



National Aeronautics and  
Space Administration  
Langley Research Center

Scientific and Technical  
Information Program Office

# Scientific and Technical Aerospace Reports

# STAR

Volume 41

Issue 8

April 18, 2003

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# NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program plays a key part in helping NASA maintain this important role.

The NASA STI Program provides access to the NASA Aeronautics and Space Database, the largest collection of aeronautical and space science in the world. The STI Program is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

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

- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

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The NASA STI Program is managed by the NASA STI Program Office (STIPO). STIPO is the administrative office at Langley Research Center for the NASA STI Program.

For more information about the NASA STI Program, you can:

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- Telephone the NASA STI Help Desk at (301) 621-0390
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NASA STI Help Desk  
NASA Center for AeroSpace Information  
7121 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 world wide aerospace-related 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 & 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 Research & Development (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 Scientific and Technical Information (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 website at <http://www.sti.nasa.gov>.

# NASA STI Availability Information

## NASA Center for AeroSpace Information (CASI)

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

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

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## National Technical Information Service (NTIS)

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

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The U.S. Congress established the **Federal Depository Library Program** (FDLP) to ensure access by 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 [http://www.access.gpo.gov/su\\_docs](http://www.access.gpo.gov/su_docs).

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

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

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

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

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

*A Biweekly Publication of the National Aeronautics and Space Administration*

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VOLUME 42, JANUARY 16, 2004

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*.

**20040000109** University of Central Florida, Orlando, FL, USA

**Glenn-HT/BEM Conjugate Heat Transfer Solver for Large-Scale Turbomachinery Models**

Divo, E.; Steinthorsson, E.; Rodriguez, F.; Kassab, A. J.; Kapat, J. S.; Heidmann, James D., Technical Monitor; April 2003; 69 pp.; In English

Contract(s)/Grant(s): NAG3-2691; WU 708-87-23

Report No.(s): NASA/CR-2003-212195; E-13798; NAS 1.26:212195; No Copyright; Avail: CASI; [A04](#), Hardcopy

A coupled Boundary Element/Finite Volume Method temperature-forward/flux-hack algorithm is developed for conjugate heat transfer (CHT) applications. A loosely coupled strategy is adopted with each field solution providing boundary conditions for the other in an iteration seeking continuity of temperature and heat flux at the fluid-solid interface. The NASA Glenn Navier-Stokes code Glenn-HT is coupled to a 3-D BEM steady state heat conduction code developed at the University of Central Florida. Results from CHT simulation of a 3-D film-cooled blade section are presented and compared with those computed by a two-temperature approach. Also presented are current developments of an iterative domain decomposition strategy accommodating large numbers of unknowns in the BEM. The blade is artificially sub-sectioned in the span-wise direction, 3-D BEM solutions are obtained in the subdomains, and interface temperatures are averaged symmetrically when the flux is updated while the fluxes are averaged anti-symmetrically to maintain continuity of heat flux when the temperatures are updated. An initial guess for interface temperatures uses a physically-based 1-D conduction argument to provide an effective starting point and significantly reduce iteration. 2-D and 3-D results show the process converges efficiently and offers substantial computational and storage savings. Future developments include a parallel multi-grid implementation of the approach under MPI for computation on PC clusters.

Author

*Turbomachinery; Three Dimensional Models; Boundary Element Method; Conductive Heat Transfer; Algorithms*

**20040000866** NASA Glenn Research Center, Cleveland, OH, USA

**Jet Screech Noise Computation**

Loh, Ching Y.; Hultgren, Lennart S.; October 2003; 15 pp.; In English

Contract(s)/Grant(s): WBS 22-708-90-25

Report No.(s): NASA/TM-2003-212626; E-14184; NAS 1.15:212626; No Copyright; Avail: CASI; [A03](#), Hardcopy

The near-field screech-tone noise of a typical underexpanded circular jet issuing from a sonic nozzle is simulated numerically. The self-sustained feedback loop is automatically established in the simulation. The computed shock-cell structure, acoustic wave length, screech tone frequencies, and sound pressure levels in the near field are in good agreement with existing experimental results.

Author

*Jet Aircraft Noise; Screech Tones; Aeroacoustics; Computerized Simulation*

**20040002080** NASA Ames Research Center, Moffett Field, CA, USA

**Staying on the Lookout**

Larsen, Frank; ASK Magazine; December 2003, No. 15, pp. 16-18; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper presents a discussion on The Experimental Aircraft Association (EAA) AirVenture in Oshkosh, Wisconsin, which is one of the biggest aircraft shows in the world. It is also a huge public relations event for NASA. The alliance of different NASA Centers to collaborate on projects is also discussed.

