advection becomes less recognizable.
DTIC
Advection; Doppler Effect; Frequencies; Frequency Converters; Frequency Shift; Measurement; Ocean Surface; Orbital Velocity; Spectra; Water Waves

20070016746 Pennsylvania State Univ., State College, PA USA
Modal Analysis Using the Singular Value Decomposition
Fahnline, J B; Campbell, R L; Hambric, S A; May 2004; 21 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464680; TR-04-008; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464680

Many methods exist for identifying modal parameters from experimental transfer function measurements. For frequency domain calculations, rational fraction polynomials have become the method of choice, although it generally requires the user to identify frequency bands of interest along with the number of modes in each band. This process can be tedious, especially for systems with a large number of modes, and it assumes the user can accurately assess the number of modes present in each band from frequency response plots of the transfer functions. When the modal density is high, better results can be obtained by using the singular value decomposition to help separate the modes before the modal identification process begins. In a typical calculation, the transfer function data for a single frequency is arranged in matrix form with each column representing a different drive point. The matrix is input to the singular value decomposition algorithm and left- and right-singular vectors and a diagonal singular value matrix are computed. The calculation is repeated at each analysis frequency and the resulting data is used to identify the modal parameters. In the optimal situation, the singular value decomposition will completely separate the modes from each other, so that a single transfer function is produced for each mode with no residual effects. A graphical method has been developed to simplify the process of identifying the modes, yielding a relatively simple method for computing mode shapes and resonance frequencies from experimental data.
DTIC
Decomposition; Frequencies

20070016855 Florida Univ., Gainesville, FL USA
Quantitative Study of Nanoscale Contact and Pre-Contact Mechanics Using Force Modulation
Syed Asif, S A; Wahl, K J; Colton, R J; Nov 1999; 7 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F49620-96-1-0026
Report No.(s): AD-A465073; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465073

For submicron-scale mechanical property measurements, depth sensing nanoindentation techniques are very successful and gaining much attention. However, for ultra-small volumes of materials below a length scale of 10 nm, measuring the quantitative mechanical properties of materials is still a problem. The atomic force microscope (AFM) has very good surface sensitivity and has been shown to measure nanomechanical properties. However cantilever instability, conventional force detection and displacement sensing make contact area measurement difficult, hence the measured mechanical properties are usually only qualitative. In this article, we show that combining force modulation with depth sensing nanoindentation allows measurement of the mechanical properties of materials on the nanometer scale. With this technique we have studied the role of oxide layers on the mechanical response of Si surfaces. We also present a novel quantitative stiffness imaging technique, which can be used to directly map the mechanical properties of materials with submicron lateral resolution.
DTIC
Modulation; Quantitative Analysis

20070016862 Naval Research Lab., Washington, DC USA
Nanoindentation and Contact Stiffness Measurement Using Force Modulation with a Capacitive Load-Displacement Transducer
Syed Asif, S A; Wahl, K J; Colton, R J; May 1999; 7 pp.; In English
Report No.(s): AD-A465093; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465093

We have implemented a force modulation technique for nanoindentation using a three-plate capacitive load-displacement

transducer. The stiffness sensitivity of the instrument is ~0.1 N/m. We show that the sensitivity of this instrument is sufficient to detect long-range surface forces and to locate the surface of a specimen. The low spring mass (236 mg), spring constant (116 N/m) and damping coefficient (0.008 Ns/m) of the transducer allows measurement of the damping losses for nanoscale contacts. We present the experimental technique, important specimen mounting information, and system calibration for nanomechanical property measurement.
DTIC
Capacitance; Displacement; Loads (Forces); Measurement; Modulation; Nanoindentation; Stiffness; Transducers

20070017067 North Carolina State Univ., Raleigh, NC USA
Viscoelastic Mapping of the Arterial Ovine System using a Kelvin Model
Valdez-Jasso, D; Haider, M A; Banks, H T; Bia, D; Zocalo, Y; Armentano, R; Olufsen, M S; Mar 19, 2007; 19 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): FA9550-04-1-0220
Report No.(s): AD-A465195; No Copyright; Avail.: CASI: A03, Hardcopy

The mechanics of the arterial wall is complex, due to its material structure and load conditions, which influence the hemodynamic properties as well as the growth and remodeling process of the cardiovascular system. Arterial remodeling can be found both locally and globally. Local remodeling is typically a result of disease, while global remodeling can be found even for healthy arteries. In this study we have analyzed how elastic and viscoelastic properties differ across 7 locations along the large ovine arteries in 11 sheep. We combined the Kelvin model with experimental measurements of vessel diameter and pressure obtained in-vitro at conditions mimicking the in-vivo dynamics. Elastic and viscoelastic wall properties were assessed by analyzing values of four model parameters across the 7 locations. To do so we solved an inverse problem, resulting in computed estimates for each of the four parameter values that minimize the residual between the data and the model. We used sensitivity analysis to compute standard errors, and confidence intervals for all model parameters. Results showed that while elastic properties including Young's modulus and the vessel wall thickness varied across locations (smaller arteries were stiffer than larger arteries) viscoelastic relaxation parameters did not differ significantly across locations. We also showed that for all locations, the inclusion of viscoelastic behavior, e.g., using the Kelvin model, is important to capture pressure-area dynamics.
DTIC
Arteries; Mapping; Viscoelasticity

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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*.

20070016963 University of Southern California, Marina del Rey, CA USA
A Novel Multichannel Panning Method for Standard and Arbitrary Loudspeaker Configurations
Sadek, Ramy; Kyriakakis, Chris; Oct 31, 2004; 6 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-99-D-0046
Report No.(s): AD-A464895; No Copyright; Avail.: Defense Technical Information Center (DTIC)

This paper presents a novel panning algorithm called Speaker-Placement Correction Amplitude Panning (SPCAP) which guarantees conservation of loudspeaker power output. The method is appropriate for any speaker arrangement (e.g. ITU 5.1, 10.2, etc.), and scales with the number of speakers. SPCAP works by correcting initial pan values based on speaker placement to achieve constant power output. Because panning occurs over an arbitrary number of speakers (i.e. is not pair-wise), SPCAP provides two significant advantages over discrete panning schemes. First, pan values for current and future surround-sound formats (e.g. 5.1 and 10.2) are guaranteed to conserve power under any lower-resolution setup, making dynamic up/down mixing in non-standard setups feasible. Second, SPCAP provides a framework for producing wide (non point-source) sounds.
DTIC
Acoustics; Algorithms; Loudspeakers

20070017245 Florida Univ., Gainesville, FL, USA
Development of a Tunable Electromechanical Acoustic Liner for Engine Nacelles
Liu, Fei; Sheplak, Mark; Cattafesta, Louis N., III; February 28, 2007; 94 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NNL04AA13A; No Copyright; Avail.: CASI: A05, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017245

This report describes the development of a tunable electromechanical Helmholtz resonator (EMHR) for engine nacelles using smart materials technology. This effort addresses both near-term and long-term goals for tunable electromechanical acoustic liner technology for the Quiet Aircraft Technology (QAT) Program. Analytical models, i.e. lumped element model (LEM) and transfer matrix (TM) representation of the EMHR, have been developed to predict the acoustic behavior of the EMHR. The models have been implemented in a MATLAB program and used to compare with measurement results. Moreover, the prediction performance of models is further improved with the aid of parameter extraction of the piezoelectric backplate. The EMHR has been experimentally investigated using standard two-microphone method (TMM). The measurement results validated both the LEM and TM models of the EMHR. Good agreement between predicted and measured impedance is obtained. Short- and open circuit loads define the limits of the tuning range using resistive and capacitive loads. There is approximately a 9% tuning limit under these conditions for the non-optimized resonator configuration studied. Inductive shunt loads result in a 3 degree-of-freedom DOF) system and an enhanced tuning range of over 20% that is not restricted by the short- and open-circuit limits. Damping coefficient ‘ measurements for piezoelectric backplates in a vacuum chamber are also performed and indicate that the damping is dominated by the structural damping losses, such as compliant boundaries, and other intrinsic loss mechanisms. Based on models of the EMHR, a Pareto optimization design of the EMHR has been performed for the EMHR with non-inductive loads. The EMHR with non-inductive loads is a 2DOF system with two resonant fiequencies. The tuning ranges of the two resonant frequencies of the EMHR with non-inductive loads cannot be optimized simultaneously; a trade-off (i.e., a Pareto solution) must be reached. The Pareto solution provides the information for a designer that shows how design trade-offs can be used to satisfy specific design requirements. The optimization design of the EMHR with inductive loads aims at optimal tuning of these three resonant fiequencies. The results indicate that it is possible to keep the acoustic reactance of the resonator close to a constant over a given frequency range. An effort to mimic the second layer of the NASA 2DOF liner using a piezoelectric composite diaphragm has been made. The optimal acoustic reactance of the second layer of the NASA 2DOF liner is achieved using a thin PVDF composite diaphragm, but matching the acoustic resistance requires further investigation. Acoustic energy harvesting is achieved by connecting the EMHR to an energy reclamation circuit that converts the ac voltage signal across the piezoceramic to a conditioned dc signal. Energy harvesting experiment yields 16 m W continuous power for an incident SPL of 153 dB. Such a level is sufficient to power a variety of low power electronic devices. Finally, technology transfer has been achieved by converting the original NASA ZKTL FORTRAN code to a MATLAB code while incorporating the models of the EMHR. Initial studies indicate that the EMHR is a promising technology that may enable lowpower, light weight, tunable engine nacelle liners. This technology, however, is very immature, and additional developments are required. Recommendations for future work include testing of sample EMHR liner designs in NASA Langley s normal incidence dual-waveguide and the grazing-incidence flow facility to evaluating both the impedance characteristics as well as the energy reclamation abilities. Additional design work is required for more complex tuning circuits with greater performance. Poor electromechanical coupling limited the electromechanical tuning capabilities of the proof of concept EMHR. Different materials than those studies and perhaps novel composite material systems may dramatically improvehe electromechanical coupling. Such improvements are essential to improved mimicking of existing double layer liners.

Author

Acoustic Emission; Electromechanics; Linings; Nacelles; Engine Design; Mathematical Models; Smart Materials

20070017252 NASA Langley Research Center, Hampton, VA, USA

Rapid SAW Sensor Development Tools

Wilson, William C.; Atkinson, Gary M.; [2007]; 7 pp.; In English; CANEUS/NASA Workshop on Fly-by-Wireless for Aerospace Vehicles, 27-28 Mar. 2007, Grapevine, TX, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 645846.02.07.07; Copyright; Avail.: CASI: A02, Hardcopy

The lack of integrated design tools for Surface Acoustic Wave (SAW) devices has led us to develop tools for the design, modeling, analysis, and automatic layout generation of SAW devices. These tools enable rapid development of wireless SAW sensors. The tools developed have been designed to integrate into existing Electronic Design Automation (EDA) tools to take advantage of existing 3D modeling, and Finite Element Analysis (FEA). This paper presents the SAW design, modeling, analysis, and automated layout generation tools.

Author

Surface Acoustic Wave Devices; Sensors; Automatic Control; Systems Health Monitoring; Systems Engineering

20070017924 NASA Langley Research Center, Hampton, VA, USA
Method for Standardizing Sonic-Boom Model Pressure Signatures Measured at Several Wind-Tunnel Facilities
Mack, Robert J.; April 2007; 14 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): WBS 984754.02.07.07.12.03
Report No.(s): NASA/TM-2007-214854; L-19320; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017924

Low-boom model pressure signatures are often measured at two or more wind-tunnel facilities. Preliminary measurements are made at small separation distances in a wind tunnel close at hand, and a second set of pressure signatures is measured at larger separation distances in a wind-tunnel facility with a larger test section. In this report, a method for correcting and standardizing the wind-tunnel-measured pressure signatures obtained in different wind tunnel facilities is presented and discussed.
Author
Sonic Booms; Wind Tunnels; Low Pressure; Standardization; Test Chambers; Signatures

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*.

20070016936 Air Force Research Lab., Kirkland AFB, NM USA
Extending Hyperspectral Capabilities with Dualband Infrared Focal Plane Arrays
LeVan, Paul D; Hartke, John P; Dereniak, Eustace L; Beecken, Brian P; Jan 2007; 11 pp.; In English
Report No.(s): AD-A464852; AFRL-VS-PS-TP-2007-1008; No Copyright; Avail.: CASI: A03, Hardcopy

Dualband infrared focal plane arrays (FPA) were developed originally for multi-spectral imaging applications, where their advantages in compactness and band-to-band pixel registration, relative to conventional multispectral imagers, were recognized. As dualband FPA architecture is matured for quantum well and mercury cadmium telluride focal plane arrays, and becomes within the grasp of strained layer superlattice technology, applications in addition to multi-waveband imaging come to mind. In various hyperspectral applications that employ gratings, the different grating orders can sometimes be paired with the wavebands of the dual- (or multi-) waveband FPA, allowing high efficiency hyperspectral imaging over very broad wavelength regions. Exploiting the 'third dimension' of FPA detecting layers for dual- and multi-waveband capability proved its usefulness for multi-waveband imaging; this paper will show similar advantages for hyperspectral applications and describe such applications.
DTIC
Focal Plane Devices; Frequencies; Imagery; Infrared Radiation

20070017062 Institute of Physical and Chemical Research, Saitama, Japan
X-Ray-Induced Fluorescence Spectroscopy with EBIT
Ozawa, S; Wakasugi, M; Okamura, M; Koizumi, T; Fukuda, M; Katayama, T; Jan 2004; 10 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465186; No Copyright; Avail.: CASI: A02, Hardcopy

Highly charged ions have a great potential for further insight in atomic physics or nuclear physics. We are planning an x-ray-induced fluorescence spectroscopy of highly charged ion trapped in EBIT. In the present paper we report an estimation of the feasibility of the experiment with EBIT and the present status of the demonstration experiment with synchrotron radiation and highly charged ion beam produced by a laser ion source.
DTIC
Charged Particles; Spectroscopy; X Ray Fluorescence; X Ray Spectroscopy

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*.

20070017898 NASA Glenn Research Center, Cleveland, OH, USA

Space and Terrestrial Power System Integration Optimization Code BRMAPS for Gas Turbine Space Power Plants With Nuclear Reactor Heat Sources

Juhasz, Albert J.; Feb. 13, 2007; 51 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): WBS 463169.01.03; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017898

In view of the difficult times the US and global economies are experiencing today, funds for the development of advanced fission reactors nuclear power systems for space propulsion and planetary surface applications are currently not available. However, according to the Energy Policy Act of 2005 the U.S. needs to invest in developing fission reactor technology for ground based terrestrial power plants. Such plants would make a significant contribution toward drastic reduction of worldwide greenhouse gas emissions and associated global warming. To accomplish this goal the Next Generation Nuclear Plant Project (NGNP) has been established by DOE under the Generation IV Nuclear Systems Initiative. Idaho National Laboratory (INL) was designated as the lead in the development of VHTR (Very High Temperature Reactor) and HTGR (High Temperature Gas Reactor) technology to be integrated with MMW (multi-megawatt) helium gas turbine driven electric power AC generators. However, the advantages of transmitting power in high voltage DC form over large distances are also explored in the seminar lecture series. As an attractive alternate heat source the Liquid Fluoride Reactor (LFR), pioneered at ORNL (Oak Ridge National Laboratory) in the mid 1960's, would offer much higher energy yields than current nuclear plants by using an inherently safe energy conversion scheme based on the Thorium --\g U233 fuel cycle and a fission process with a negative temperature coefficient of reactivity. The power plants are to be sized to meet electric power demand during peak periods and also for providing thermal energy for hydrogen (H2) production during 'off peak' periods. This approach will both supply electric power by using environmentally clean nuclear heat which does not generate green house gases, and also provide a clean fuel H2 for the future, when, due to increased global demand and the decline in discovering new deposits, our supply of liquid fossil fuels will have been used up. This is expected within the next 30 to 50 years, as predicted by the Hubbert model and confirmed by other global energy consumption prognoses. Having invested national resources into the development of NGNP, the technology and experience accumulated during the project needs to be documented clearly and in sufficient detail for young engineers coming on-board at both DOE and NASA to acquire it. Hands on training on reactor operation, test rigs of turbomachinery, and heat exchanger components, as well as computational tools will be needed. Senior scientist/engineers involved with the development of NGNP should also be encouraged to participate as lecturers, instructors, or adjunct professors at local universities having engineering (mechanical, electrical, nuclear/chemical, and/or materials) as one of their fields of study.

Author

Optimization; Computer Programs; Power Plants; Systems Integration; Aerospace Systems; Heat Sources; Reactor Technology; High Temperature Nuclear Reactors; Gas Turbine Engines

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*.

20070016854 Harrison (Robert G.), Edinburgh, UK

Fundamentals and Application of Stimulated Brillouin Scattering in Optical Fibre

Harrison, Robert; Lu, W; May 2004; 10 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): FA8655-03-1-3051

Report No.(s): AD-A465071; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465071

This report results from a contract tasking Dr, Robert G Harrison as follows: The contractor will investigate expansion of his existing computer code in order to model Stimulated Brillouin Scattering (SBS) in an optical fiber and its dependence

on numerical aperture and laser power He will investigate the appearance of both stochastic and deterministic elements in the observed SBS and using his modified computer model, determine the optimum conditions for generating steady-state SBS with maximum efficiency,
DTIC
Brillouin Effect; Fiber Optics; Optical Fibers

20070016866 Naval Research Lab., Washington, DC USA
Latest Results from the 32 km Maritime Lasercom Link at the Naval Research Laboratory, Chesapeake Bay Lasercom Test Facility
Burris, H R; Moore, C I; Seingen, L A; Vilcheck, M J; Tulchinsky, D A; Mahon, R; Wasiczko, L M; Stell, M F; Suite, M R; Davis, M A; Jan 2005; 12 pp.; In English
Report No.(s): AD-A465152; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465152

The Naval Center for Space Technology at the Naval Research Laboratory reports the latest results from the long-range, maritime, free-space lasercom test facility located between Chesapeake Beach, MD and Tilghman Island, MD. The two sections of the facility are separated by 16.2 km of the Chesapeake Bay. Using a new OC-48 receiver developed by NRL's Optical Science Division with a sensitivity of 33dBm for 10-9 bit error rate at 2.5 Gbps, we have closed a 32.4 km maritime lasercom link (round trip across the Chesapeake Bay) and performed bit error rate testing while transmitting 1.13 Terabytes of data. Bit error rate testing was also performed at lower data rates when atmospheric conditions were not favorable for high speed (2.5 Gbps), including testing at 150 Mbps through light fog and rain. In addition, we have set up a system for digitizing and transmitting full-color, uncompressed, video along with six audio channels and three RS-232 data channels over the maritime link. The digital link operated at 311 Mbps and could be maintained indefinitely, depending on atmospheric conditions. Several complete videos were transmitted in entirety or in part as well as live video from a handheld camcorder to test the system operation and robustness. The transmitter and receiver were co-located on the western shore of the bay at the NRL Chesapeake Bay Detachment. The data for both the bit error rate testing and the video was transmitted across the bay and returned from an array of retroreflectors located on a tower at Tilghman Island on the eastern shore. The lasercom links were closed with static pointing and with no active atmospheric aberration mitigation such as adaptive optics or fast steering mirrors on the receiver optics.
DTIC
Chesapeake Bay (US); Lasers; Optical Communication; Test Facilities; Video Signals

20070016977 University of Applied Sciences, Muenster, Germany
Thick Capacitive Meshes on Polyimide Substrates
Lueker, Arne; Sternberg, Oren; Hein, Herbert; Schulz, Joachim; Moeller, Karl-Dieter; Jan 2004; 6 pp.; In English
Report No.(s): AD-A464917; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Thick capacitive meshes of nickel on substrates of thickness 25 micrometers have been produced by electroplating into a photoresist mould. The Micro-Stripes program by Flomerics has been used for the interpretation of the experimentally measured far infrared spectrum. The measured reflection resonance mode and the transmission wave guide mode agree well with the analytical predictions.
DTIC
Capacitance; Electroplating; Infrared Filters; Microstructure; Polyimides; Substrates

20070017008 Purdue Univ., West Lafayette, IN USA
The Impact of Optical Comb Stability on Waveforms Generated via Spectral Line-by-Line Pulse Shaping
Huang, Chen-Bin; Jiang, Zhi; Leaird, Daniel E; Weiner, Andrew M; Feb 14, 2007; 14 pp.; In English
Contract(s)/Grant(s): FA9550-06-1-0189; Proj-V631/00
Report No.(s): AD-A464982; No Copyright; Avail.: CASI: A03, Hardcopy

Optical arbitrary waveform generation using the line-by-line pulse shaping technique has been shown to be sensitive to variations in the offset frequency of the input frequency comb due to time-domain waveform interference. Here we present a frequency-domain model that is able to predict waveform changes arising from offset frequency variations. In experiments we controllably shift the frequency of a comb derived from a phase-modulated CW laser, which allows us to quantitatively investigate waveforms generated by pulse shaping as a function of offset frequency. Experimental data are in excellent

agreement with the predictions of our frequency-domain model. In addition, we propose and analyze new waveforms designed for monitoring of offset frequency variations by pulse shaping.
DTIC
Frequencies; Optical Waveguides; Spectra; Stability; Waveforms

20070017009 Purdue Univ., West Lafayette, IN USA
Infrared-Sensitive Photorefractive Polymer Composite Devices
Peyghambarian, Nasser N; Mar 28, 2007; 29 pp.; In English
Contract(s)/Grant(s): FA9550-04-1-0096
Report No.(s): AD-A464987; No Copyright; Avail.: CASI: A03, Hardcopy

The main goal of the effort was to develop high performing photorefractive (PR) polymer composites working at 1 micrometer by one photon photorefractivity and two photon photorefractive devices operating at 1.5 micrometers. The utilization of these photorefractive devices for beam cleanup and reconstruction of aberrated images was also an important objective of the effort. We have accomplished these goals by developing highly efficient one photon sensitive photorefractive devices operating at about 1 micrometer with high diffraction efficiency, near video rate response time and high two beam coupling gain. This is the first time demonstration of an all-organic photorefractive material beyond 830 nanometers and the results are the best among any near-infrared photorefractive materials under similar experimental conditions.
DTIC
Composite Materials; Infrared Radiation; Polymers; Sensitivity

20070017974 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
M1 Mirror Print-Thru Investigation and Performance on the Thermo-Opto-Mechanical Testbed for the Space Interferometry Mission
Feria, V. Alfonso; Lam, Jonathan; Van Buren, Dave; May 24, 2006; 9 pp.; In English; SPIE Astronomical Telescopes and Instrumentation, 24-31 May 2006, Orlando, FL, USA; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39876

This paper presents the studies carried out to determine the source of the surface distortions on the M1 mirror as well as comparison and model validation during testing. This research was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.
Author
Optical Measuring Instruments; Interferometers; Mirrors; Surface Distortion; Position Errors; Loads (Forces); Deformation; Space Missions; Finite Element Method

20070017988 NASA Johnson Space Center, Houston, TX, USA
GEO Population Estimates using Optical Survey Data
Barker, Edwin S.; Matney, Mark J.; [2007]; 1 pp.; In English; 2007 Space Control Conference, 1 - 3 May 2007, Lexington, MA, USA; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017988

Optical survey data taken using the NASA Michigan Orbital Debris Survey Telescope (MODEST) gives us an opportunity to statistically sample faint object population in the Geosynchronous (GEO) and near-GEO environment. This paper will summarize the MODEST survey work that has been conducted by NASA since 2002, and will outline the techniques employed to arrive at the current population estimates in the GEO environment for dim objects difficult to detect and track using current systems in the Space Surveillance Network (SSN). Some types of orbits have a higher detection rate based on what parts of the GEO belt is being observed, a straightforward statistical technique is used to debias these observations to arrive at an estimate of the total population potentially visible to the telescope. The size and magnitude distributions of these fainter debris objects are markedly different from the catalogued population. GEO debris consists of at least two different populations, one which follows the standard breakup power law and one which has anomalously high Area-to-Mass Ratios (1 to approx. 30 square meters per kilogram; a sheet of paper = approx. 13 square meters per kilogram). The Inter-Agency Space Debris Coordination Committee (IADC) is investigating objects in GEO orbits with anomalously high Area-to-Mass Ratios (AMRs). The ESA Space Debris Telescope discovered this population and has and its properties of inclinations (0 to 30 degrees), changing eccentricities (0 and 0.6), and mean motions (approx. 1 rev), will be presented. The accepted interpretation of this orbital behavior is that solar radiation pressure drives the perturbations causing time varying inclinations and eccentricities.

The orbital parameters are unstable for this population and thus difficult to predict. Their dim visual magnitudes and photometric variability make observations a challenge. The IADC has enlisted a series of observatories (participating institutions: University of Michigan/CTIO, Astronomical Institute University of Bern, Boeing LTS / AMOS, Keldysh Institute of Applied Mathematics) at different longitudes. Complete observational coverage over periods of days to months will provide a better understanding of the properties, such as solar radiation pressure effects on orbital elements, size, shape, attitude, color variations, and spectral characteristics. Results from recent observational programs will be summarized, and includes a description of the orbit elements prediction processes, a summary of the metric tracking performance, and some photometric characteristics of this class of debris.
Author
Geosynchronous Orbits; Populations; Estimating; Optics; Surveys; Space Debris

20070018002 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Space Flight Requirements for Fiber Optic Components: Qualification Testing and Lessons Learned
Ott, Melanie N.; June 22, 2006; 30 pp.; In English; The Second ESA-NASA Working Meeting on Optoelectronics: Qualification of Technologies and Lessons Learned from Satellite LIDAR and Altimeter Missions, 21 - 21 Jun. 2006, Noordwijk, Netherlands; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070018002

This viewgraph presentation reviews the qualification testing requirements for Fiber Optic Components used during space flight. Since most components for space flight fiber optic components are now commercial of the shelf (COTS) products, and the changes at Goddard Space Flight Center, such as short term projects, and low budgets and other changes, have made full qualification of Fiber Optic Components not only too expensive also impossible. This presentation reviews the environmental parameters, the testing and or testing requirements of some optical components on board some NASA satellites.
CASI
Fiber Optics; Performance Tests; Qualifications; Optical Equipment; Photonics; Quality Control

75
PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90\fAstrophysics*.

20070017485 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Modeling the Self-organized Critical Behavior of Earth's Plasma Sheet Reconnection Dynamics
Klimas, Alexander J.; [2006]; 1 pp.; In English; Princeton Plasma Physics Laboratory meeting, 13-15 Apr. 2006, Princeton, NJ, USA; No Copyright; Avail.: Other Sources; Abstract Only

Analyses of Polar UVI auroral image data show that bright night-side high-latitude W emissions exhibit so many of the key properties of systems in self-organized criticality that an alternate interpretation has become virtually impossible. These analyses will be reviewed. It is now necessary to find and model the source of this behavior. We note that the most common models of self-organized criticality are numerical sandpiles. These are, at root, models that govern the transport of some quantity from a region where it is loaded to another where it is unloaded. Transport is enabled by the excitation of a local threshold instability; it is intermittent and bursty, and it exhibits a number of scale-free statistical properties. Searching for a system in the magnetosphere that is analogous and that, in addition, is known to produce auroral signatures, we focus on the reconnection dynamics of the magnetotail plasma sheet. In our previous work, a driven reconnection model has been constructed and has been under study. The transport of electromagnetic (primarily magnetic) energy carried by the Poynting flux into the reconnection region of the model has been examined. All of the analysis techniques (and more) that have been applied to the auroral image data have also been applied to this Poynting flux. New results will be presented showing that this model also exhibits so many of the key properties of systems in self-organized criticality that an alternate interpretation is implausible. A strong correlation between these key properties of the model and those of the auroral UV emissions will be demonstrated. We suggest that, in general, the driven reconnection model is an important step toward a realistic plasma physical model of self-organized criticality and we conclude, more specifically, that it is also a step in the right direction toward modeling the multiscale reconnection dynamics of the magnetotail.
Author
Magnetic Field Reconnection; Plasma Layers; Auroras; Statistical Distributions; Excitation

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*.

20070016720 Naval Research Lab., Washington, DC USA
Optimization of Buffer Layers for InGaAs/AIGaAs PIN Optical Modulators Grown on GaAs Substrates by Molecular Beam Epitaxy
Katzer, D S; Rabinovich, W S; Ikossi-Anastasiou, K; Gilbreath, G C; May 2000; 6 pp.; In English
Report No.(s): AD-A464630; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464630

In this work we compare the effect of the buffer layer on the device quality and surface morphology of strained InGaAs/AlGaAs PIN multiple quantum well (MQW) modulators. We examine GaAs buffer layers and linearly graded InGaAs buffer layers. Our results indicate that for lower indium concentrations in the quantum wells (less than about 23%) better device performance and surface morphology are obtained by growing directly on GaAs. PIN MQWs with indium mole fractions higher than about 24% have better properties when a linearly graded buffer layer is used.
DTIC
Gallium Arsenides; Indium Gallium Arsenides; Modulators; Molecular Beam Epitaxy; Pins; Quantum Wells; Substrates

20070016864 Air Force Research Lab., Hanscom AFB, MA USA
Depolarization Ratio of Rayleigh Scattered Radiation by Molecules
Sharma, Ramesh D; Burtt, Kelly D; Jan 12, 2007; 8 pp.; In English
Contract(s)/Grant(s): Proj-1010
Report No.(s): AD-A465096; AFRL-VS-HA-TR-2007-1029; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465096

The depolarization ratios of Rayleigh scattered radiation by molecules has been used to measure the ratio of anisotropic polarizability in the laboratory. The authors have calculated the depolarization ratio for N2, Ch3Cl, and H2O from the fors principles. It is shown that the depolarization ratio derived from input polarizabilities differs by a factor of about 4 for the sum of 1 diatom N2, by a factor of about 2.9 for symmetric top CH3Cl, and by a factor of about 5 for asymmetric top H2O. These large discrepancies arise because in deriving the ratio of anisotropic polarizability to isotropic (average) polarizability from the measured depolarization ratio, the constraints imposed by the conservation of angular momentum have been completely ignored.
DTIC
Anisotropy; Depolarization; Molecules; Rayleigh Scattering

20070016906 Glasgow Univ., UK
The Impact of Unintentional Discrete Charges in a Nominally Undoped Channel of a Thin Body Double Gate MOSFET: Classical to Full Quantum Simulation
Martinez, A; Barker, J R; Svizhenko, A; Anantram, M P; Brown, A R; Biegel, B; Asenov, A; Jan 2006; 5 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464713; No Copyright; Avail.: CASI: A01, Hardcopy

A comparison of full quantum device simulation with semi-classical methods is made for an unintended single atomistic dopant at various locations in a 10 nm double gate MOSFET transistor. The density gradient method comes closest to the non-equilibrium Green function results for fails seriously when the unwanted charge is located well-within the channel.
DTIC
Field Effect Transistors; Semiconductors (Materials); Simulation

20070017887 NASA Langley Research Center, Hampton, VA USA
Systems and Methods for Fabricating Thin Films
Beamesdefer, Michael A., Inventor; October 20, 2005; 12 pp.; In English
Patent Info.: Filed 18 Feb. 2005; US-Patent-Appl-SN-066654; US-Patent-Appl-SN-546311
Report No.(s): PB2007-105989; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017887

Disclosed are systems and methods for depositing thin films of uniform thickness. In an exemplary system, there is a coating chamber, an optical fiber in the coating chamber, and a plate oriented to receive light from the optical fiber. The exemplary system also includes a processor configured to process a light signal reflected from a thin film layer on a substrate. The coating process is responsive to the reflected light signal received from the thin film layer.
Author
Thin Films; Fabrication

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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*.

20070016940 Army Research Lab., Aberdeen Proving Ground, MD USA
Classical Methods for Frequency-Based Equations of State
Segletes, Steven B; Mar 2007; 42 pp.; In English
Contract(s)/Grant(s): Proj-AH80
Report No.(s): AD-A464859; ARL-RP-166; No Copyright; Avail.: CASI: A03, Hardcopy

A review of recent work by the author in the area of classical equation-of-state development is presented. The scope of the review extends from equation-of-state stability constraints to a frequency-based, closed-form equation-of-state formulation incorporating the effects of non-nearest lattice neighbors.
DTIC
Equations of State; Frequencies; Thermodynamics

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*.

20070016716 Naval War Coll., Newport, RI USA
Information Operations: Where Next?
Buchholz, David R; Feb 14, 2005; 21 pp.; In English
Report No.(s): AD-A464548; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464548

This paper addresses the 'ownership' of joint information operations (IO) by asking if U.S. Strategic Command (USSTRATCOM) is the right combatant commander to coordinate all Department of Defense (DoD) information operations. Doctrine already addresses the issue of combatant commander responsibility for ensuring that IO is planned and executed in the respective commands, but an IO vacuum exists with respect to standardized IO training and integration across the combatant commands. For this reason and others there is a compelling argument for the major responsibility for DoD information operations integration to fall under the control of U.S. Joint Forces Command (USJFCOM). The paper first explains how USSTRATCOM became the IO integrator for DoD IO. This is followed by the definition of joint IO as found in Joint Publication 3-13. The author then presents four historical examples of IO covering conflicts in four different geographic regions spanning 60 years. The examples include the use of IO during the Battle of Leyte Gulf in the Pacific theater, World War II; during Operation Desert Storm in Iraq; during Operation Noble Anvil in Kosovo, Serbia; and during Operation Uphold Democracy in Haiti. These examples highlight how IO, if successfully implemented, can be a force multiplier and mission enabler. They also shed light on the difficulties and consequences encountered if an IO strategy is not properly implemented. Finally, the command missions of USSTRATCOM and USJFCOM are analyzed to illustrate why USJFCOM is the command most suited to play the major role in the integration and projection of joint IO.
DTIC
Command and Control; Military Operations; Warfare

20070016721 Global Information Systems Technology, Inc., Champaign, IL USA
Assessing Army Professional Forums Metrics for Effectiveness and Impact
Cianciolo, Anna T; Heiden, Charles G; Prevou, Michael I; Oct 2006; 122 pp.; In English
Contract(s)/Grant(s): W74V8H-04-D-0044; Proj-D730
Report No.(s): AD-A464632; No Copyright; Avail.: CASI: A06, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464632

The rate of change in the operational environment outpaces the development of doctrine and schoolhouse instruction, leaders must direct their own development in order to adaptively and professionally meet the challenges brought on by Army transformation. Army professional forums (APFs), powered by advances in collaborative toolsets and multimedia presentation software, provide a means for leader self-development and professional growth. The research was conducted as an initial exploration of this area. The early stages of this initiative present the most valuable opportunity to establish checks that ensure the initiative is functioning effectively and meeting organizational goals. Establishing such checks enhances the organizational impact of the initiative. The APF assessment framework developed in the present research enables the assessment of APFs during the early stages of the Army knowledge-management initiative.
DTIC
Information Management; Leadership; Military Personnel; Personnel Development

20070016736 Library of Congress, Washington, DC USA
Protetion of National Security Information
Elsea, Jennifer K; Dec 26, 2006; 28 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464663; CRS-RL33502; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464663

Continued revelations involving alleged disclosures of classified information to the news media or to others who are not entitled to receive it have renewed Congress's interest with regard to the possible need for legislation to provide for criminal punishment for the 'leaks' of classified information. Opponents of any such legislation express concern regarding the possible consequences to freedom of the press and other First Amendment values. The current laws for protecting classified information have been criticized as a patchwork of sometimes abstruse and antiquated provisions that are not consistent and do not cover all the information the government legitimately needs to protect. Certain information is protected regardless of whether it belongs to the government or is subject to normal classification. Information related to' the national defense' is protected even though no harm to the national security is intended or is likely to be caused through its disclosure. However, nonmilitary information with the potential to cause serious damage to the national security is only protected from willful disclosure with the requisite intent or knowledge regarding the potential harm. For example, under 50 U.S.C. 783, the communication of classified information by a government employee is expressly punishable only if the discloser knows or has reason to believe the recipient is an agent or representative of a foreign government, but not, for example, if the recipient is an agent of an international terrorist organization. This report describes the current state of the law with regard to the unauthorized disclosure of classified information, including criminal and civil penalties that can be imposed on violators, as well as some of the disciplinary actions and administrative procedures available to federal agencies with respect to their employees, as such measures have been addressed by federal courts.
DTIC
Classifications; Defense Program; Information Transfer; Security

20070016805 Naval Research Lab., Washington, DC USA
Realizing the Network-Centric Warfare Vision: Network Technology Challenges and Guidelines
Freebersyser, James A; Macker, Joseph P; Jan 2001; 6 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464962; XB-NRL/ITD/5500; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464962

An expanded and improved information technology capability is the fundamental heart of the network -centric warfare (NCW) vision. The NCW vision is worthy and is a direct path to achieving improved collaborative power and information dominance. The potential benefits of diverse information sharing and interconnection are manifold, but at the same time difficult to fully predict and quantify. Moreover, along with unforeseen benefits, additional concerns often arise with technological enhancements to information sharing and access. In this paper, we consider several sources of friction working against achieving the NCW vision, we outline the technical challenges that must be met to overcome this friction, and we make some suggestions in progressing towards a set of solutions.
DTIC
Information Systems; Warfare

20070016813 Naval Research Lab., Washington, DC USA
What Price Privacy? (and why identity theft is about neither identity nor theft)
Shostack, Adam; Syverson, Paul; Jan 2004; 15 pp.; In English
Report No.(s): AD-A465002; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465002

It is commonplace to note that in surveys people claim to place a high value on privacy while they paradoxically throw away their privacy in exchange for a free hamburger or a two dollar discount on groceries. The usual conclusion is that people do not really value their privacy as they claim to or that they are irrational about the risks they are taking. Similarly it is generally claimed that people will not pay for privacy; the failure of various ventures focused on selling privacy is offered as evidence of this. In this chapter we will debunk these myths. Another myth we will debunk is that identity theft is a privacy problem. In fact it is an authentication problem and a problem of misplaced liability and cost. When these are allocated to those who create them, the problem does not exist. Finally we consider the oft asked question of how much privacy should be given up for security. We find this to be the wrong question. Security of institutions may decrease and infrastructure costs may be increased by a reduction in privacy.
DTIC
Consumers; Economic Analysis; Identities; Privacy; Security

20070016814 Naval War Coll., Newport, RI USA
Improving Information Warfare Targeting: An IW Fires System
Leney, Derek J; Feb 14, 2005; 30 pp.; In English
Report No.(s): AD-A465003; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465003

Information Operations (IO) has grown in importance during recent conflicts. Yet some aspects of IO coordination and integration have fallen short of expectations. This has led to a desire by many in the IO community to better manage Information Warfare 'fires' using the Joint Targeting Cycle as a rational process for their execution. However, current doctrine and joint organizations do not adequately provide for control of these fires. This paper addresses the conceptual challenges of Information Warfare (IW) targeting, including the differences between attacking 'will' and attacking 'capability.' Recent lessons learned in Iraq and Kosovo highlight additional IO problems within the Joint Targeting Cycle. An IW Fires System is proposed to address these shortcomings, providing a formalized and connected organization for IW targeting and fire support.
DTIC
Computer Networks; Electronic Warfare; Fires; Military Operations; Target Acquisition; Warfare