CASI

*NASA Programs; Aeronautics; Aircraft Industry*

## 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*.

**20040000366** Stanford Univ., Stanford, CA

### **Advances in Aerodynamic Shape Optimization Using Control Theory**

Jameson, Antony; Alonso, Juan J.; Jan. 2000; 16 pp.; In English

Contract(s)/Grant(s): F49620-98-1-0222

Report No.(s): AD-A418452; AFRL-SR-AR-TR-03-0470; No Copyright; Avail: CASI; [A03](#), Hardcopy

The main objective of this has been the development and maturation of an adjoint-based, viscous design techniques for Aerodynamic Shape Optimization (ASO) of complete aircraft configurations. We have followed a systematic approach in the development, validation and testing of our methods. In addition, we have carried out some preliminary work in the development of a mathematical environment for high-fidelity aero-structural optimization as a first step towards the realization of a high-fidelity multidisciplinary optimization capability. A number of significant milestones achieved in this process are detailed in the final report.

DTIC

*Aerodynamic Configurations; Design Optimization; Aircraft Configurations*

**20040001029** NASA Langley Research Center, Hampton, VA, USA

### **A Quick Method for Evaluating the Merits of a Proposed Low Sonic Boom Concept**

Mack, Robert J.; November 2003; 38 pp.; In English

Contract(s)/Grant(s): WU 23-706-92-02

Report No.(s): NASA/TM-2003-212653; L-18334; NAS 1.15:212653; No Copyright; Avail: CASI; [A03](#), Hardcopy

The characteristics of a proposed low-boom aircraft concept cannot be adequately assessed unless it is given an extensive, time-consuming, mission-performance, and sonic-boom analyses. So, it would be useful to have a method for performing a quick first-order sonic-boom and mission-range analysis. The evaluation method outlined in this report has the attributes of being both fast and reasonably accurate. It can also be used as a design tool to estimate the sonic-boom ground overpressures, mission range, and beginning-cruise weight of a new low-boom concept during the first stages of preliminary design.

Author

*Sonic Booms; Computer Programs*

**20040001059** NASA Langley Research Center, Hampton, VA, USA

### **The Role of Analytic Methods in Computational Aeroacoustics**

Farassat, F.; Posey, J. W.; [2003]; 4 pp.; In English; Aerospace National Simulation Symposium 2003, 2003

Contract(s)/Grant(s): 23-781-10-00; No Copyright; Avail: CASI; [A01](#), Hardcopy

As air traffic grows, annoyance produced by aircraft noise will grow unless new aircraft produce no objectionable noise outside airport boundaries. Such ultra-quiet aircraft must be of revolutionary design, having unconventional planforms and most likely with propulsion systems highly integrated with the airframe. Sophisticated source and propagation modeling will be required to properly account for effects of the airframe on noise generation, reflection, scattering, and radiation. It is tempting to say that since all the effects are included in the Navier-Stokes equations, time-accurate CFD can provide all the answers. Unfortunately, the computational time required to solve a full aircraft noise problem will be prohibitive for many years to come. On the other hand, closed form solutions are not available for such complicated problems. Therefore, a hybrid approach is recommended in which analysis is taken as far as possible without omitting relevant physics or geometry. Three

examples are given of recently reported work in broadband noise prediction, ducted fan noise propagation and radiation, and noise prediction for complex three-dimensional jets.

Author

*Aeroacoustics; Computational Fluid Dynamics; Jet Aircraft Noise; Air Traffic; Mathematical Models*

**20040003799** NASA Glenn Research Center, Cleveland, OH, USA

**Synthetic Jets in Cross-Flow, Part 1, Round Jet**

Zaman, K. B. M. Q.; Milanovic, Ivana M.; [2003]; 13 pp.; In English; 16th AIAA Computational Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA

Report No.(s): AIAA Paper 2003-3714; Copyright; Avail: CASI; [A03](#), Hardcopy

Results of an experimental investigation on synthetic jets from round orifices with and without cross-flow are presented. Jet Reynolds number up to 46,000 with a fully turbulent approach boundary layer, and Stokes number up to 400. are covered. The threshold of stroke length for synthetic jet formation. in the absence of the cross-flow, is found to be  $Lo/D$  approximately 0.5. Above  $Lo/D$  is approximately 10, the profiles of normalized centerline mean velocity appear to become invariant. It is reasoned that the latter threshold may be related to the phenomenon of saturation of impulsively generated vortices. In the presence of the cross-flow, the penetration height of a synthetic jet is found to depend on the momentum- flux ratio . When this ratio is defined in terms of the maximum jet velocity and the cross-flow velocity. not only all data collapse but also the jet trajectory is predicted well by correlation equation available for steady jets-in-cross-flow. Distributions of mean velocity, streamwise vorticity as well as turbulence intensity for a synthetic jet in cross-flow are found to be similar to those of a steady jet-in-cross-flow. A pair of counter-rotating streamwise vortices, corresponding to the bound vortex pair of the steady case, is clearly observed. Mean velocity distribution exhibits a dome of low momentum fluid pulled up from the boundary layer, and the entire domain is characterized by high turbulence.