20070016844 Naval Research Lab., Washington, DC USA
Several Secure Store and Forward Devices
Goldschlag, David M; Mar 1996; 10 pp.; In English
Report No.(s): AD-A465060; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465060

DoD system high enclaves are often isolated from systems at other security levels because the usual connectors (guards) are expensive to procure, integrate, accredit, and operate, and usually require a human in the middle to review the data flow, independent of direction. This isolation reduces the effectiveness of information systems. The secure store and forward devices described in this paper can be used to solve an important (yet tractable) half of the problem: moving data from LOW to HIGH without a human in the middle. These devices were expressly designed to be easy to accredit. Security critical function is both minimized and separated from non-security critical function to reduce the need for trusted components. A prototype implementation of one of these store and forward devices is described as well.
DTIC
Access Control; Information Systems; Local Area Networks; Message Processing; Reliability; Security; Systems Engineering

20070016851 Pennsylvania Transportation Inst., University Park, PA USA
A Scalable and Extensible Interactive Scenario Architecture for Distributed Command and Control Simulations
El-Nasr, Magy S; Jones, Rashaad E; McNeese, Michael; Jun 2004; 32 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465068; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465068

Interactive virtual environments are becoming increasingly popular for their utility in virtual training, distributed decision-making and collaborative environments. Some of these applications rely on a scenario that is revealed to the user as he/she interacts with synthetic objects and characters that inhabit virtual worlds. The development and authoring of interactive dynamic scenarios is often hard and difficult to accomplish using current techniques. Many interactive scenario developers use decision trees, which yield very limiting and unfulfilling training experiences, because they do not stimulate learning or thinking beyond the scripted paths. Some researchers proposed plan-based interactive narrative architectures, which, although superior to decision trees, do not scale and do not address user's goals and intentions, yielding inflexible scenarios that do not adapt suitably to players goals or behaviors. In this paper, we propose a dynamic scenario architecture that aims at enhancing scalability and reuse by using a multi-agent layered problem solving technique. Additionally, the interactive scenario architecture will automatically adapt to users goals by integrating a user model and a user monitoring technique.
DTIC
Active Control; Command and Control; Distributed Parameter Systems; Pulse Rate; Scalers; Simulation

20070016863 Scripps Institution of Oceanography, La Jolla, CA USA
Nearshore Canyon Experiment
Guza, Robert T; Mar 2007; 4 pp.; In English
Contract(s)/Grant(s): N00014-02-1-0415
Report No.(s): AD-A465095; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465095
The objective of the Nearshore Canyon Experiment (NCEX) was to understand the effect of complex continental-shelf bathymetry on surface gravity waves and on the breaking-wave-driven circulation onshore of the irregular bathymetry. The NCEX observations were the first extensive quantitative field measurements of the effect of severe alongshore bathymetric inhomogeneities (here a submarine canyon) on incident waves, and on the surfzone circulation.
DTIC
Bathymeters; Canyons; Data Bases; Surveys

20070016867 Naval Research Lab., Washington, DC USA
Formalizing GDOI Group Key Management Requirements in NPATRL
Meadows, Catherine; Syverson, Paul; Cervesato, Iliano; Jan 2001; 11 pp.; In English
Contract(s)/Grant(s): N00173-00-C-2086; INT98-15731
Report No.(s): AD-A465153; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465153
Although there is a substantial amount of work on formal requirements for two and three-party key distribution protocols, very little has been done on requirements for group protocols. However, since the latter have security requirements that can differ in important but subtle ways, we believe that a rigorous expression of these requirements can be useful in determining whether a given protocol can satisfy an application's needs. In this paper we make a first step in providing a formal understanding of security requirements for group key distribution by using the NPATRL language, a temporal requirement specification language for use with the NRL Protocol Analyzer. We specify the requirements for GDOI, a protocol being proposed as an IETF standard, which we are formally specifying and verifying in cooperation with the MSec working group.
DTIC
Analyzers; Internets; Protocol (Computers); Requirements

20070016921 Naval Postgraduate School, Monterey, CA USA
Research on Deception in Defense of Information Systems
Rowe, Neil C; Auguston, Mikhail; Drusinsky, Doron; Michael, J B; Jun 2004; 31 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464829; No Copyright; Avail.: CASI: A03, Hardcopy
Our research group has been broadly studying the use of deliberate deception by software to foil attacks on information systems. This can provide a second line of defense when access controls have been breached or against insider attacks. The thousands of new attacks being discovered every year that subvert access controls say that such a second line of defense is desperately needed. We have developed a number of demonstration systems, including a fake directory system intended to waste the time of spies, a Web information resource that delays suspicious requests, a modified file-download utility that pretends to succumb to a buffer overflow, and a tool for systematically modifying an operating system to insert deceptive

responses. We are also developing an associated theory of deception that can be used to analyze and create offensive and defensive deceptions, with especial attention to reasoning about time using temporal logic. We conclude with some discussion of the legal implications of deception by computers.
DTIC
Computer Programs; Deception; Information Systems

20070016942 University of South Florida, Tampa, FL USA
Development of a Framework for Multimodal Research: Creation of a Bibliographic Database
Coovert, Michael D; Gray, Ashley A; Elliott, Linda R; Redden, Elizabeth S; Mar 2007; 95 pp.; In English
Contract(s)/Grant(s): DAAD19-01-C-0065; Proj-62716AH70
Report No.(s): AD-A464861; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The purpose of this report is to describe the development of a framework to enable classification, evaluation, and comparison of multimodal display research, based on task demands, display characteristics, research design, and individual differences. In this report, we describe the process by which a bibliographic database was developed and organized. First, the framework was specified, which then guided the identification and review of research and theory-based articles that were included in the bibliography. The results of the overall effort, the multimodal framework and article tracking sheet, bibliographic database, and searchable multimodal database make substantial and valuable contributions to the accumulation and interpretation of multimodal research. References collected in this effort are listed in the appendix.
DTIC
Bibliographies; Data Bases

20070016954 New Orleans Univ., LA USA
A Rapidly Relocatable Ocean Prediction System
Peggion, Germania; Barron, Charlie; Rowley, Clark; May 2006; 6 pp.; In English
Report No.(s): AD-A464878; NRL/PP/7320-06-6212; No Copyright; Avail.: CASI: A02, Hardcopy

Accurate ocean forecast requires and combines knowledge in physics, mathematics, computer sciences, drawing greatest advantage of the new technologies for access, analysis and distribution of the data. We will describe NCOM_OS, a portable, relocatable, and user-friendly prediction system based on the Naval Coastal Ocean Model (NCOM). The system has been developed and routinely applied in support of naval operation. With this product, analysis and prediction can be provided for any part of the word, usually within six hours of the request. For a rapid configuration, a set of data and products are generally on a low resolution and the system has the capability of replacing them with local and high-resolution databases. The simulations are usually on multiple 1-way nesting domains. The open boundary conditions for the outer nest are extracted from a operational, real-time global version of NCOM with approximately 1/8 degree resolution at mid-latitudes. We will present the results from some real-time exercises in coastal areas. One of the current applications is in support of the Autonomous Underwater Vehicle (AUV) testing exercise off Panama City, Fla. A preliminary configuration started running in a pseudo-operational mode (real-time forecast with forecasted winds) on August 15, 2004. We will present this configuration and discuss how it was able to model in real-time the effects of Hurricanes Ivan and Katrina on the Gulf of Mexico & its coastal areas
DTIC
Autonomy; Computerized Simulation; Military Operations; Ocean Models; Oceans; Prediction Analysis Techniques; Underwater Vehicles

20070016962 Army War Coll., Carlisle Barracks, PA USA
Post Conflict Reconstruction: A Selected Bibliography
Moyer, Jeanette M; Jan 2007; 27 pp.; In English
Report No.(s): AD-A464894; No Copyright; Avail.: CASI: A03, Hardcopy

American military, diplomatic, and humanitarian personnel continue to participate in postconflict reconstruction efforts around the world. This selected bibliography lists references for readings about postconflict reconstruction in general, as well as describing the aftermath of war in the following countries: Afghanistan, Bosnia, Haiti, Iraq, Kosovo, and Somalia. With the exception of some important older titles, most of the books, documents, articles and online resources cited are dated 2003 to the present. All items in the bibliography are available in the U.S. Army War College Library (USAWC Library). For users' convenience, at the end of the entries, the authors have added library call numbers, Internet addresses, or database links. Call numbers indicate the item's shelf location in the USAWC library. Please note that call numbers can vary from library to library.

Web sites were accessed during January 2007. This bibliography and others, compiled by the library's research librarians, are available online through the Library's home page http://www.carlisle.army.mil/library/bibliographies.htm.
DTIC
Bibliographies; United States; Warfare

20070017019 Mitre Corp., Bedford, MA USA
State of the Art in CyberSecurity Monitoring: A Supplement
LaPadula, Leonard J; Sep 2001; 18 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F19628-99-C-0001
Report No.(s): AD-A465099; MP-99B0000020R1SUPP2; No Copyright; Avail.: CASI: A03, Hardcopy

This paper is a supplement to the author's report, 'State of the Art in Cybersecurity Monitoring' (Sep 2000), and depends heavily on its companion paper, 'CyberSecurity Monitoring Tools and Projects: A Compendium of Commercial and Government Tools and Not-For-Profit Research Projects' (Aug 2001). Both of these referenced papers are revisions of the original 1999 publications. In September 2000, he issued an update to the state of the art paper. The update took a new look at the commercial marketplace, based on the latest cybersecurity monitoring compendium published in August 2000, to discern any trends and identify new kinds of products. Some new research and development initiatives were identified. Finally, the update offered commentary on the relationship between the commercial sector and MITRE's military sponsors and what the state of affairs might augur. This supplement neither incrementally extends the referenced update nor replaces it. Rather, it takes an independent look at the commercial products in the cybersecurity monitoring area and speculates on what the findings may mean to MITRE's military sponsors. The appendix presents a summary of commercial off-the-shelf (COTS) cybersecurity monitoring products in tabular form. The information includes name of tool, type of tool, when it was released, and commercial vendor.
DTIC
Commercial Off-the-Shelf Products; Computer Networks; Computer Programs; Information Systems

20070017020 Mitre Corp., Bedford, MA USA
Security Services Application Programming Interface (SS API) Developer's Security Guidance
Fayad, Amgad; Faatz, Don; Mar 2000; 65 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAB07-99-C-C201
Report No.(s): AD-A465100; MTR-99W0000027; No Copyright; Avail.: CASI: A04, Hardcopy

This document describes a specification of security services for distributed applications in the Defense Information Infrastructure (DII) Common Operating Environment (COE). Security services include identification and authentication, encryption, access control, and auditing. The security services are referred to as the COE security services API (COE SS API). The document includes a high-level description of the COE SS API, a formal Java-based specification, a mapping from the specification to the C and Java programming languages, and sample applications to demonstrate how the COE SS API can be used. Appendixes are as follows: Java Specification for the COE SS API, Java Programming Language Mapping, Sample Java Programs, C Language Mapping, and Sample C Programs.
DTIC
Application Programming Interface; Client Server Systems; Computer Information Security; Defense Program; Information Systems; Security

20070017021 Mitre Corp., Bedford, MA USA
CyberSecurity Monitoring Tools and Projects: A Compendium of Commercial and Government Tools and Government Research Projects
LaPadula, Leonard J; Aug 2000; 128 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F19628-99-C-0001
Report No.(s): AD-A465101; MP-00B0000018R3; No Copyright; Avail.: CASI: A07, Hardcopy

This document is a compendium of CyberSecurity Monitoring (CSMn) automated tools and research projects. In the first appendix to this document, users will find an explanation of what the author means by CyberSecurity Monitoring. In the second appendix, users will find a description of the attributes used to describe the tools and projects. In the descriptions of tools and projects, the author has used the unverified claims of the vendors and projects, paraphrasing what they have written to ensure a uniform style of presentation. In some cases, some other source of information was used; these cases are noted individually. The third appendix focuses on projects being conducted at the Air Force Research Laboratory, Rome, NY. These

projects encompass intrusion detection, damage assessment and recovery, forensic analysis, analysis and decision support, and intrusion detection support tools. A compendium of this type cannot cover all CSMn tools and projects -- there are too many of them and the population changes rapidly. For the commercial off-the-shelf (COTS) products, the author started the compendium in the latter half of 1998, and published the first version of it in March 1999 under the title 'Compendium of Anomaly Detection and Reaction Tools and Projects.' On May 17, 2000, he issued a revision of that work, which included more products and projects as well as new types of automated tools. In this Aug 2000 version of the compendium, the author has avoided the use of the word 'anomaly' and has narrowed the subject matter from cybersecurity management to cybersecurity monitoring. This revision includes all the government off-the-shelf (GOTS) products for which information could be obtained (4). All the research and development projects are ones that are funded, directly or indirectly, by the U.S. government. The compendium is organized into three sections: (1) Commercial Off-the-Shelf Products, (2) Government Off-the-Shelf Products, and (3) Research and Development.
DTIC
Commercial Off-the-Shelf Products; Computer Networks; Computer Programs; United States

20070017022 Mitre Corp., Bedford, MA USA
State of the Art in CyberSecurity Monitoring: An Update
LaPadula, Leonard J; Sep 2000; 22 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F19628-99-C-0001
Report No.(s): AD-A465102; MP-99B0000020R1SUPP1; No Copyright; Avail.: CASI: A03, Hardcopy

This paper is an update to the author's report, 'State of the Art in CyberSecurity Monitoring' (Sep 2000), and depends heavily on its companion paper, 'CyberSecurity Monitoring Tools and Projects: A Compendium of Commercial and Government Tools and Government Research Projects' (Aug 2000). Both of these referenced papers are revisions of the original 1999 publications. Although this update claims there are no major trends discernible since the publication of the 2000 report, it should nevertheless have utility for anyone interested in the state of the art in cybersecurity monitoring since it was described in the original report. There have been some noteworthy developments in the past year or so, including new commercial tools being released and new government research initiatives. The update first considers who the market leaders are and takes a look at mergers, acquisitions, and product transfers. It revisits commercial offerings and government research and development efforts. Based on these short reviews and other information gathered over the past year, the update considers technical trends. The update is organized as follows: (1) Commercial Products -- a look at the marketplace and a summary of commercial products based on the updated (Aug 2000) CyberSecurity Monitoring Compendium; (2) Research and Development -- identification of some new initiatives; and (3) Technical Trends -- discussion of trends and commentary on what the state of affairs augurs for MITRE's military sponsors. The appendix presents a summary of commercial off-the-shelf (COTS) cybersecurity monitoring products in tabular form. The information includes name of tool, type of tool, when it was released, and commercial vendor.
DTIC
Commercial Off-the-Shelf Products; Computer Networks; Computer Programs; Information Systems

20070017035 Naval Research Lab., Washington, DC USA
An Agent-Based Approach to Inference Prevention Distributed Database Systems
Chang, LiWu; Moskowitz, Ira S; Tracy, James; Jan 2002; 17 pp.; In English
Report No.(s): AD-A465129; XB-NRL/MR/5540; No Copyright; Avail.: CASI: A03, Hardcopy

We propose an inference prevention agent as a tool that enables each of the databases in a distributed system to keep track of probabilistic dependencies with other databases and then use that information to help preserve the confidentiality of sensitive data. This is accomplished with minimal sacrifice of the performance and survivability gains that are associated with distributed database systems.
DTIC
Data Bases; Inference; Prevention

20070017036 Naval Research Lab., Washington, DC USA
A Procedure for Verifying Security Against Type Confusion Attacks
Meadows, Catherine; Jan 2003; 12 pp.; In English
Report No.(s): AD-A465130; No Copyright; Avail.: CASI: A03, Hardcopy

A type confusion attack is one in which a principal accepts data of one type as data of another. Although it has been shown

by Heather et al. that there are simple formatting conventions that will guarantee that protocols are free from simple type confusions in which fields of one type are substituted for fields of another, it is not clear how well they defend against more complex attacks, or against attacks arising from interaction with protocols that are formatted according to different conventions. In this paper we show how type confusion attacks can arise in realistic situations even when the types are explicitly defined in at least some of the messages, using examples from our recent analysis of the Group Domain of Interpretation Protocol. We then develop a formal model of types that can capture potential ambiguity of type notation, and outline a procedure for determining whether or not the types of two messages can be confused. This work extends our earlier work on the subject in that it includes an explicit model of attacker and defender and extends the informal model of the type confusion attack in terms of a game between an intruder and a set of honest principals in or earlier work to a more formal model in which actions of intruder and honest principals are described explicitly. This gives us a simpler, more intuitive approach that allows us to calculate probabilities in a more systematic manner, and to compare different intruder strategies and different assumptions about the way in which the protocol is implemented in terms of their effects on type confusion.
DTIC
Cryptography; Games; Protocol (Computers); Security

20070017040 Naval Research Lab., Washington, DC USA
Statistical Sensitive Data Protection and Inference Prevention with Decision Tree Methods
Chang, LiWu; Jan 2003; 4 pp.; In English
Report No.(s): AD-A465138; No Copyright; Avail.: CASI: A01, Hardcopy

We present a new approach for protecting sensitive data in a relational table (columns: attributes; rows: records). If sensitive data can be inferred by unauthorized users with non-sensitive data, we have the inference problem. We consider inference as correct classification and approach it with decision tree methods. As in our previous work, sensitive data are viewed as classes of those test data and non-sensitive data are the rest attribute values. In general, however, sensitive data may not be associated with one attribute (i.e., the class), but are distributed among many attributes. We present a generalized decision tree method for distributed sensitive data. This method takes in turn each attribute as the class and analyze the corresponding classification error. Attribute values that maximize an integrated error measure are selected for modification. Our analysis shows that modified attribute values can be restored and hence, sensitive data are not securely protected. This result implies that modified values must themselves be subjected to protection. We present methods for this ramified protection problem and also discuss other statistical attacks.
DTIC
Classifications; Computer Information Security; Decision Theory; Distributed Processing; Inference; Prevention; Sensitivity

20070017065 Naval Research Lab., Washington, DC USA
A Decision Theoretical Based System for Information Downgrading
Moskowitz, LiWu /Chang, Ira S; Jan 2000; 8 pp.; In English
Report No.(s): AD-A465192; No Copyright; Avail.: CASI: A02, Hardcopy

It is sometimes necessary for the owner of proprietary data to publicize some of it while keeping the rest as private. For example, when releasing census data or corporate financial information, the release must be conducted in a manner consistent with individual privacy. The process of publicly releasing formerly private data is called downgrading. However, it may be possible to infer unreleased private information from the downgraded public information--the so called inference problem. Here, we discuss some of the design decisions that we have made, and continue to make, concerning our prototype for a high assurance system that evaluates downgrading decisions based upon the amount of private information that may be deduced through inference. Our software system, the Rational Downgrader, is composed of a knowledge-based decision maker to determine the rules that may be inferred, a GUARD to measure the amount of leaked information, and a parsimonious downgrader to modify the initial downgrading decisions. At present, we have restricted the Rational Downgrader to relational databases. Of course, the underlying theories apply to all forms of data. In this paper, we concentrate on design decisions made with the aim of achieving high assurance with respect to an optimality condition.
DTIC
Computer Programs; Inference; Relational Data Bases

20070017262 Executive Office of the President, Washington, DC USA
Networking and Information Technology Research and Development. Advanced Foundations for American Innovation. Supplement to the President's FY 2004 Budget
Sep 2003; 66 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465000; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The American imagination challenged to invent new technologies to meet vital national needs launched and powered a digital revolution that ultimately swept around the globe Today U.S. ingenuity is extending advances in computing networking, software, and information management technologies to a vast array of new applications and devices that are shaping national defense and national security capabilities driving rising economic productivity, supporting leading-edge scientific and medical research, and adding powerful new dimensions to the ways citizens work, learn, communicate, and interact with government. The Federal agencies whose fundamental information technology (IT) research is described in this document sponsored many of the scientific breakthroughs that set the foundations for the information age (see timeline on front-cover foldout). Working collaboratively in the multiagency Federal Networking and Information Technology Research and Development (NITRD) Program these agencies continue to foster an unrivalled U.S. capacity for innovation - the Nation's most vital resource for national security, economic development and continuous improvements in living standards for all Americans.

DTIC

Data Management; Federal Budgets; Information Systems; Networks; Research Management; Technology Assessment

20070017264 Executive Office of the President, Washington, DC USA

Guide to the NITRD Program FY 2004-FY 2005. Supplement to the President's Budget for FY 2005

Dec 2004; 114 pp.; In English; Original contains color illustrations

Report No.(s): AD-A464999; No Copyright; Avail.: Defense Technical Information Center (DTIC)

The Supplement to the President's FY 2005 Budget reports on the FY 2004 research and development (R&D) activities and FY 2005 plans of the multiagency Networking and Information Technology Research and Development (NITRD) Program. A collaborative effort of many Federal agencies (listed on pages 2-3), the NITRD Program is the Nation's principal source of long-term, fundamental information technology (IT) R&D, including advanced technologies in high-end computing systems and software, high-speed networking, software assurance and reliability, human-computer interaction, and information management, as well as research in the socioeconomic and workforce development implications of these new technologies. Each year, the NITRD Supplement to the President's Budget, also known as the Blue Book, seeks to illuminate the breadth of the NITRD portfolio and the impact of NITRD research advances on U.S. leadership in national defense and national security, cutting-edge science and technology, and economic prosperity, and on improving the quality of life for all Americans. This year's Blue Book highlights the technical domains, called Program Component Areas (PCAs), in which the NITRD agencies conduct IT research and collaborate to achieve common goals. The report, based on information provided by the agencies, is structured to serve as a detailed guide to the program, including both collaborative and agency-by-agency activities in FY 2004 and plans for FY 2005. The document begins with an overview of the NITRD Program, followed by sections on each NITRD PCA. The NITRD budget request for FY 2005, by agency and by PCA, appears on page 83, along with FY 2004 estimates.

DTIC

Data Management; Information Systems; Networks; Research Management

20070017284 National Counterintelligence Center, Washington, DC USA

Annual Report to Congress on Foreign Economic Collection and Industrial Espionage: 2001

Oct 2001; 12 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465109; No Copyright; Avail.: CASI: A03, Hardcopy

The Intelligence Authorization Act for Fiscal Year 1995 requires that the President annually submit to Congress updated information on the threat to U.S. industry from foreign economic collection and industrial espionage. This report updates the sixth 'Annual Report to Congress on Foreign Economic Collection and Industrial Espionage,' which was released in Sep 2000. The Authorization Act specifies that the annual report is to examine three aspects of the threat to U.S. industry: the number and identity of the foreign governments believed to be conducting industrial espionage, the industrial sectors and types of information and technology targeted by such espionage, and the methods used to conduct espionage. To prepare this assessment, the Office of the National Counterintelligence Executive (NCIX) requested the assistance of the Intelligence Community, including the Central Intelligence Agency (CIA), the Defense Intelligence Agency (DIA), the Department of State, and the Federal Bureau of Investigation (FBI). As the world's leading industrial power and leader in technology development, the USA continues to be a prime target of foreign economic collection and industrial espionage. The USA pays a high financial price for economic espionage. The business community estimates that, in calendar year 2000, economic espionage cost from $100-250 billion in lost sales. The greatest losses to U.S. companies involve information concerning manufacturing processes and research and development. Increasing competition for limited global resources will intensify

economic collection against the USA, including the theft of trade secrets and competitive business information.
DTIC
Congressional Reports; Economics; Industries; Organizations; United States

20070017286 National Counterintelligence Center, Washington, DC USA
Annual Report to Congress on Foreign Economic Collection and Industrial Espionage: 1999
Jan 1999; 6 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465108; No Copyright; Avail.: CASI: A02, Hardcopy

The Intelligence Authorization Act for Fiscal Year 1995 requires that the President annually submit to Congress updated information on the threat to U.S. industry from foreign economic collection and industrial espionage. This report updates the fourth 'Annual Report to Congress on Foreign Economic Collection and Industrial Espionage,' which was released in 1998. As a result of the global shift toward economic and technological competition, some foreign countries are becoming increasingly engaged in economic and industrial espionage. Foreign targeting of U.S. technology and economic and proprietary information is a growing concern. Economic and industrial espionage against the USA by foreign entities, both government-sponsored and private, threatens U.S. economic competitiveness and results in the loss of millions of U.S. dollars and thousands of jobs annually. The USA continues to be the preeminent world power. It has vital economic interests and military responsibilities around the globe. The protection of trade secret information, critical technologies, and proprietary information is an integral part of U.S. economic security. Due to the importance of maintaining U.S. economic competitiveness, current policy is to treat foreign threats to the economic well-being of the USA as a national security issue. Foreign countries, including some traditional allies, continue their attempts to collect information against U.S. interests. While foreign efforts persist, the U.S. Intelligence Community has detected no significant change from past patterns in both the nature and extent of the threat or in the type of technologies being targeted and collection methods employed. As in previous years, over a half dozen nations continue to be the most active collectors of U.S. proprietary information and critical technologies. These nations gather information through both open and legal means as well as through clandestine efforts.
DTIC
Congressional Reports; Economics; Industries; Organizations; United States

20070017288 National Counterintelligence Center, Washington, DC USA
Annual Report to Congress on Foreign Economic Collection and Industrial Espionage: 1998
Jan 1998; 17 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465107; No Copyright; Avail.: CASI: A03, Hardcopy

The Intelligence Authorization Act for Fiscal Year 1995 requires that the President annually submit to Congress updated information on the threat to U.S. industry from foreign economic collection and industrial espionage. This report updates the third 'Annual Report to Congress on Foreign Economic Collection and Industrial Espionage,' which was released in June 1997. Among the key findings are the following: despite the adoption of the Economic Espionage Act of 1996, many foreign countries, including some traditional U.S. allies, continue their attempts to acquire U.S. trade secret information and critical technologies for military and commercial application, through both legal and illegal means; updated information, as reported by the U.S. Intelligence Community, reaffirms the findings of the 1997 Annual Report to include the origin of the threat, collection targets, and methods of operation; analysis of updated information indicates that 8 countries are most actively targeting U.S. proprietary economic information, trade secrets, and critical technologies; in an effort to more effectively qualify the threat, 4 of the 12 most active collectors listed in the 1997 Annual Report were taken off the 1998 Priority Country List; collection efforts continue to be driven by military force modernization, economic competition, and commercial modernization using technologies with dual-use applications; and clandestine collection efforts continue, however, consistent with traditional espionage operations, a significant majority of foreign intelligence collection is initially conducted through legal and open means and may be a precursor to economic espionage. The appendix presents 7 case summaries of foreign industrial espionage.
DTIC
Congressional Reports; Economics; Industries; Organizations; United States

20070017289 Army Research Lab., Adelphi, MD USA
Information Assurance Tasks Supporting the Processing of Electronic Records Archives
Nguyen, Binh; Racine, Glenn; Luu, Brian; Cole, John; Mar 2007; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464699; ARL-TR-4064; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464699

This document reports the results of three (3) information assurance tasks that support the distributed processing of electronic records archives during FY06: (1) transfer network intrusion detection technologies to NARA, (2) analyze the performance costs of security products deployed in a web server, and (3) evaluate a secure virtual private network (VPN) product.
DTIC
Distributed Processing; Documents

20070017290 National Counterintelligence Center, Washington, DC USA
Annual Report to Congress on Foreign Economic Collection and Industrial Espionage: 1997
Jan 1997; 22 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465106; No Copyright; Avail.: CASI: A03, Hardcopy

The Intelligence Authorization Act for Fiscal Year 1995 requires that the President annually submit to Congress updated information on the threat to U.S. industry from foreign economic collection and industrial espionage. This report updates the second 'Annual Report to Congress on Foreign Economic Collection and Industrial Espionage 1996,' which was released in May 1996. Among the key findings are the following: the Economic Espionage Act of 1996, signed by President Clinton, will help to protect valuable U.S. trade secrets; updated information reaffirms the findings of the 1996 Annual Report and includes the origin of the threat, collection targets, and methods of operation; traditional threat countries and a number of nontraditional threat countries continue their collection of U.S. trade secrets; the U.S. counterintelligence community has specifically identified the suspicious collection and acquisition activities of foreign entities from at least 23 countries; analysis of updated information indicates that of those identified countries, 12 are assessed to be most actively targeting U.S. proprietary economic information and critical technologies (this list has not changed since the 1996 Annual Report); the increasing value of trade secrets in the global and domestic marketplaces, and the corresponding spread of technology, have combined to significantly increase both the opportunities and motives for conducting economic espionage; foreign collection continues to focus on U.S. trade secrets and S&T information and products; of particular interest to foreign collectors are dual-use technologies; while the clandestine efforts of foreign intelligence services continue, changes in collection methods of operation are evidenced by a transition from reliance on clandestine and illegal activity to overt and legal collection methods; this transition is not limited to commercially sponsored activity, but also includes foreign intelligence service activity.
DTIC
Congressional Reports; Economics; Industries; Organizations; United States

20070017294 National Counterintelligence Center, Washington, DC USA
Annual Report to Congress on Foreign Economic Collection and Industrial Espionage: 1996
Jan 1996; 15 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465105; No Copyright; Avail.: CASI: A03, Hardcopy

The Intelligence Authorization Act for Fiscal Year 1995 requires that the President annually submit to Congress updated information on the threat to U.S. industry from foreign economic collection and industrial espionage. This document updates the first 'Annual Report to Congress on Foreign Economic Collection and Industrial Espionage 1995,' which was released in July 1995. Contributors noted little new in the origin of the threat, collection targets, or methods used in effecting economic collection and industrial espionage. Analysis of updated information reported by U.S. counterintelligence agencies indicates that individuals, corporations, or government entities associated with at least 12 countries are assessed to be actively targeting U.S. proprietary economic information and critical technologies. This includes all of the 10 countries previously identified in the 1995 Annual Report. The 12 countries assessed to be actively collecting against U.S. interests have shown particular determination, and in most cases a willingness to use illegal and covert means, to collect U.S. economic and technological information. Inquiries and investigations of suspicious incidents have increased significantly; there are tentative indications of an expansion of nontraditional collection targeting U.S. industry. Foreign collection continues to focus on economic and S&T information and products. U.S. Defense investigators noted a primary focus on information systems technology. Foreign government and commercial collection continues to focus on dual-use technologies. Overt, open-source, and legal collection methods are most evident, but reliance on illegal, covert, and traditional espionage methods has not abated. Analysis suggests venues of collection efforts may be in flux as communications proliferate and marketplace expansion continues. These developments will provide more opportunities to access targeted information and technologies in the USA and globally.
DTIC
Congressional Reports; Economics; Industries; Organizations; United States

20070017296 Executive Office of the President, Washington, DC USA

Networking and Information Technology Research and Development. Supplement to the President's Budget for FY 2002

Jul 2001; 55 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465006; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Today, at the beginning of a new millennium, networking and information technologies are transforming our world, generating unprecedented American prosperity, and building revolutionary new infrastructures for commerce, communication, human development, national security, and scientific research. In this remarkable period of transformation, the USA stands preeminent as the world's information technology pioneer, research leader, and foremost developer and deployer of cutting-edge computing, high-speed telecommunications, and information technology (IT) systems.

DTIC

Information Systems; Networks; Research Management; Technology Assessment

20070017315 Massachusetts Univ., Amherst, MA USA

Resource-Bounded Information Gathering for Correlation Clustering

Kanani, Pallika; McCallum, Andrew; Jan 2007; 4 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): HM1582-06-1-2013; IIS-0326249

Report No.(s): AD-A464769; No Copyright; Avail.: Defense Technical Information Center (DTIC)

ONLINE: http://hdl.handle.net/100.2/ADA464769

We present a new class of problems, called resource-bounded information gathering for correlation clustering. Our goal is to perform correlation clustering under circumstances in which accuracy may be improved by augmenting the given graph with additional information. This information is obtained by querying an external source under resource constraints. The problem is to develop the most effective query selection strategy to minimize some loss function on the resulting partitioning. We motivate the problem using an entity resolution task.

DTIC

Cluster Analysis; Graphs (Charts); Data Correlation

20070017330 Naval Research Lab., Washington, DC USA

An Approach for Semantic Query Processing with UDDI

Luo, Jim; Montrose, Bruce; Kang, Myong; Jan 2005; 11 pp.; In English; Original contains color illustrations

Report No.(s): AD-A465160; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465160

UDDI is not suitable for handling semantic markups for Web services due to its flat data model and limited search capabilities. In this paper, we introduce an approach to allow for support of semantic service descriptions and queries using registries that conforms to UDDI V3 specification. Specifically, we discuss how to store complex semantic markups in the UDDI data model and use that information to perform semantic query processing. Our approach does not require any modification to the existing UDDI registries. The add-on modules reside only on clients who wish to take advantage of semantic capabilities. This approach is completely backward compatible and can integrate seamlessly into existing infrastructure.

DTIC

Semantics; Specifications; Query Languages; Queueing Theory

20070017334 Naval Research Lab., Washington, DC USA

Reasoning About Security Models

McLean, John; Jan 1987; 10 pp.; In English

Report No.(s): AD-A465058; No Copyright; Avail.: CASI: A02, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465058

A method for evaluating security models is developed and applied to the model of Bell and LaPadula. The method shows the inadequacy of the Bell and LaPadula model, in particular,and the impossibility of any adequate definition of a secure system based solely on the notion of a secure state. The implications for the fruitfulness of seeking a global definition of a secure system and for the state of foundational research in computer security, in general, is discussed.

DTIC

Models; Computer Information Security; Methodology; Data Processing

20070017337 Naval Research Lab., Washington, DC USA

Anonymous Connections and Onion Routing

Syverson, Paul F; Goldschlag, David M; Reed, Michael G; Jan 1997; 12 pp.; In English

Report No.(s): AD-A465126; No Copyright; Avail.: Defense Technical Information Center (DTIC)

Onion Routing provides anonymous connections that are strongly resistant to both eavesdropping and traffic analysis. Unmodified Internet applications can use these anonymous connections by means of proxies. The proxies may also make communication anonymous by removing identifying information from the data stream. Onion routing has been implemented on Sun Solaris 2.X with proxies for Web browsing, remote logins, and e-mail. This paper's contribution is a detailed specification of the implemented onion routing system, a vulnerability analysis based on this specification, and performance results.

DTIC

Data Processing; Architecture (Computers); Cryptography

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LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

20070017472 Government Accountability Office, Washington, DC, USA

Issues Surrounding the Transition from the Space Shuttle to the Next Generation of Human Space Flight Systems

March 28, 2007; 19 pp.; In English

Report No.(s): GAO-07-595T; No Copyright; Avail.: CASI: A03, Hardcopy

NASA is in the midst of a transition effort that will include a massive transfer of people, hardware, and infrastructure. Based on ongoing and work completed to-date, we have identified a number of issues that pose unique challenges to NASA as it transitions from the shuttle to the next generation of human space flight systems while at the same time seeking to minimize the time the USA will be without its own means to put humans in space. These issues include: sustaining a viable workforce; effectively managing systems development efforts; managing the supplier base; providing logistical support to the International Space Station; identifying and disposing of property and equipment; ensuring adequate environmental remediation; and transforming its business processes and financial management system. NASA already has in place many processes, policies, procedures and support systems to carry out this transition. However, successful implementation of the transition will depend on thoughtful execution and effective oversight. How well NASA overcomes some of the challenges we have identified will not only have an effect on NASA's ability to effectively manage the gap in the U.S. human access to space, but will also affect the agency's ability to secure a sound foundation for the President's space exploration policy.

Author

International Space Station; Space Exploration; Manned Space Flight; Mission Planning; NASA Programs; Project Management

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SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through\f93*.

20070016700 Wyle Labs., Inc., Houston, TX, USA

Liquid Metering Centrifuge Sticks (LMCS): A Centrifugal Approach to Metering Known Sample Volumes for Colorimetric Solid Phase Extraction (C-SPE)

Gazda, Daniel B.; Schultz, John R.; Clarke, Mark S.; July 12, 2007; 8 pp.; In English; Original contains color and black and white illustrations

Report No.(s): 07ICES-200; Copyright; Avail.: CASI: A02, Hardcopy

Phase separation is one of the most significant obstacles encountered during the development of analytical methods for water quality monitoring in spacecraft environments. Removing air bubbles from water samples prior to analysis is a routine task on earth; however, in the absence of gravity, this routine task becomes extremely difficult. This paper details the development and initial ground testing of liquid metering centrifuge sticks (LMCS), devices designed to collect and meter a known volume of bubble-free water in microgravity. The LMCS uses centrifugal force to eliminate entrapped air and

reproducibly meter liquid sample volumes for analysis with Colorimetric Solid Phase Extraction (C-SPE). C-SPE is a sorption-spectrophotometric platform that is being developed as a potential spacecraft water quality monitoring system. C-SPE utilizes solid phase extraction membranes impregnated with analyte-specific colorimetric reagents to concentrate and complex target analytes in spacecraft water samples. The mass of analyte extracted from the water sample is determined using diffuse reflectance (DR) data collected from the membrane surface and an analyte-specific calibration curve. The analyte concentration can then be calculated from the mass of extracted analyte and the volume of the sample analyzed. Previous flight experiments conducted in microgravity conditions aboard the NASA KC-135 aircraft demonstrated that the inability to collect and meter a known volume of water using a syringe was a limiting factor in the accuracy of C-SPE measurements. Herein, results obtained from ground based C-SPE experiments using ionic silver as a test analyte and either the LMCS or syringes for sample metering are compared to evaluate the performance of the LMCS. These results indicate very good agreement between the two sample metering methods and clearly illustrate the potential of utilizing centrifugal forces to achieve phase separation and metering of water samples in microgravity.
Author
Water Quality; Centrifugal Force; Extraction; Spacecraft Environments; Air Sampling; Microgravity; Solid Phases; Diffuse Radiation

20070016704 NASA Johnson Space Center, Houston, TX, USA
Digital Learning Network Education Events for the Desert Research and Technology Studies
Paul, Heather L.; Guillory, Erika R.; [2007]; 5 pp.; In English; ICES, 9-12 Jul. 2007, Chicago, IL, USA; Original contains color illustrations
Contract(s)/Grant(s): 731384.06.04.01.05.10
Report No.(s): 07ICES-10; Copyright; Avail.: CASI: A01, Hardcopy

NASA s Digital Learning Network (DLN) reaches out to thousands of students each year through video conferencing and webcasting. As part of NASA s Strategic Plan to reach the next generation of space explorers, the DLN develops and delivers educational programs that reinforce principles in the areas of science, technology, engineering and mathematics. The DLN has created a series of live education videoconferences connecting the Desert Research and Technology Studies (RATS) field test to students across the USA. The programs are also extended to students around the world via live webcasting. The primary focus of the events is the Vision for Space Exploration. During the programs, Desert RATS engineers and scientists inform and inspire students about the importance of exploration and share the importance of the field test as it correlates with plans to return to the Moon and explore Mars. This paper describes the events that took place in September 2006.
Author
Education; Video Communication; Video Conferencing; Teleconferencing; Students; Field Tests