Author

*Jet Flow; Aerodynamic Forces*

### 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*.

**20040000046** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**On-Orbit Edge Response Measurements for IKONOS Panchromatic Images**

Blonski, Slawomir; March 25, 2002; 2 pp.; In English; High Spatial Resolution Commercial Imagery Workshop-IKONOS, 25 Mar. 2003, Reston, VA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00027-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

IKONOS panchromatic images of edge targets created from NASA ESAD 20-m x 20-m tarps deployed at Stennis Space Center, Mississippi are presented. This paper is in viewgraph form.

CASI

*Images; Targets; Air Transportation*

**20040000145** NASA Langley Research Center, Hampton, VA, USA

**Concept of Operations for the NASA Weather Accident Prevention (WxAP) Project, Version 2.0**

Green, Walter S.; Tsoucalas, George; Tanger, Thomas; January 9, 2003; 28 pp.; In English

Contract(s)/Grant(s): 728-40-10-03

Report No.(s): NASA/TM-2003-212424/VER2.0; L-18329/VER2.0; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Weather Accident Prevention Concept of Operations (CONOPS) serves as a decision-making framework for research and technology development planning. It is intended for use by the WxAP members and other related programs in NASA and the FAA that support aircraft accident reduction initiatives. The concept outlines the project overview for program level 3 elements-such as AWIN, WINCOMM, and TPAWS (Turbulence)-that develop the technologies and operating capabilities to form the building blocks for WxAP. Those building blocks include both retrofit of equipment and systems and development

of new aircraft, training technologies, and operating infrastructure systems and capabilities. This Concept of operations document provides the basis for the WxAP project to develop requirements based on the operational needs of the system users. It provides the scenarios that the flight crews, airline operations centers (AOCs), air traffic control (ATC), and flight service stations (FSS) utilize to reduce weather related accidents. The provision to the flight crew of timely weather information provides awareness of weather situations that allows replanning to avoid weather hazards. The ability of the flight crew to locate and avoid weather hazards, such as turbulence and hail, contributes to safer flight practices.

Author

*Accident Prevention; NASA Programs; Civil Aviation; Airline Operations; Aerospace Technology Transfer; Weather Forecasting*

## 04

### AIRCRAFT COMMUNICATIONS AND NAVIGATION

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

**20040000570** North Carolina State Univ., Raleigh, NC, USA

#### **GPS Auto-Navigation Design for Unmanned Air Vehicles**

Nilsson, Caroline C. A.; Heinzen, Stearns N.; Hall, Charles E., Jr.; Chokani, Ndaona; December 10, 2003; 125 pp.; In English  
Contract(s)/Grant(s): NCC1-01008; No Copyright; Avail: CASI; [A06](#), Hardcopy

A GPS auto-navigation system is designed for Unmanned Air Vehicles. The objective is to enable the air vehicle to be used as a test-bed for novel flow control concepts. The navigation system uses pre-programmed GPS waypoints. The actual GPS position, heading, and velocity are collected by the flight computer, a PC104 system running in Real-Time Linux, and compared with the desired waypoint. The navigator then determines the necessity of a heading correction and outputs the correction in the form of a commanded bank angle, for a level coordinated turn, to the controller system. This controller system consists of 5 controller! (pitch rate PID, yaw damper, bank angle PID, velocity hold, and altitude hold) designed for a closed loop non-linear aircraft model with linear aerodynamic coefficients. The ability and accuracy of using GPS data, is validated by a GPS flight. The autopilots are also validated in flight. The autopilot unit flight validations show that the designed autopilots function as designed. The aircraft model, generated on Matlab SIMULINK is also enhanced by the flight data to accurately represent the actual aircraft.