20070017451 NASA Johnson Space Center, Houston, TX, USA
Considerations on Terrestrial Iron Depositing Analogs to Earliest Mars
Brown, Igor I.; Allen, Carlton C.; Sarkisova, S. A.; Garrison, D. H.; McKay, D. S.; [2007]; 1 pp.; In English; 2nd International Workshop Exploring Mars and Its Earth Analogues, 19-23 Jun. 2007, Trento, Italy; No Copyright; Avail.: Other Sources; Abstract Only

Iron oxide and hydroxide minerals, including hematite, can mineralize and preservemicrofossils and physical biomarkers (Allen at al., 2004). Preserved remnants of phototrophic microorganisms are recognized as biosignatures of past life on Earth (Schopf, 2006). To date, two types of surface iron depositing environments have been studied as analogs to possible habitable environments on earliest Mars: the highly acidified Rio Tinto River (Iberian Belt, Spain) [Gomez Ortis et al., 2007], and the nearneutral iron depositing Chocolate Pots Hot Spring (Yellowstone National Park, US) [Parenteau at al., 2005]. While phototrophs in the Rio Tinto are only represented by eukaryotic algae (Amaral Zettler et all., 2002), Chocolate Pots is mainly populated with cyanobacteria (Pierson et all., 2000; Brown et all., 2007). Which of these environments is the closer analog to a potentially habitable early Mars? Paleobiological data, combined with recent ‘tree of life’ interpretations, suggest that phototrophic eukaryotes evolved not earlier than 2.5 - 2.8 b.y. after Earth s accretion (4.6 b.y.), while cyanobacteria and /or their iron-tolerant predecessors evolved between 1 - 1.5 b.y. after accretion (Brown et al., 2007). Lindsay and Brasier (2002) postulated that microbial life on Mars surface could have lasted no more than 1-1.5 b.y. after Mars accretion (also 4.6 b.y.). Recent multispectral mapping of Mars suggests that near-neutral wet environments prevailed at approximately this time (Bibring, et al., 2006). Thus, near-neutral iron depositing hot springs such as Chocolate Pots Hot Spring seem to be the more likely habitable analogs for earliest Mars.
Author
Iron Oxides; Hydroxides; Minerals; Biomarkers; Microorganisms; Hematite; Paleobiology; Photomapping; Mars (Planet); Life Sciences; Earth Analogs

20070017944 AI Solutions, Inc., Lanham, MD, USA

Realistic Covariance Prediction for the Earth Science Constellation

Duncan, Matthew; Long, Anne; [2006]; 12 pp.; In English; AAS/AIAA Astrodynamics Specialist Conference, 21-24 Aug. 2006, Keystone, CO, USA; Original contains color illustrations; Copyright; Avail.: CASI: A03, Hardcopy

Routine satellite operations for the Earth Science Constellation (ESC) include collision risk assessment between members of the constellation and other orbiting space objects. One component of the risk assessment process is computing the collision probability between two space objects. The collision probability is computed using Monte Carlo techniques as well as by numerically integrating relative state probability density functions. Each algorithm takes as inputs state vector and state vector uncertainty information for both objects. The state vector uncertainty information is expressed in terms of a covariance matrix. The collision probability computation is only as good as the inputs. Therefore, to obtain a collision calculation that is a useful decision-making metric, realistic covariance matrices must be used as inputs to the calculation. This paper describes the process used by the NASA/Goddard Space Flight Center's Earth Science Mission Operations Project to generate realistic covariance predictions for three of the Earth Science Constellation satellites: Aqua, Aura and Terra.

Author

Covariance; Probability Density Functions; Satellite Constellations; Probability Theory; Earth Sciences; Decision Making; Monte Carlo Method

20070017981 NASA Johnson Space Center, Houston, TX, USA

Derivation and Application of a Global Albedo yielding an Optical Brightness To Physical Size Transformation Free of Systematic Errors

Mulrooney, Dr. Mark K.; Matney, Dr. Mark J.; [2007]; 2 pp.; In English; Advanced Maui Optical and Space Surveillance Technologies Conference, 12 - 15 Sept. 2007, Maui, HI, USA

Contract(s)/Grant(s): NNJ05HI05C; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017981

Orbital object data acquired via optical telescopes can play a crucial role in accurately defining the space environment. Radar systems probe the characteristics of small debris by measuring the reflected electromagnetic energy from an object of the same order of size as the wavelength of the radiation. This signal is affected by electrical conductivity of the bulk of the debris object, as well as its shape and orientation. Optical measurements use reflected solar radiation with wavelengths much smaller than the size of the objects. Just as with radar, the shape and orientation of an object are important, but we only need to consider the surface electrical properties of the debris material (i.e., the surface albedo), not the bulk electromagnetic properties. As a result, these two methods are complementary in that they measure somewhat independent physical properties to estimate the same thing, debris size. Short arc optical observations such as are typical of NASA's Liquid Mirror Telescope (LMT) give enough information to estimate an Assumed Circular Orbit (ACO) and an associated range. This information, combined with the apparent magnitude, can be used to estimate an 'absolute' brightness (scaled to a fixed range and phase angle). This absolute magnitude is what is used to estimate debris size. However, the shape and surface albedo effects make the size estimates subject to systematic and random errors, such that it is impossible to ascertain the size of an individual object with any certainty. However, as has been shown with radar debris measurements, that does not preclude the ability to estimate the size distribution of a number of objects statistically. After systematic errors have been eliminated (range errors, phase function assumptions, photometry) there remains a random geometric albedo distribution that relates object size to absolute magnitude. Measurements by the LMT of a subset of tracked debris objects with sizes estimated from their radar cross sections indicate that the random variations in the albedo follow a log-normal distribution quite well. In addition, this distribution appears to be independent of object size over a considerable range in size. Note that this relation appears to hold for debris only, where the shapes and other properties are not primarily the result of human manufacture, but of random processes. With this information in hand, it now becomes possible to estimate the actual size distribution we are sampling from. We have identified two characteristics of the space debris population that make this process tractable and by extension have developed a methodology for performing the transformation.

Author

Aerospace Environments; Debris; Optical Measurement; Circular Orbits; Systematic Errors; Radar Cross Sections; Radar Measurement; Range Errors; Albedo; Brightness; Photometry

20070017999 NASA Marshall Space Flight Center, Huntsville, AL, USA

Science and Technology Directorate Publications and Presentations, January 1-December 31, 2005

Summers, F. G., Compiler; September 2006; 56 pp.; In English

Report No.(s): NASA/TM-2006-214606; M-1175; No Copyright; Avail.: CASI: A04, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017999

This Technical Memorandum (TM) lists the significant publications and presentations of the Science and Technology Directorate during the period January 1-December 31, 2005. Entries in the main part of the document are categorized according to NASA Reports (arranged by report number), Open Literature, and Presentations (arranged alphabetically by title). Most of the articles listed under Open Literature have appeared in refereed professional journals, books, monographs, or conference proceedings. Although many published abstracts are eventually expanded into full papers for publication in scientific and technical journals, they are often sufficiently comprehensive to include the significant results of the research reported. Therefore, published abstracts are listed separately in a subsection under Open Literature. Questions or requests for additional information about the entries in this report should be directed to Dr. J.F. Spann, Jr. (VP60; 961-7512) or to one of the authors.

Author

Astrophysics; Biophysics; Microgravity; Earth Sciences; Documents; Abstracts

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ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

20070016685 NASA Goddard Space Flight Center, Greenbelt, MD, USA

SWIFT Detects a remarkable Gamma-ray Burst, GRB 060514, that introduces a New Classification Scheme

Gehrels, N.; Norris, J. P.; Mangano, V.; Barthelmy, S. D.; Burrows, D. N.; Granot, J.; Kaneko, Y.; Kouveliotou, C.; Markwardt, C. B.; Meszaros, P.; Nakar, E.; Nousek, J. A.; O'Brien, P. T.; Page, M.; Palmer, D. M.; Parsons, A. M.; Roming, P. W. A.; Sakamoto, T.; Sarazin, C. L.; Schady, P.; Stamatikos, M.; Woosley, S. E.; [2007]; 13 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

Gamma ray bursts (GFU3s) are known to come in two duration classes, separated at approx.2 s. Long bursts originate from star forming regions in galaxies, have accompanying supernovae (SNe) when near enough to observe and are likely caused by massive-star collapsars. Recent observations show that short bursts originate in regions within their host galaxies with lower star formation rates, consistent with binary neutron star (NS) or NS - black hole (BH) mergers. Moreover, although their hosts are predominantly nearby galaxies, no SNe have been so far associated with short GRBs. We report here on the bright, nearby GRB 060614 that does not fit in either class. Its approx.102 s duration groups it with long GRBs, while its temporal lag and peak luminosity fall entirely within the short GRB subclass. Moreover, very deep optical observations exclude an accompanying supernova, similar to short GRBs. This combination of a long duration event without accompanying SN poses a challenge to both a collapsar and merging NS interpretation and opens the door on a new GRB classification scheme that straddles both long and short bursts.

Author

Star Formation Rate; Gamma Ray Bursts; Black Holes (Astronomy); Classifications; Supernovae; Massive Stars; Binary Stars

20070016687 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Thermospheric Studies with Mars Global Surveyor

Lemoine, F. G.; Bruinsma, S.; Chin, D. S.; Forbes, J. M.; August 24, 2006; 13 pp.; In English; American/AAS Strodynamics Conference, 21-24 Aug. 2006, Keystone, CO, USA

Report No.(s): AIAA Paper 2006-6395; Copyright; Avail.: CASI: A03, Hardcopy

The Mars Global Surveyor spacecraft has been located in a near-circular, polar, and low-altitude mapping orbit about Mars for six years, since February 1999. The spacecraft is tracked routinely by the antennae of the Deep Space Network (DSN), using the X Band radio system of the spacecraft. These tracking data have been used for routine spacecraft navigation, and for radio science studies, such as the estimation of the static and time-varying gravity field of Mars. In this paper we describe the methodology for reduction of these data in order to estimate the Mars atmospheric density (normalized to an altitude 380 km) over half a solar cycle, where we discern the correlation of the density with the incident solar flux, and the 27-day solar rotation. The results show that the density at the MGS altitude varies from a mean of 0.7 x 10(exp -17) grams/cu cm near aphelion to a mean of 3.0 x 10(exp -17)grams/cu cm near perihelion.

Author

Mars Global Surveyor; Thermosphere; Atmospheric Composition; Trace Elements; Gravitational Fields; Variations; Mars Atmosphere

20070016694 NASA Goddard Space Flight Center, Greenbelt, MD, USA
XMM-Newton Archival Study of the ULX Population in Nearby Galaxies
Winter, Lisa M.; Mushotzky, Richard F.; Reynolds, christopher S.; May 31, 2006; 54 pp.; In English
Report No.(s): astro-ph/0512480v2; Copyright; Avail.: CASI: A04, Hardcopy

We present the results of an archival XMM-Newton study of the bright X-ray point sources (L(sub X) greater than 10(exp 38 erg per second)) in 32 nearby galaxies. From our list of approximately 100 point sources, we attempt to determine if there is a low-state counterpart to the Ultraluminous X-ray (ULX) population, searching for a soft-hard state dichotomy similar to that known for Galactic X-ray binaries and testing the specific predictions of the IMBH hypothesis. To this end, we searched for low-state objects, which we defined as objects within our sample which had a spectrum well fit by a simple absorbed power law, and high-state objects, which we defined as objects better fit by a combined blackbody and a power law. Assuming that low-state)) objects accrete at approximately 10% of the Eddington luminosity (Done & Gierlinski 2003) and that high-state objects accrete near the Eddington luminosity we further divided our sample of sources into low and high state ULX sources. We classify 16 sources as low-state ULXs and 26 objects as high-state ULXs. As in Galactic black hole systems, the spectral indices, GAMMA, of the lowstate objects, as well as the luminosities, tend to be lower than those of the high-state objects. The observed range of blackbody temperatures for the high state is 0.1-1 keV, with the most luminous systems tending toward the lowest temperatures. We therefore divide our high-state ULXs into candidate IMBHs (with blackbody temperatures of approximately 0.1 keV) and candidate stellar mass BHs (with blackbody temperatures of approximately 1.0 keV). A subset of the candidate stellar mass BHs have spectra that are well-fit by a Comptonization model, a property similar of Galactic BHs radiating in the very-high state near the Eddington limit.
Author
XMM-Newton Telescope; Luminosity; Galaxies; Populations; X Ray Binaries

20070016711 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Burst Oscillations: A New Spin on Neutron Stars
Strohmayer, Tod; January 10, 2007; 1 pp.; In English; 209th AAS Meeting, 5-10 Jan. 2007, Seattle, WA, USA; No Copyright; Avail.: Other Sources; Abstract Only

Observations with NASA's Rossi X-ray Timing Explorer (RXTE) have shown that the X-ray flux during thermonuclear X-ray bursts fr-om accreting neutron stars is often strongly pulsed at frequencies as high as 620 Hz. We now know that these oscillations are produced by spin modulation of the thermonuclear flux from the neutron star surface. In addition to revealing the spin frequency, they provide new ways to probe the properties and physics of accreting neutron stars. I will briefly review our current observational and theoretical understanding of these oscillations and discuss what they are telling us about neutron stars.
Author
Neutron Stars; Oscillations; Gamma Ray Bursts; X Ray Astronomy

20070016839 National Optical Astronomy Observatories, Tucson, AZ USA
Gas in the Terrestrial Planet Region of Disks: CO Fundamental Emission from T Tauri Stars
Najita, Joan; Carr, John S; Mathieu, Robert D; Jun 1, 2003; 23 pp.; In English
Report No.(s): AD-A465054; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA465054

We report the results of a high-resolution spectroscopic survey for CO fundamental emission from T Tauri stars. CO fundamental emission is frequently detected, with the likely origin of the emission in the circumstellar disk. An initial assessment of the line profiles indicates that the emission region includes the equivalent of the terrestrial planet region of our solar system, a result that suggests the utility of CO fundamental emission as a probe of disks at planet formation distances. Since fundamental emission is detected frequently from both close binary and apparently single stars, it appears that both low column density regions, such as disk gaps, and temperature inversion regions in disk atmospheres can produce significant emission. The estimated excitation temperature of the emitting gas is unexpectedly warm for the disk radii that they appear to probe. Thus, the surface gaseous component of inner disks may be significantly warmer than the surface dust component. We also detect CO emission from a transitional T Tauri star. Because fundamental emission from CO and its isotopes is sensitive to a wide range of gas masses, CO fundamental emission may prove useful in measuring the residual gas content of dissipating disks. This may be an effective way to explore the gas dissipation timescale in inner disks and to thereby place constraints on the timescale for giant planet formation.
DTIC
Carbon Monoxide; Emission; Planets; T Tauri Stars; Terrestrial Planets

20070016840 Naval Research Lab., Washington, DC USA

The [C II] 158 Micron Line Deficit in Ultraluminous Infrared Galaxies Revisited

Luhman, M L; Satyapal, S; Fischer, J; Wolfire, M G; Sturm, E; Dudley, C C; Lutz, D; Genzel, R; Sep 10, 2003; 19 pp.; In English

Report No.(s): AD-A465055; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/100.2/ADA465055

We present a study of the [C II] 157.74-micrometer fine-structure line in a sample of 15 ultraluminous infrared (IR) galaxies using the Long Wavelength Spectrometer (LWS) on the Infrared Space Observatory (ISO). We confirm the observed order of magnitude deficit (compared to normal and starburst galaxies) in the strength of the [C II] line relative to the far-infrared (FIR) dust continuum emission found in our initial report, but here with a sample that is twice as large. This result suggests that the deficit is a general phenomenon affecting 4 out of 5 ULIRGs. We present an analysis using observations of generally acknowledged photodissociation region (PDR) tracers, which suggests that a high ultraviolet flux incident on a moderate density n PDR could explain the deficit. However, comparisons with other ULIRG observations, including, and 6.2-micrometer polycyclic aromatic hydrocarbon (PAH) emission, suggest that high PDRs alone cannot produce a self-consistent solution that is compatible with all of the observations. We propose that non-PDR contributions to the FIR continuum can explain the apparent [C II] deficiency.

DTIC

Galaxies; Infrared Radiation; Luminosity

20070017018 Naval Research Lab., Washington, DC USA

Is the High-Energy Emission from Centaurus A Compton-Scattered Jet Radiation?

Skibo, J G; Dermer, C D; Kinzer, R L; Jan 1994; 14 pp.; In English

Report No.(s): AD-A465052; No Copyright; Avail.: CASI: A03, Hardcopy

We consider whether the hard X-ray and soft gamma-ray emission from Centaurus A is beamed radiation from the active nucleus which is Compton-scattered into our line-of-sight. We derive the spectrum and degree of polarization of scattered radiation when incident beamed radiation is scattered from a cold (kappa Tau \h\h mec2) electron cloud moving with bulk relativistic motion along the jet axis, and calculate results for an unpolarized, highly-beamed incident power-law photon source. The spectra of the scattered radiation exhibit a cut-off at gamma-ray energies due to electron recoil. The cut off energy depends on the observer's viewing angle and the bulk Lorentz factor of the scattering medium. We fit the OSSE data from Centaurus A with this model and find that if the scatterers are not moving relativistically, then the angle the jet makes with respect to our line-of-sight is 61 degrees plus or minus 5 degrees. We predict a high degree of polarization of the scattered radiation below ~300 keV. Future measurements with X-ray and gamma-ray polarimeters could be used to constrain or rule out such a scenario.

DTIC

Compton Effect; Electron Scattering; Emission; Galaxies; Radio Galaxies; Radio Jets (Astronomy)

20070017400 NASA Marshall Space Flight Center, Huntsville, AL, USA

Prompt and Afterglow Emmision Properties of Gamma-ray Bursts with Spectroscopically Identified Supernovae

Kaneko, Yuki; Ramirez-Ruiz, Enrico; Granot, Jonathan; Kouveliotou, Chryssa; Woosley, Stan E.; Patel, Sandeep K.; Rol, Evert; In'TZant, Jean J. M.; VanDerHorst, Alexander J.; Wijers, Ralph A. M. J.; Strom, Richard; The Astrophysical Journal; January 2007; Volume 654, pp. 385-402; In English; Original contains black and white illustrations; Copyright; Avail.: Other Sources

We present a detailed spectral analysis of the prompt and afterglow emission of four nearby long-soft gamma-ray bursts (GRBs 980425,030329,031203, and 060218) that were spectroscopically found to be associated with Type IC supernovae and compare them to the general GRB population. For each event, we investigate the spectral and luminosity evolution and estimate the total energy budget based on broadband observations. The observational inventory for these events has become rich enough to allow estimates of their energy content in relativistic and subrelativistic form. The result is a global portrait of the effects of the physical processes responsible for producing long-soft GRBs. In particular, we find that the values of the energy released in mildly relativistic out8ows appears to have a sigruficantly smaller scatter than those found in highly relativistic ejecta. This is consistent with a picture in which the energy released inside the progenitor star is roughly standard, while the fracti

Author

Gamma Ray Bursts; Supernovae; Afterglows; Emission Spectra

20070017409 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

Progress in testing exo-planet signal extraction on the TPF-I Planet Detection Testbed

Martin, Stefan R.; Szwaykowski, Piotr; Loya, Frank M.; Liewer, Kurt; May 24, 2006; 10 pp.; In English; SPIE Astronomical Telescopes and Instrumentation, 24-30 May 2006, Orlando, FL, USA; Original contains color illustrations; Copyright; Avail.: Other Sources

ONLINE: http://hdl.handle.net/2014/39930

The TPF Interferometer (TPF-I) concept is being studied at the Jet Propulsion Laboratory and the TPF-I Planet Detection Testbed has been developed to simulate the detection process for an earthlike planet orbiting a star within about 15 pc. The testbed combines four beams of infrared light simulating the operation of a dual chopped Bracewell interferometer observing a star and a faint planet. This paper describes the results obtained this year including nulling of the starlight on four input beams at contrast ratios up to 250,000 to 1, and detection of faint planet signals at contrast ratios with the star of 2 million to 1.

Author

Planet Detection; Extrasolar Planets; Extraction; Signal Detection; Astronomical Interferometry

20070017423 Naval Research Lab., Washington, DC USA

Timing Noise Properties of GRO J0422+32

Grove, J E; Strickman, M S; Matz, S M; Hua, X -M; Kazanas, D; Titarchuk, L; Jan 1994; 15 pp.; In English

Report No.(s): AD-A465053; No Copyright; Avail.: CASI: A03, Hardcopy

OSSE observed the transient black hole candidate GRO J0422+32 (XN Per 92) between 1992 August 11 and 1992 September 17. High time resolution data were obtained in several energy bands over the approximately equal to 35-600 keV range with a timing resolution of 8 ms. Power spectra at energies below 175 keV show substantial low-frequency red noise with a shoulder at a few 10 (exp -2) Hz, peaked noise with characteristic frequency near 0.2 Hz, and a second shoulder at a few Hz. The frequencies of the shoulders and the peak are independent of energy and source intensity. The complex cross spectrum indicates that photons in the 75-175 keV band lag photons in the 35-60 keV band by a time roughly proportional to the inverse of the Fourier frequency. The maximum lag observed is approximately equal to 300 ms. The power and lag spectra are consistent with the production of the gamma rays through thermal Comptonization in an extended hot corona with a power-law density profile.

DTIC

Black Holes (Astronomy); Noise Spectra; Time Measurement; Gamma Ray Astronomy

20070017426 NASA Goddard Space Flight Center, Greenbelt, MD, USA

SWIFT Discovery of Gamma-ray Bursts without Jet Break Feature in their X-ray Afterglows

Sato, G.; Yamazaki, R.; Sakamoto, T.; Takahashi, T; Nakazawa, K.; Nakamura, T.; Toma, K.; Hullinger, D.; Tashiro, M.; Parsons, A. M.; Krimm, H. A.; Barthelmy, S. D.; Gehrels, N.; Burrows, D. N.; O'Brien, P. T.; Osborne, J. P.; Chincarini, G.; Lamb, D. Q.; [2007]; 24 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): MOE-18740153; MOE-14079207; MOE-14047212; MOE-14204024; NCC5-637; Copyright; Avail.: CASI: A03, Hardcopy

We analyze Swift gamma-ray bursts (GRBs) and X-ray afterglows for three GRBs with spectroscopic redshift determinations - GRB 050401, XRF 050416a, and GRB 050525a. We find that the relation between spectral peak energy and isotropic energy of prompt emissions (the Amati relation) is consistent with that for the bursts observed in pre-Swift era. However, we find that the X-ray afterglow lightcurves, which extend up to 10 - 70 days, show no sign of the jet break that is expected in the standard framework of collimated outflows. We do so by showing that none of the X-ray afterglow lightcurves in our sample satisfies the relation between the spectral and temporal indices that is predicted for the phase after jet break. The jet break time can be predicted by inverting the tight empirical relation between the peak energy of the spectrum and the collimation-corrected energy of the prompt emission (the Ghirlanda relation). We find that there are no temporal breaks within the predicted time intervals in X-ray band. This requires either that the Ghirlanda relation has a larger scatter than previously thought, that the temporal break in X-rays is masked by some additional source of X-ray emission, or that it does not happen because of some unknown reason.

Author

Afterglows; Gamma Ray Bursts; Swift Observatory; X Rays

20070017430 NASA Goddard Space Flight Center, Greenbelt, MD, USA
X-ray Variability Characteristics of the Narrow line SEYFERT 1 MKN 766 I: Energy Dependent Timing Properties
Markowitz, A.; Turner, T. J.; Papadakis, I.; Arevalo, P.; Reeves, J. N.; Miller, L.; [2007]; 13 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 a six-revolution XMM-Newton observation in 2005. The resulting PSDs, which have highest temporal frequency resolution for an AGN PSD to date, show breaks which increase in temporal frequency as photon energy increases; break frequencies differ by an average of approx.0.4 in the log between the softest and hardest bands. The consistency of the 2001 and 2005 observations variability properties, namely PSD shapes and the linear rms-flux relation, suggests the 2005 observation is simply a low-flux extension of the 2001 observation. The coherence function is measured to be approx.0.6-0.9 at temporal frequencies below the PSD break, and is lower for relatively larger energy band separation; coherence also drops significantly towards zero above the PSD break frequency. Temporal frequency-dependent soft-to-hard time lags are detected in this object for the first time: lags increase towards longer time scales and as energy separation increases. Cross-spectral properties are the thus consistent with previous measurements for Mkn 766 (Vaughan & Fabian 2003) and 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
Seyfert Galaxies; Black Holes (Astronomy); Temporal Resolution; Variability; Energy Bands; Time Lag; Accretion Disks

20070017443 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Suzaku Observation of Two Ultraluminous X-ray Sources in NGC 1313
Mizuno, T.; Miyawaki, R.; Ebisawa, K.; Kubota, A.; Miyamoto, M.; Winter, L.; Ueda, Y.; Isobe, N.; Dewangan, G.; Mushotzky, R.F.; Petre, R.; January 2007; 23 pp.; In English; Original contains black and white illustrations; Copyright; Avail.: CASI: A03, Hardcopy

TA study was made of two ultraluminous X-ray sources (ULXs) in the nearby faceon, late-type Sb galaxy NGC 1313 using data from Suzaku, the 5th Japanese X-ray satellite. Within the 90 ks observation, both sources named X-1 and X-2 exhibited luminosity change by about 50%. The o.4-10keV X-ray luminosity was measured. For X-1, the spectrum exhibited a strong power-law component with a high energy cutoff which is thought to arise from strong Comptonization by a disk corona, suggesting the source was in a very high state. Absorption line features with equivalent widths of 40-80 eV found at 7.00 keV and 7.8 keV in the X-1 spectrum support the presence of a highly ionized plasma and a high mass accretion rate on the system. The spectrum of X-2 in fainter phase is presented by a multicolor disk blackbody model.
Derived from text
X Ray Sources; Line Spectra; Luminosity; Accretion Disks

20070017476 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Temporal Profiles and Spectral Lags of XRF 060218
Liang, En-Wei; Zhang, Bin-Bin; Stamatikos, Mike; Zhang, Bing; Norris, Jay; Gehrels, Neil; Zhang, Jin; Dai, Z. G.; [2006]; 6 pp.; In English
Contract(s)/Grant(s): NNH06CC03B; NNG06GH62G; NNG05GB67G; NNSF-10463001; Copyright; Avail.: CASI: A02, Hardcopy

The spectral and temporal properties of the nonthermal emission of the nearby XRF 060218 in the 0.3-150 keV band are studied. We show that both the spectral energy distribution and the light-curve properties suggest the same origin of the nonthermal emission detected by Swift BAT and XRT. This event has the longest pulse duration and spectral lag observed to date among the known GRBs. The pulse structure and its energy dependence are analogous to typical GRBs,. By extrapolating the observed spectral lag to the Compton Gamma Ray Observatory (CGRO) BATSE bands we find that the hypothesis that this event complies with the same luminosity-lag relation with bright GRBs cannot be ruled out at 2 sigma significance level. These intriguing facts, along with its compliance with the Amati relation, indicate that XRF 060218 shares the similar radiation physics as typical GRBs.
Author
Spectral Energy Distribution; Gamma Ray Bursts; Astrophysics; X Ray Astronomy; Temporal Distribution

20070017885 NASA Johnson Space Center, Houston, TX, USA

Vernal Crater, SW Arabia Terra: MSL Candidate with Extensively Layered Sediments, Possible Lake Deposits, and a Long History of Subsurface Ice

Oehler, Dorothy Z.; Allen, Carlton C.; [2007]; 4 pp.; In English; 7th International Conference on Mars, 9-13 Jul. 2007, Pasadena, CA, USA; Original contains color illustrations; No Copyright; Avail.: CASI: A01, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017885

Vernal Crater is a Mars Science Laboratory (MSL) landing site candidate providing relatively easy access to extensively layered sediments as well as potential lake deposits. Sediments of Vernal Crater are 400-1200 m below those being investigated by Opportunity in Meridiani Planum, and as such would allow study of significantly older geologic units, if Vernal Crater were selected for MSL. The location of Vernal Crater in SW Arabia Terra provides exceptional scientific interest, as rampart craters and gamma-ray spectrometer (GRS) data from the region suggest a long history of ice/fluids in the subsurface. The potential value of this MSL candidate is further enhanced by reports of atmospheric methane over Arabia, as any insight into the source of that methane would significantly increase our understanding of Mars. Finally, should MSL survive beyond its prime mission, the gentle slope within Vernal Crater would provide a route out of the crater for study of the once ice/fluid-rich plains.

Author

Gamma Ray Spectrometers; Craters; Sediments; Mars Surface; Ice; Mars Landing Sites; Deposits

20070017972 NASA Marshall Space Flight Center, Huntsville, AL, USA

e+/- Pair Loading and the Origin of the Upstream Field in GRB Shocks

Ramirez-Ruiz, Enrico; Nishikawa, Ken-Ichi; Hededal, Christian B.; October 27, 2006; 2 pp.; In English; Original contains color illustrations; Copyright; Avail.: CASI: A01, Hardcopy

We investigate here the effects of plasma instabilities driven by rapid e(sup plus or minus) pair cascades, which arise in the environment of GRB sources as a result of back-scattering of a seed fraction of their original spectrum. The injection of e(sup plus or minus) pairs induces strong streaming motions in the ambient medium. One therefore expects the pair-enriched medium ahead of the forward shock to be strongly sheared on length scales comparable to the radiation front thickness. Using three-dimensional particle-in-cell simulations, we show that plasma instabilities driven by these streaming e(sup plus or minus) pairs are responsible for the excitation of near-equipartition, turbulent magnetic fields. Our results reveal the importance of the electromagnetic filamentation instability in ensuring an effective coupling between e(sup plus or minus) pairs and ions, and may help explain the origin of large upstream fields in GRB shocks.

Author

Electron-Positron Pairs; Gamma Ray Bursts; Shock Waves; Magnetic Fields; Mathematical Models

20070017997 NASA Goddard Space Flight Center, Greenbelt, MD, USA

Gamma-Ray Bursts in the Swift Era

Gehrels, Neil; Cannizzo, John K.; Norris, Jay P.; [2007]; 24 pp.; In English; Original contains black and white illustrations; No Copyright; Avail.: CASI: A03, Hardcopy

ONLINE: http://hdl.handle.net/2060/20070017997

GRB research has undergone a revolution in the last two years. The launch of Swift, with its rapid slewing capability, has greatly increased the number and quality of GRB localizations and X-ray and optical afterglow lightcurves. Over 160 GRBs have been detected, and nearly all that have been followed up with the on-board narrow field telescopes. Advances in our understanding of short GRBs have been spectacular. The detection of X-ray afterglows has led to accurate localizations from ground based observatories, which have given host identifications and redshifts. Theoretical models for short GRB progenitors have, for the first time, been placed on a sound foundation. The hosts for the short GRBs differ in a fundamental way from the long GRB hosts: short GRBs tend to occur in non-star forming galaxies or regions, whereas long GRBs are strongly concentrated within star forming regions. Observations are consistent with a binary neutron star merger model, but other models involving old stellar populations are also viable. Swift has greatly increased the redshift range of GRB detection. The highest redshift GRBs, at zeta approx. 5-6, are approaching the era of reionization. Ground-based deep optical spectroscopy of high redshift bursts is giving metallicity measurements and other information on the source environment to much greater distance than other techniques. The localization of GRB 060218 to a nearby galaxy, and association with SN 2006aj, added a valuable member to the class of GRBs with detected supernova. The prospects for future progress are excellent given the \g10 year orbital lifetime of the Swift satellite.

Author

Gamma Ray Bursts; X Ray Optics; Red Shift; Neutron Stars; Afterglows; Binary Stars

90
ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

20070016714 Naval Research Lab., Washington, DC USA
OSSE Observations of Cosmic Gamma-Ray Bursts
Share, G H; Johnson, W N; Kinzer, R L; Kroeger, R A; Kurfess, J D; Murphy, R J; Strickman, M S; Matz, S M; Grabelsky, D A; Purcell, W R; Ulmer, M P; Cameron, R A; Jung, G V; Grove, J E; Jan 1992; 7 pp.; In English
Report No.(s): AD-A464520; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464520

The Oriented Scintillation Spectrometer Experiment detected over 80 cosmic gamma-ray bursts from mid-April to late November 1991. Data at 16 ms resolution were accumulated from its large-area NaI shields in response to BATSE triggers. Rates in excess of 5000 cts/16 ms were observed from the 1991 May 3 burst. Bursts on June 1 and August 7 were observed in the spectrometer's aperture. Preliminary information on both the spectrum and location of the source of the June 1 burst are provided. Plans for future observations and analyses of bursts are discussed.
DTIC
Cosmic Rays; Gamma Ray Bursts

20070016724 Rochester Univ., NY USA
Probing the Dust-Enshrouded Regions of the Interacting Galaxy System ARP 299: A Near-Infrared Study
Satyapal, S; Watson, D M; Forrest, W J; Pipher, J L; Fischer, J; Greenhouse, M A; Smith, H A; Woodward, Charles E; May 10, 1999; 13 pp.; In English
Report No.(s): AD-A464642; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464642

We present high spectral resolution and near-infrared broadband images of the Arp 299=NGC 3690/IC 694 galaxy system. The emission is found to be concentrated at the positions of three active regions, known as sources A, B, and C. From our flux ratio we find the visual extinction toward the ionized gas in A, B, and C is ~6, 6, and 2 magnitudes, respectively, assuming case B recombination and a foreground screen geometry for the obscuring material. Our observations can be explained entirely by a starburst model for the Arp 299 system. The putative active galactic nucleus (AGN) in source A does not dominate the properties of this source. We see no evidence of broad recombination lines. In addition, the ratio of the 3.29 micron dust feature to total luminosity, a tracer of starburst activity, is consistent in each source with that seen in M82 and other starburst galaxies. Also, our imaging observations reveal that the dust feature emission is concentrated in the nucleus of source A, contrary to the extended annular distribution of the feature emission seen surrounding the nucleus of the more distant Seyfert galaxy NGC 7469. In this galaxy, the absence of the feature emission in the nucleus has been attributed to the destruction of the dust carriers in the hard radiation field surrounding the AGN. Our observations suggest that all of the active regions in Arp 299 are characterized by starburst episodes. The observed CO indices and Br(gamma) equivalent widths imply that source B is older than source A and source C is the youngest star-forming region. Although these regions are probably complex physical systems not necessarily characterized by a single coeval population of stars, we have compared our observations with an instantaneous starburst model with a Salpeter initial mass function. Using this simple model, we find starburst ages of ~6x10(exp 6), 8x10(exp 6), and 4x10(exp 6) for sources A, B, and C, respectively.
DTIC
Dust; Galaxies; Stellar Evolution

20070016745 California Univ., Los Angeles, CA USA
ISO LWS Spectroscopy of M82: A Unified Evolutionary Model
Colbert, James W; Malkan, Matthew A; Clegg, Peter E; Cox, Pierre; Fischer, Jacqueline; Lord, Steven D; Luhman, Michael; Satyapal, Shobita; Smith, Howard A; Spinoglio, Luigi; Jan 1999; 10 pp.; In English
Report No.(s): AD-A464679; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464679

We present the first complete far-infrared spectrum (43-197 micrometers) of M82, the brightest infrared galaxy in the sky, taken with the Long Wavelength Spectrometer of the Infrared Space Observatory (ISO). We detected seven fine structure emission lines, [O I] 63 and 145 micrometers, [O III] 52 and 88 micrometers , [N II] 122 micrometers, [N III] 57 micrometers, and [C II] 158 micrometers, and fitted their ratios to a combination starburst and photodissociation region (PDR) model. The

best fit is obtained with H II regions with n=250/cu cm, an ionization parameter of 10(exp -3.5), and PDRs with n=10(exp 3.3)/cu cm and a far-ultraviolet flux of Go=10(exp 2.8). We applied both continuous and instantaneous starburst models, with our best fit being a 3-5 Myr old instantaneous burst model with a 100 M (sun) cutoff. We also detected the ground-state rotational line of OH in absorption at 119.4 micrometers. No excited level OH transitions are apparent, indicating that the OH is almost entirely in its ground state with a column density ~4x10(exp 14) sq cm. The spectral energy distribution over the long-wavelength spectrometer wavelength range is well fitted with a 48 K dust temperature and an optical depth, Tau(sub Dust) proportional to varies as gamma (exp -1).
DTIC
Far Infrared Radiation; Galaxies; Spectra; Spectroscopy

20070016751 Naval Research Lab., Washington, DC USA
Detection of Soft Gamma-Ray Emission from the Seyfert II Galaxy NGC 4507 by the OSSE Telescope (Preprint)
Bassani, L; Malaguti, G; Jourdain, E; Roques, J P; Johnson, W N; Jan 1995; 11 pp.; In English
Report No.(s): AD-A464695; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464695

We report the first soft gamma-ray observation by the OSSE experiment onboard the CGRO of the optically selected Seyfert II galaxy, NGC 4507. The source was observed on two separate weeks in 1993 and detected between 50 and 200 keV at a confidence level of 7 . There is no evidence of flux variability within or between the two observation periods which sample timescales from days to months. The source spectrum obtained from combining the two sets of data is best described by spectral forms including some exponential cutoff. The observed shape is steeper than the one observed by GINGA in the X-ray band in 1990. The joint GINGA/OSSE spectrum is best described by an absorbed power law exponentially cutoff at high energies and having an iron K alpha emission line. Comparison between NGC 4507 and other Seyfert galaxies indicate that although at low energies a difference between type I and II objects is possible (but still weak in this specific case) at high energies the observed shapes are indeed similar. We interpret this as evidence that the primary source emission (i.e. not reprocessed by material in the source) is the same for both types; this finding is in agreement with the unified scheme of Seyfert galaxies. Apart from its own interest, the OSSE detection of hard X-ray emission from a Seyfert II galaxy is also important for the implications it has on the contribution of Seyfert galaxies of both types to the cosmic diffuse background, as type II objects are expected to outnumber type I sources.
DTIC
Galaxies; Gamma Rays; Seyfert Galaxies; Telescopes

20070016752 Naval Research Lab., Washington, DC USA
Luminous Molecular Hydrogen Emission in the Galaxy System NGC 3690-IC 694
Fischer, J; Simon, M; Benson, J; Solomon, P M; Oct 1, 1983; 5 pp.; In English
Contract(s)/Grant(s): NSF-8116049
Report No.(s): AD-A464696; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464696

We report the detection of fine emission of vibrationally excited H2 from the galaxy system NGC 3690-IC 694. The line emission is distributed within the system. The total observed luminosity in the H2 upsilon = 1-0 S(l) line alone is approximately 1.5 x l0(exp 7) solar luminosity. We also detected Br(gamma) line emission of the system; its observed luminosity indicates that at least 4 X 10(exp 54) ionizing photons per second are required to maintain ionization of the H II. The H2 is probably heated by shocks, and the mass of hot H2 exceeds 2 x lO(exp 4) solar mass.
DTIC
Galaxies; Hydrogen; Molecular Gases

20070016753 Naval Research Lab., Washington, DC USA
ISO AR-IR Spectroscopy of IR-Bright Galaxies and ULIRGs
Fisher, J; Luhman, M L; Satapal, S; Greenhouse, M A; Stacey, G J; Bradford, C M; Lord, S D; Brauher, J R; Unger, S J; Clegg, P E; Jan 1999; 9 pp.; In English
Report No.(s): AD-A464697; No Copyright; Avail.: Defense Technical Information Center (DTIC)
ONLINE: http://hdl.handle.net/100.2/ADA464697

Based on far-infrared spectroscopy of a small sample of nearby infrared bright and ultraluminous infrared galaxies (ULIRGs) with the ISO Long Wavelength Spectrometer we find a dramatic progression in ionic/atomic fine-structure emission

line and molecular/atomic absorption line characteristics in these galaxies extending from strong [O III]52,88 micrometer and [N III]57 micrometer line emission to detection of only faint [C II]158 micrometer line emission from gas in photodissociation regions in the ULIRGs. The molecular absorption spectra show varying excitation as well, extending from galaxies in which the molecular population mainly occupies the ground state to galaxies in which there is significant population in higher levels. In the case of the prototypical ULIRG, the merger galaxy Arp 220, the spectrum is dominated by absorption lines of OH, H2O, CH, and [O I]. Low [O III]88 micrometer line flux relative to the integrated far-infrared flux correlates with low excitation and does not appear to be due to far-infrared extinction or to density effects. A progression toward soft radiation fields or very dusty H II regions may explain these effects.
DTIC
Far Infrared Radiation; Galaxies; Infrared Spectroscopy

20070016754 Naval Research Lab., Washington, DC USA
Molecular Hydrogen Line Emission in Seyfert Galactic Nuclei
Fisher, J; Geballe, T R; Smith, Howard A; Simon, M; Storey, J W; Sep 15, 1987; 10 pp.; In English
Contract(s)/Grant(s): NSF-8313828
Report No.(s): AD-A464698; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464698

We report on 2 micrometers spectroscopy of three Seyfert and two star burst galactic nuclei. We have detected line emission from vibrationally excited H2 in the Seyfert galactic nuclei NGC 1275, NGC 3227, and NGC 4151. For NGC 1275 and NGC 4151, these detections are the first reported detections of molecular line emission. We have also measured the Br(gamma) line flux in NGC 4151 and obtained an upper limit on the Br(gamma) line flux in NGC 1275. There is large range in the observed S(1) to Br(gamma) line ratio for both Seyfert and starburst galaxies (measured in this work and by others). We rule out UV fluorescence based on the S(1) to Br(gamma) line ration and the H2 line ratios in the Seyfert galaxy NGC 1275. Shocks probably excite the H2 emission in this galaxy. UV fluorescence may be the excitation mechanism in the Seyfert 1 galaxies NGC 4151 and NGC 3227. The H2 lines are not formed in the broad-line regions these Seyfert 1 galaxies based on our measured upper limits on the S(1) line widths. Simple starburst models cannot account for the highest of the measured ratios of S(1) to Br(gamma) line flux, most notably in the starburst galaxy NGC 6240 and in the peculiar Seyfert NGC 1275. Since the galaxies with the largest values of this ratio also have strong morphological evidence of galaxy-galaxy interactions, global shocks rather than shocks within young stellar outflows and remnants may be responsible for the excitation of the molecular hydrogen in these galaxies.
DTIC
Galactic Nuclei; Galaxies; Hydrogen; Molecular Gases; Seyfert Galaxies

20070016775 Naval Research Lab., Washington, DC USA
Hard X-Ray and IR Observations of Cygnus X-3
Matz, S M; Fender, R P; Bell-Burnell, S J; Grove, J E; Strickman, M S; Mar 15, 1996; 5 pp.; In English
Report No.(s): AD-A464760; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464760

In 1994 June-July we obtained nearly concurrent measurements of Cyg X-3 in hard X-rays and the infrared, using the OSSE instrument on GRO and the UKIRT. OSSE made a high significance measurement of the hard X-ray (\g 50 keV) orbital light curve. Five days after the end of the OSSE observations we obtained a good IR K-band light curve from data covering one orbit of Cyg X-3. Measurements of the light curve phase and shape probe the geometry of the system and the physics of radiation production and scattering. We determined for the first time that the light curve phases are consistent at these two different wavelengths. The light curve shapes were both marginally inconsistent (at about the 0.2% level) with the canonical soft X-ray shape measured by EXOSAT in 1983{1985. Underlying variations in DC IR flux and flaring during the observation make it difficult to draw unambiguous conclusions; more observations, with better IR coverage, are needed.
DTIC
Infrared Astronomy; X Rays

20070016797 Queen Mary and Westfield Coll., London, UK
ISO-LWS Spectroscopy of Centaurus A: Extended Star Formation
Unger, S J; Clegg, P E; Stacey, G J; Cox, P; Fisher, J; Greenhouse, M; Lord, S D; Luhman, M L; Satyapal, S; Smith, H A; Jan 2000; 7 pp.; In English
Report No.(s): AD-A464795; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464795

We present the first full FIR spectrum of Centaurus A (NGC 5128) from 43 - 196.7 micrometers. The data was obtained with the ISO Long Wavelength Spectrometer (LWS). We conclude that the FIR emission in a 70' beam centred on the nucleus is dominated by star formation rather than active galactic nucleus (AGN) activity. The flux in the far-infrared lines is ~1% of the total FIR: the [C II] line flux is ~0.4% FIR and the [O I] line is ~0.2%, with the remainder arising from [O III], [N II] and [N III] lines. These are typical values for starburst galaxies. The ratio of the [N III] / [N II] line intensities from the HII regions in the dust lane corresponds to an effective temperature, Teff ~35,500 K, implying that the tip of the main sequence is headed by O8.5 stars and that the starburst is ~6 x 10(exp 6) years old. This suggests that the galaxy underwent either a recent merger or a merger which triggered a series of bursts. The N/O abundance ratio is consistent with the range of ~0.2 - 0.3 found for Galactic HII regions. We estimate that \h 5% of the observed [C II] arises in the cold neutral medium (CNM) and that ~10% arises in the warm ionized medium (WIM). The main contributors to the [C II] emission are the PDRs, which are located throughout the dust lane and in regions beyond where the bulk of the molecular material lies. On scales of ~1 kpc the average physical properties of the PDRs are modelled with a gas density, II ~10(exp 3) cu cm, an incident far-UV field, G ~10(exp 2) times the local Galactic field, and a gas temperature of ~250 K.
DTIC
Galaxies; Infrared Spectra; Spectroscopy; Star Formation

20070016816 Naval Research Lab., Washington, DC USA
RXTE Observations of BL Hyi and V2301 Oph
Wolff, Michael T; Wood, Kent S; Imamura, James N; Steiman-Cameron, Thomas; Middleditch, John; Jan 1999; 14 pp.; In English; Original contains color illustrations
Report No.(s): AD-A465015; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA465015
We acquired x-ray data for the AM Herculis systems BL Hyi and V2301 Oph using the PCA detector on the Rossi X-Ray Timing Explorer during September-November 1997. We also obtained broad-band optical photometry for BL Hyi using the 1.5m telescope at the Cerro Tololo Inter-American Observatory during September 1997, that was simultaneous with one short stretch of RXTE x-ray observations. In both systems the x-ray emission is consistent with a bright pole and a fainter pole. We find an orbit modulated optical QPO in BL Hyi consistent with previous results. We characterize the hard x-ray properties of these two systems in this poster.
DTIC
X Ray Astronomy; X Ray Timing Explorer

20070016976 Naval Research Lab., Washington, DC USA
Timing Studies of X-Ray Binary Orbits
Ray, P S; Wolff, M T; Wood, K S; Hertz, P; Jan 2003; 11 pp.; In English; Original contains color illustrations
Report No.(s): AD-A464916; No Copyright; Avail.: Defense Technical Information Center (DTIC)
X-ray astronomy, by necessity, involves the study of highly variable stars, nearly all of them in binary systems where one member is a compact object such as a neutron star or black hole. These systems allow us to probe physical effects in regions of extreme gravity, high temperatures, and intense magnetic fields that are characteristic of compact objects and are unattainable in laboratory experiments. By studying the brightness variations and eclipses using space-based X-ray telescopes, we can determine the binary system orbital parameters and characteristics of the mass transfer that powers these variations. This, in turn, allows us ultimately to understand better the evolution of these exotic binary systems. Here we describe two such studies carried out at NRL: the discovery of the orbit of a neutron star orbiting a hot supergiant star, and the surprising orbital period evolution observed in a lowmass X-ray binary.
DTIC
X Ray Astronomy; X Ray Binaries

20070017285 Naval Research Lab., Washington, DC USA
Photoionization Modeling of Infrared Fine-Structure Lines in Luminous Galaxies with Central Dust-Bounded Nebulae
Fischer, Jacqueline; Allen, Robert; Dudley, C C; Satyapal, Shobita; Luhman, Michael L; Wolfire, Mark G; Smith, Howard A; Jan 2001; 5 pp.; In English
Report No.(s): AD-A464702; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464702
Far-infrared spectroscopy of a small sample of IR-bright galaxies taken with the Infrared Space Observatory Long

Wavelength Spectrometer has revealed a dramatic progression extending from strong fine-structure line emission from photoionized and photodissociated gas in the starburst galaxy Arp 299 to faint [C II]158 micrometers line emission and absorption in lines of OH, H2O, CH, and [O I] in the ultraluminous galaxy Arp 220. The progression to weaker emission lines is accompanied by lower excitation and does not appear to be due to far-infrared extinction or density effects. Although aging of short duration starbursts with a relatively small range in age might explain much of the sequence, the spectra of Arp 220 and other ultraluminous galaxies may be more reasonably explained by high ionization parameter, dust-bounded nebulae. To test this hypothesis, we ran photoionization models of mid- and far-infrared lines for power law (index -1.5) and starburst cases with moderate (500 cm(exp -3)) and high (10(exp 5) cm(exp -3)) densities. Indeed, we find that for dust-bounded nebulae and photonization by a power law source, the relative emission line strengths and the high-to-low ionization infrared line ratios decrease with ionization parameter. For starburst ionization sources and dust-bounded nebulae, the [N III] 57 micron/[N II] 122 micron line ratio is found to drop with ionization parameter.
DTIC
Dust; Fine Structure; Galaxies; Infrared Radiation; Nebulae; Photoionization

20070017287 Naval Research Lab., Washington, DC USA
Galaxies: The Long Wavelength View
Fischer, J; Jan 2000; 7 pp.; In English
Report No.(s): AD-A464700; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464700

Far-infrared spectroscopy obtained with the ISO LWS has shown that there is strong variation (more than 2 orders of magnitude) in the [C II]/FIR ratios in galaxies extending from blue compact dwarfs, to normal and starburst galaxies, down to elliptical and ultraluminous galaxies (ULICs). The variation in the relative [C 11]158 micrometer line strength has been attributed to low metallicity in blue compact dwarfs, high (Go)/n for normal galaxies and ULIGs, soft radiation fields in ellipticals, and extinction or enhanced abundance of dust in ionized regions in ULIGs. Full ISO/LWS far-infrared (43 - 197 micrometer) spectra of six nearby IR-bright galaxies reveal a dramatic progression of decreasing fine-structure line emission from ionized species to molecular (OH and H2O) absorption line dominated. The archetypical ULIC, Arp 220, lies at the absorption line dominated end of this sequence. For Arp 220, radiative transfer models indicate that it is optically thick in the FIR and that the water molecules observed in absorption are radiatively excited. If extinction plays a role in the sequence it appears from this analysis that the affected regions are heavily obscured even in the far-infrared, while the detected line emission is not more obscured in ULIGs than in starbursts. Linear correlation between polycyclic aromatic hydrocarbon (PAH) 6.2 micrometer feature strength and the [C II)158 micrometer line strength in starbursts and ULIGs suggests a similar effect for these emitting species, and that the detected PAR emission is not more obscured in ULIGs than in lower luminosity starbursts.
DTIC
Far Infrared Radiation; Galaxies

20070017291 Naval Research Lab., Washington, DC USA
The First Stellar Abundance Measurements in the Galactic Center: The M Supergiant IRS 7
Carr, John S; Sellgren, K; Balachandran, Suchitra C; Feb 10, 2000; 17 pp.; In English
Report No.(s): AD-A464637; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464637

The first measurement of the photospheric abundances in a star at the Galactic center are presented. A detailed abundance analysis of the Galactic center M2 supergiant IRS 7 was carried out using high-resolution near-infrared echelle spectra. The Fe abundance for IRS 7 was found to be close to solar, [Fe/H] = 0.02 +/- 0.13, and nearly identical to the Fe abundance we obtained for the nearby M supergiants alpha Ori and VV Cep. Analysis of the first and second overtone lines of CO was used to derive an effective temperature of 3600 +/- 230 K, a microturbulent velocity of 3.0 +/- 0.3 km s(exp -1), and a carbon abundance log e (C) = 7.78 +/- 0.13, or [C/H] = -0.77. In addition, we find a high depletion of 0.74 +/- 0.32 dex in O and an enhancement of 0.92 +/- 0.18 dex in N. These abundances are consistent with the dredge-up of CNO cycle products but require deep mixing in excess of that predicted by standard models for red supergiants. In light of our measured solar Fe abundance for IRS 7, we discuss other indicators of metallicity at the Galactic center, the interpretation of low-resolution near-infrared spectra of late-type giants and supergiants, including the need for caution in using such spectra as measures of metallicity, and the evolution of massive young stars at the Galactic center. We suggest the possibility that rapid stellar rotation is common for stars formed under conditions in the Galactic center, and that extra internal mixing induced by high rotation

rates, rather than evolution at high metallicity, is the explanation for many of the unusual properties of the hot emission-line stars in the Galactic center.
DTIC
Stars; Supergiant Stars

20070017366 NASA Goddard Space Flight Center, Greenbelt, MD, USA
An Unusual Precursor Burst with Oscillations from SAX J1808.4-3658
Bhattacharyya, Sudip; Strohmayer, E.; August 11, 2006; 8 pp.; In English; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017366

We report the finding of an unusual, weak precursor to a thermonuclear X-ray burst from the accreting millisecond pulsar SAX 51808.4-3658. The burst in question was observed on Oct. 19, 2002 with the Rossi X-Ray Timing Explorer (RXTE) proportional counter array (PCA). The precursor began approx. equal to 1 s prior to the onset of a strong radius expansion burst, lasted for about 0.4 s, and exhibited strong oscillations at the 401 Hz spin frequency. Oscillations are not detected in the approx. equal to 0.5 s interval between the precursor and the main burst. The estimated peak photon flux and energy fluence of the precursor are about 1/25, and 1/500 that of the main burst, respectively. From joint spectral and temporal modeling, we find that an expanding burning region with a relatively low temperature on the spinning neutron star surface can explain the oscillations, as well as the faintness of the precursor with respect to the main part of the burst. We discuss some of the implications of our findings for the ignition and spreading of thermonuclear flames on neutron stars.
Author
Oscillations; Pulsars; X Rays; Thermonuclear Power Generation

20070017425 Northwestern Univ., Evanston, IL USA
OSSE Limits on Pre- and Post-Burst Emission (Preprint)
Matz, S M; Grove, J E; Johnson, W N; Kurfess, J D; Share, G H; Jul 12, 1995; 5 pp.; In English
Report No.(s): AD-A464792; No Copyright; Avail.: CASI: A01, Hardcopy
ONLINE: http://hdl.handle.net/100.2/ADA464792

The existence of either pre- or post-burst emission can provide substantial new information about the burst source and its local environment. We have data from several events serendipitously in or near the OSSE field of view at the time of the burst. We present pre- and post-burst flux limits from one such event, GRB 940301. The OSSE data for other periods when scheduled observations have included burst locations will enable us to search for pre- and post- burst emission on many time scales.
DTIC
Gamma Ray Bursts; X Ray Astronomy

20070017427 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Spectropolarimetric Evolution of V838 Mon
Wisniewski, John P.; [2007]; 8 pp.; In English; The Nature of V838 Mon and Its Light Echo, 16-19 May 2006, La Palma, Spain
Contract(s)/Grant(s): NCC5-637; No Copyright; Avail.: CASI: A02, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017427

I review photo-polarimetric and spectropolarimetric observations of V838 Mon, which revealed that it had an asymmetrical inner circumstellar envelope following its 2nd photometric outburst. Electron scattering, modified by preor post-scattering H absorption, is the polarizing mechanism in V838 Mon's envelope. The simplest geometry implied by these observations is that of a spheroidal shell, flattened by at least 20% and having a projected position angle on the sky of approx. 37 degrees. Analysis of V838 Mon's polarized flux reveals that this electron scattering shell lies interior to the envelope region in which Halpha and Ca II triplet emission originates. To date, none of the theoretical models proposed for V838 Mon have demonstrated that they can reproduce the evolution of V838 Mon's inner circumstellar environment, as probed by spectropolarimetry.
Author
Polarimeters; Photometers; Astrophysics; Stellar Envelopes

20070017873 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Predicting the Starquakes in PSR J0537-6910
Middleditch, J.; Marshall, F. E.; Wang, Q. D.; Gotthelf, E. V.; Zhang, W.; [2007]; 55 pp.; In English; Copyright; Avail.: CASI: A04, Hardcopy

We report the results of more than seven years of monitoring of PSR J0537-6910, the 16 ms pulsar in the Large Magellanic Cloud, using data acquired with the Rossi X-ray Timing Explorer. During this campaign the pulsar experienced 22 sudden increases in frequency ('glitches' - 21 with increases of at least eight microHz) amounting to a total gain of over six parts per million of rotation frequency superposed on its gradual spindown of nu-dot = -2 x 10(exp -l0) Hz /s. The time interval from one glitch to the next obeys a strong linear correlation to the amplitude of the first glitch, with a mean slope of about 400 days per part per million (6.5 days per micro Hz), such that these intervals can be predicted to within a few days, an accuracy which has never before been seen in any other pulsar. There appears to be an upper limit of approximately 40 micro Hz for the size of glitches in all pulsars, with the 1999 April glitch of PSR J0537-6910 as the largest so far. The change of its spindown across the glitches, delta (nu-dot), appears to have the same hard lower limit of -1.5 x 10 (exp -13) Hz/s, as, again, that observed in all other pulsars. The spindown continues to increase in the long term, nu-dot = -10(exp -21) Hz / s(exp 2), and thus the timing age of PSR 505374910 (-0.5 nu nu-dot (exp -1) continues to decrease at a rate of nearly one year every year, consistent with movement of its magnetic moment away from its rotational axis by one radian every 10,000 years, or about one meter per year. PSR J0537-6910 was likely to have been born as a nearly-aligned rotator spinning at 75-80 Hz, with a absolute value of nu considerably smaller than its current value of 2x 10(exp -10) Hz per second. Its pulse profile consists of a single pulse which is found to be flat at its peak for at least 0.02 cycles. Glitch activity may grow exponentially with a timescale of 170 years nu nu-dot ((nu nu-dot)(sub crab))exp -l in all young pulsars.
Author
Frequencies; Pulsars; Starquakes

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*.

20070017405 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Phoenix Mars Scout UHF Relay-Only Operations
Lewicki, Christopher A.; Krajewski, Joel; Ilott, Peter; Dates, Jason; June 19, 2006; 8 pp.; In English; AIAA 9th International Conference on Spacecraft Operations (SpaceOps, 19-24 Jun. 2006, Rome, Italy; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39934

The Phoenix Mars Scout Lander will launch in August 2007 and land on the northern plains of Mars in May of 2008. In a departure from traditional planetary surface mission operations, it will have no direct-to-Earth communications capability and will rely entirely on Mars-orbiting relays in order to facilitate command and control as well as the return of science and engineering data. The Mars Exploration Rover missions have demonstrated the robust data-return capability using this architecture, and also have demonstrated the capability of using this method for command and control. The Phoenix mission will take the next step and incorporate this as the sole communications link. Operations for 90 Sols will need to work within the constraints of Odyssey and Mars Reconnaissance Orbiter communications availability, anomalies must be diagnosed and responded to through an intermediary and on-board fault responses must be tolerant to loss of a relay. These and other issues pose interesting challenges and changes in paradigm for traditional space operations and spacecraft architecture, and the approach proposed for the Phoenix mission is detailed herein.
Author
Ultrahigh Frequencies; Scout Launch Vehicle; Communication Networks; Mission Planning; Spacecraft Design; Phoenix Sounding Rocket

20070017421 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Anomaly Recovery and the Mars Exploration Rovers
Matijevic, Jacob R.; Dewell, Elizabeth A.; June 23, 2006; 17 pp.; In English; AIAA SpaceOps Conference, 19-24 Jun. 2006, Rome, Italy; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39897

The premise of the design of operations for the Mars Exploration Rovers (MER) is that the vehicles will drive each day. As a result, they will encounter some aspect of the terrain environment that cannot be anticipated or otherwise accommodated by the sequences linked onboard that day. The operations team then must correct the problem by planning then commanding the execution of a different drive the next day. Often other aspects of the operation on the surface of Mars: environmental

changes, component degradation, errors in sequence design or execution, etc., lead to anomalies which must be addressed before normal operations can resume. The operational design that makes it possible to recover from a driving error each day also reduces the time needed to recover from anomalies. As an example of the efficiency achieved, less than 5% (about 30 sols out of 700 sols of operations) of the time on the surface has been devoted to recovery from anomalies for each vehicle. In this paper the major anomalies experienced by the MER rovers will be recounted and the streamlined approaches to addressing these problems described. The operational flexibility developed for these missions is also a function of the system design that anticipated a number of likely faults and conditions arising from uncertainty in sequence execution and environmental change. This design will be described as well as the considerations in operation that motivated this design. These considerations will likely be present in any future surface mission.
Author
Anomalies; Mars Exploration; Mars Roving Vehicles; Mars Surface; Systems Engineering

20070017433 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Advances in Distributed Operations and Mission Activity Planning for Mars Surface Exploration
Fox, Jason M.; Norris, Jeffrey S.; Powell, Mark W.; Rabe, Kenneth J.; Shams, Khawaja; June 19, 2006; 11 pp.; In English; AIAA 9th International Conference on Space Operations (SpaceOps, 10-24 Jun. 2006, Rome, Italy; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39854

A centralized mission activity planning system for any long-term mission, such as the Mars Exploration Rover Mission (MER), is completely infeasible due to budget and geographic constraints. A distributed operations system is key to addressing these constraints; therefore, future system and software engineers must focus on the problem of how to provide a secure, reliable, and distributed mission activity planning system. We will explain how Maestro, the next generation mission activity planning system, with its heavy emphasis on portability and distributed operations has been able to meet these design challenges. MER has been an excellent proving ground for Maestro's new approach to distributed operations. The backend that has been developed for Maestro could benefit many future missions by reducing the cost of centralized operations system architecture.
Author
Mars Exploration; Mars Surface; Mission Planning; Distributed Processing; Data Systems

20070017435 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Science Planning for the NASA Mars Reconnaissance Orbiter Mission
Wenkert, Daniel D.; Bridges, Nathan T.; Eggemeyer, William Curtis; Hale, Amy Snyder; Kass, David; Martin, Terry Z.; Noland, Stephen J.; Safaeinili, Ali; Smrekar, Suzanne; June 19, 2006; 9 pp.; In English; AIAA 9th International Conference on Space Operations (SpaceOps, 19-24 Jun. 2006, Rome, Italy; Original contains color and black and white illustrations; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39832

The Mars Reconnaissance Orbiter (MRO), launched on August 12, 2005, carries six science instruments, each with unique requirements for repetitive global monitoring, regional or global survey mapping, and/or targeted observations of Mars. Some prefer nadir-only observations, while other instruments require many off-nadir observations (especially for stereo viewing). Because the operations requirements are often incompatible, an interactive science planning process has been developed. This process is more complex than in some recent NASA Mars missions, but less complex (and more repetitive) than processes used by many large planetary missions. It takes full advantage of MRO's novel onboard processing capabilities, and uses simple electronic interactions between geographically distributed teams. This paper describes the process used during MRO's Primary Science Phase (PSP) to plan both interactive and non-interactive observations of Mars, and what has already been learned in the tests and rehearsals preparing for PSP.
Author
Mars Reconnaissance Orbiter; NASA Programs; Space Missions; Mission Planning; Aerospace Sciences

20070017452 NASA Johnson Space Center, Houston, TX, USA
Multispectral Imaging from Mars PATHFINDER
Ferrand, William H.; Bell, James F., III; Johnson, Jeffrey R.; Bishop, Janice L.; Morris, Richard V.; [2007]; 29 pp.; In English; Copyright; Avail.: CASI: A03, Hardcopy

The Imager for Mars Pathfinder (IMP) was a mast-mounted instrument on the Mars Pathfinder lander which landed on

Mars Ares Vallis floodplain on July 4, 1997. During the 83 sols of Mars Pathfinders landed operations, the IMP collected over 16,600 images. Multispectral images were collected using twelve narrowband filters at wavelengths between 400 and 1000 nm in the visible and near infrared (VNIR) range. The IMP provided VNIR spectra of the materials surrounding the lander including rocks, bright soils, dark soils, and atmospheric observations. During the primary mission, only a single primary rock spectral class, Gray Rock, was recognized; since then, Black Rock, has been identified. The Black Rock spectra have a stronger absorption at longer wavelengths than do Gray Rock spectra. A number of coated rocks have also been described, the Red and Maroon Rock classes, and perhaps indurated soils in the form of the Pink Rock class. A number of different soil types were also recognized with the primary ones being Bright Red Drift, Dark Soil, Brown Soil, and Disturbed Soil. Examination of spectral parameter plots indicated two trends which were interpreted as representing alteration products formed in at least two different environmental epochs of the Ares Vallis area. Subsequent analysis of the data and comparison with terrestrial analogs have supported the interpretation that the rock coatings provide evidence of earlier martian environments. However, the presence of relatively uncoated examples of the Gray and Black rock classes indicate that relatively unweathered materials can persist on the martian surface.
Author
Imaging Techniques; Mars Pathfinder; Near Infrared Radiation; Mars Landing Sites; Multispectral Photography

20070017838 NASA Johnson Space Center, Houston, TX, USA
Mars Exploration Rover Pancam Multispectral Imaging of Rocks, Soils, and Dust at Gusev Crater and Meridiani Planum, Chapter 13
Bell, J. F., III; Calvin, W. M.; Farrand, W.; Greeley, R.; Johnson, J. R.; Jolliff, B.; Morris, R. V.; Sullivan, R. J.; Thompson, S.; Wang, A.; Weitz, C.; Squyres, S. W.; [2007]; 61 pp.; In English; Original contains color illustrations; Copyright;
Avail.: CASI: A04, Hardcopy

Multispectral imaging from the Panoramic Camera (Pancam) instruments on the Mars Exploration Rovers Spirit and Opportunity has provided important new insights about the geology and geologic history of the rover landing sites and traverse locations in Gusev crater and Meridiani Planum. Pancam observations from near-UV to near-IR wavelengths provide limited compositional and mineralogic constraints on the presence abundance, and physical properties of ferric- and ferrous-iron bearing minerals in rocks, soils, and dust at both sites. High resolution and stereo morphologic observations have also helped to infer some aspects of the composition of these materials at both sites. Perhaps most importantly, Pancam observations were often efficiently and effectively used to discover and select the relatively small number of places where in situ measurements were performed by the rover instruments, thus supporting and enabling the much more quantitative mineralogic discoveries made using elemental chemistry and mineralogy data. This chapter summarizes the major compositionally- and mineralogically-relevant results at Gusev and Meridiani derived from Pancam observations. Classes of materials encountered in Gusev crater include outcrop rocks, float rocks, cobbles, clasts, soils, dust, rock grindings, rock coatings, windblown drift deposits, and exhumed whitish/yellowish salty soils. Materials studied in Meridiani Planum include sedimentary outcrop rocks, rock rinds, fracture fills, hematite spherules, cobbles, rock fragments, meteorites, soils, and windblown drift deposits. This chapter also previews the results of a number of coordinated observations between Pancam and other rover-based and Mars-orbital instruments that were designed to provide complementary new information and constraints on the mineralogy and physical properties of martian surface materials.
Author
Mars Exploration; Mars Roving Vehicles; Imaging Techniques; Remote Sensing; Panoramic Cameras; Mars Craters; Dust; Sedimentary Rocks; Soils; Mineralogy

20070017856 NASA Glenn Research Center, Cleveland, OH, USA
Advanced Thermal Control Technologies for 'CEV' (New Name: ORION)
Golliher, Eric; Westheimer, David; Ewert, Michael; Hasan, Mojib; Anderson, Molly; Tuan, George; Beach, Duane; March 2007; 24 pp.; In English; Spacecraft Thermal Control Workshop, 27 Feb. 2007, El Segundo, CA; Original contains color illustrations
Contract(s)/Grant(s): WBS 119103.04.01.04.03.03; No Copyright; Avail.: CASI: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017856

NASA is currently investigating several technology options for advanced human spaceflight. This presentation covers some recent developments that relate to NASA's Orion spacecraft and future Lunar missions.
Author
Temperature Control; Heat Transfer; Lunar Surface; Crew Exploration Vehicle; Space Flight

20070017882 NASA Johnson Space Center, Houston, TX, USA
Exposure of Water Ice in the Northern Mid-lattitudes of Mars
Allen, Carlton C.; Kanner, Lisa C.; [2007]; 4 pp.; In English; 7th International Conference on Mars, 9-13 Jul. 2007, Pasadena, CA, USA; Copyright; Avail.: CASI: A01, Hardcopy

Water ice is exposed in the martian north polar cap, and is occasionally exposed beyond the cap boundary. Orbital gamma ray spectrometry data strongly imply the presence of water ice within meters of the surface at latitudes north of approximately 60 deg. We have examined midlatitude areas of the northern plains displaying evidence of residual ice-rich layers, and report possible present-day exposures of ice. These exposures, if confirmed, could constrain the latitudinal and temporal stability of surface ice on Mars.
Derived from text
Exposure; Extraterrestrial Water; Mars Surface; Latitude; Ice; Polar Caps

20070017884 NASA Johnson Space Center, Houston, TX, USA
NASA/Haughton-Mars Project 2006 Lunar Medical Contingency Simulation
Scheuring, Richard A.; Jones, J. A.; Lee, P.; Comtois, J. M.; Chappell, S.; Rafiq, A.; Braham, S., et al.; May 24, 2007; 41 pp.; In English; 16th Annual 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/2060/20070017884

A viewgraph presentation describing NASA's Haughton-Mars Project (HMP) medical requirements and lunar surface operations is shown. The topics onclude: 1) Mission Purpose/ Overview; 2) HMP as a Moon/Mars Analog; 3) Simulation objectives; 4) Discussion; and 5) Forward work.
CASI
Lunar Surface; Moon; Computerized Simulation; Aerospace Medicine; Contingency; Mars Surface; NASA Space Programs

20070017919 NASA Marshall Space Flight Center, Huntsville, AL, USA
Lunar e-Library: A Research Tool Focused on the Lunar Environment
McMahan, Tracy A.; Shea, Charlotte A.; Finckenor, Miria; Ferguson, Dale; [2007]; 15 pp.; In English; 45th AIAA Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2007, Reno, NV, USA; Original contains color illustrations
Contract(s)/Grant(s): NNM06AB30C; Copyright; Avail.: CASI: A03, Hardcopy

As NASA plans and implements the Vision for Space Exploration, managers, engineers, and scientists need lunar environment information that is readily available and easily accessed. For this effort, lunar environment data was compiled from a variety of missions from Apollo to more recent remote sensing missions, such as Clementine. This valuable information comes not only in the form of measurements and images but also from the observations of astronauts who have visited the Moon and people who have designed spacecraft for lunar missions. To provide a research tool that makes the voluminous lunar data more accessible, the Space Environments and Effects (SEE) Program, managed at NASA's Marshall Space Flight Center (MSFC) in Huntsville, AL, organized the data into a DVD knowledgebase: the Lunar e-Library. This searchable collection of 1100 electronic (.PDF) documents and abstracts makes it easy to find critical technical data and lessons learned from past lunar missions and exploration studies. The SEE Program began distributing the Lunar e-Library DVD in 2006. This paper describes the Lunar e-Library development process (including a description of the databases and resources used to acquire the documents) and the contents of the DVD product, demonstrates its usefulness with focused searches, and provides information on how to obtain this free resource.
Author
Libraries; Lunar Environment; Lunar Exploration; Aerospace Environments; Data Bases; Remote Sensing; Moon

20070017934 NASA Marshall Space Flight Center, Huntsville, AL, USA
Launching to the Moon, Mars, and Beyond
Dumbacher, Daniel L.; December 2006; 20 pp.; In English; Purdue University Student Colloquium (12/7/06) and IN Advanced Aerospace Manufacturing Alliance (12/8/06}, 7-8 Dec. 2006, Indianapolis, IN, USA; Original contains color illustrations; No Copyright; Avail.: CASI: C01, CD-ROM: A03, Hardcopy
ONLINE: http://hdl.handle.net/2060/20070017934

The U.S. Vision for Space Exploration, announced in 2004, calls on NASA to finish constructing the International Space Station, retire the Space Shuttle, and build the new spacecraft needed to return to the Moon and go on the Mars. By exploring space, America continues the tradition of great nations who mastered the Earth, air, and sea, and who then enjoyed the benefits

of increased commerce and technological advances. The progress being made today is part of the next chapter in America's history of leadership in space. In order to reach the Moon and Mars within the planned timeline and also within the allowable budget, NASA is building upon the best of proven space transportation systems. Journeys to the Moon and Mars will require a variety of vehicles, including the Ares I Crew Launch Vehicle, the Ares V Cargo Launch Vehicle, the Orion Crew Exploration Vehicle, and the Lunar Surface Access Module. What America learns in reaching for the Moon will teach astronauts how to prepare for the first human footprints on Mars. While robotic science may reveal information about the nature of hydrogen on the Moon, it will most likely tale a human being with a rock hammer to find the real truth about the presence of water, a precious natural resource that opens many possibilities for explorers. In this way, the combination of astronauts using a variety of tools and machines provides a special synergy that will vastly improve our understanding of Earth's cosmic neighborhood.
Author
Space Exploration; Launch Vehicles; International Space Station; Space Transportation System; Moon; Mars (Planet); Lunar Surface; Space Shuttles; Ares 1 Launch Vehicle; Ares 5 Cargo Launch Vehicle

20070017959 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
Opportunistic Planning and Execution for Planetary Exploration
Gaines, Daniel M.; Estlin, Tara; Chouinard, Caroline; Castano, Rebecca; Castano, Andres; Bornstein, Ben; Anderson, Robert C.; Judd, Michele; Nesnas, Issa; Rabideau, Gregg; June 6, 2006; 3 pp.; In English; International Conference on Automated Planning and Scheduling, 6-10 Jun. 2006, English Lake District, UK; Copyright; Avail.: Other Sources
ONLINE: http://hdl.handle.net/2014/39892

We are developing technologies to increase the autonomous capabilities of future rover missions. Our objectives are to make rovers easier to command and to enable them to make more effective use of rover resources when problems arise or when things go better than expected. We will demonstrate OASIS (Onboard Analysis Science Investigation System) which combined planning and scheduling techniques with machine learning to enable rovers to perform robust and opportunistic science operations.
Author
Autonomy; Space Exploration; Space Missions; Mars Roving Vehicles; Mission Planning; Onboard Equipment

92
SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

20070016708 NASA Goddard Space Flight Center, Greenbelt, MD, USA
The Virtual Solar Observatory and the Heliophysics Meta-Virtual Observatory
Gurman, J. B.; Hourcle, J. A.; Bogart, R. S.; Tian, K.; Hill, F.; Suarez-Sola, I.; Zarro, D. M.; Davey, A. R.; Martens, P. C.; Yoshimura, K.; Reardon, K. M.; [2006]; 1 pp.; In English; No Copyright; Avail.: Other Sources; Abstract Only

The Virtual Solar Observatory (VSO) has survived its infancy and provides metadata search and data identification for measurements from 45 instrument data sets held at 12 online archives, as well as flare and coronal mass ejection (CME) event lists. Like any toddler, the VSO is good at getting into anything and everything, and is now extending its grasp to more data sets, new missions, and new access methods using its application programming interface (API). We discuss and demonstrate recent changes, including developments for STEREO and SDO, and an IDL-callable interface for the VSO API. We urge the heliophysics community to help civilize this obstreperous youngster by providing input on ways to make the VSO even more useful for system science research in its role as part of the growing cluster of Heliophysics Virtual Observatories.
Author
Solar Observatories; Metadata; Heliosphere; Sun

20070017393 Space Environment Technologies, Pacific Palisades, CA, USA
SOLAR2000 v2.30 and SOLARFLARE v1.01: New Capabilities for Space System Operations
Tobiska, W. Kent; 2007; 9 pp.; In English
Contract(s)/Grant(s): NNH05CD15C; NAG5-11408
Report No.(s): AIAA Paper 2007-0495; Copyright; Avail.: CASI: A02, Hardcopy

Space system operational and mission planning users have indicted a strong interest in a) high time- and spatially-resolved irradiances, b) historical 3-hour data, c) improved proxies, indices, and formats, as well as d) new models and datasets. The

applications for solar irradiance products that have been identified as most important include characterizations of neutral atmosphere and ionosphere densities along with spacecraft materials properties under energetic photon bombardment and photon-induced surface charging. We report on major improvements to the SOLAR2000 (S2K) model series that addresses these user interests. First, for the neutral density users, the S(sub 10.7) index (26-34 nm EUV) of chromospheric plage and active region extreme ultraviolet solar irradiance and the M(sub 10.7) proxy (145-165 nm FUV) of aeronomically important photospheric background and network Schumann-Runge Continuum far ultraviolet irradiances are now provided. These complement the traditional F(sub 10.7) proxy for transition region/cool corona active region XUV-EUV (0.1-121.0 nm) energy. These three daily and 81-day smoothed indices/proxies, with 1-5, and 1-day lags, respectively, are the drivers for the new Jaechia-Bowman emperical thermospheric density model (JB2006) that has reduced by half mass density uncertainties compared to previous Jacchia- and MSIS-type models. Second, for ionosphere and spacecraft surface users, nowcast data is assimilate real-time in S2K fro the GOES XRS instrument with 2-minute cadence, 1-minute granularity, 7-minute latency, and 6-hour predicts relative to the current epoch. These are used to produce data-driven high time and spectral resolution, physics-based real-time flare evolution assessment through SOLARFLARE. SOLAR2000 continues to produce 1-hour cadence, 1-day granularity, and 4.5-month predicts of high spectral resolution irradiances or broadband indices. The combination of these changes is that S2K has been transformed into a hybrid model that includes physics-based, observation-based, and data-driven modeling.

Author

Solar Flares; Aerospace Systems; Irradiance; Aeronomy; Atmospheric Models

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