Author

*Global Positioning System; Navigation; Aircraft Models*

**20040000796** NASA Langley Research Center, Hampton, VA, USA

#### **Graphical Representation of the Effects of Antenna Locations on Path Loss Data**

Jafri, Madiha; Ely, Jay; Vahala, Linda; [2003]; 4 pp.; In English; 2003 IEEE Antenna and Propagation Society International Symposium, 22-27 Jun. 2003, Columbus, OH, USA; Original contains color illustrations

Contract(s)/Grant(s): RTA 722-64-10-54; Copyright; Avail: CASI; [A01](#), Hardcopy

The use of portable wireless technology has increased dramatically over the past few years. This increased use has caused a heightened concern for electromagnetic interference from wireless-enabled technologies, such as laptop computers and cellular phones to aircraft communication and navigation radios. Researchers at NASA Langley Research Center, United Airlines and Eagles Wings Incorporated, have tested and collected interference path loss data on a United Airlines out-of-service B737 aircraft near Victorville, CA. This paper summarizes the results found from the measured data sets as well as includes graphical representations of the interference path loss data on a B737 plane with different system antennas.

Author

*Aircraft Communication; Commercial Aircraft; Electromagnetic Interference; Radio Equipment*

**20040000797** NASA Ames Research Center, Moffett Field, CA, USA, Stanford Univ., Stanford, CA, USA

#### **Discrete Abstractions of Hybrid Systems: Verification of Safety and Application to User-Interface Design**

Oishi, Meeko; Tomlin, Claire; Degani, Asaf; November 2003; 55 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N66001-01-C-8080; N00014-00-1-06637; NCC2-798; RTOP 548-40-12

Report No.(s): NASA/TM-2003-212803; Copyright; Avail: CASI; [A04](#), Hardcopy

Human interaction with complex hybrid systems involves the user, the automation's discrete mode logic, and the

underlying continuous dynamics of the physical system. Often the user-interface of such systems displays a reduced set of information about the entire system. In safety-critical systems, how can we identify user-interface designs which do not have adequate information, or which may confuse the user? Here we describe a methodology, based on hybrid system analysis, to verify that a user-interface contains information necessary to safely complete a desired procedure or task. Verification within a hybrid framework allows us to account for the continuous dynamics underlying the simple, discrete representations displayed to the user. We provide two examples: a car traveling through a yellow light at an intersection and an aircraft autopilot in a landing/go-around maneuver. The examples demonstrate the general nature of this methodology, which is applicable to hybrid systems (not fully automated) which have operational constraints we can pose in terms of safety. This methodology differs from existing work in hybrid system verification in that we directly account for the user's interactions with the system.

Author

*Systems Analysis; Complex Systems; Safety*

## 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*.

**20040000389** NASA Langley Research Center, Hampton, VA, USA

#### **A Supersonic Business-Jet Concept Designed for Low Sonic Boom**

Mack, Robert J.; October 2003; 39 pp.; In English

Contract(s)/Grant(s): 23-706-92-02

Report No.(s): NASA/TM-2003-212435; L-18307; No Copyright; Avail: CASI; [A03](#), Hardcopy

Ongoing human-response studies of sonic-boom noise indicated that a previous level of 1.0 psf might still be too annoying. This led to studies of a Supersonic Business Jet (SBJ), which might generate lower, more acceptable ground overpressures. To determine whether methods for designing a High Speed Civil Transport (HSCT) could be successfully applied, a SBJ concept was designed at the Langley Research Center. It would cruise at Mach 2, carry 10 passengers for 4000 nautical miles, and generate a 0.50 psf or less on the ground under the flight path at start of cruise. Results indicated that a 10-passenger, low-boom SBJ design was just as technically demanding as a 300-passenger, low-boom HSCT design. In this report, the sources of these technical problems are identified, and ideas for addressing them are discussed.

Author

*Sonic Booms; Supersonic Transports; Aircraft Design; Supersonic Jet Flow; Civil Aviation*

**20040000622** Mohawk Innovative Technology, Inc., Albany, NY, USA

#### **Non-Contacting Compliant Foil Seal for Gas Turbine Engine**

Salehi, Mohsen; Heshmat, Hooshang; Walton, James F.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 227-245; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper presents viewgraphs on the design of a non-contacting compliant foil seal for gas turbine engines. The topics include: 1) Compliant Gas Foil Seal-Concept to Application; 2) Compliant Foil Seal; 3) Gas Turbine Simulator and Seal Tester; 4) Subcomponent Test Rig for 6 in Seal; 5) Layout of High-Speed Seal Tester; 6) Dynamic Test; 7) Leakage Flow Experimental Result; and 8) Seal Non-Contact Operation.

CASI

*Gas Turbine Engines; Foils (Materials); Seals (Stoppers); Fabrication*

**20040000625** NASA Glenn Research Center, Cleveland, OH, USA

#### **Overview of NASA's UEET and TBCC/RTA Programs**

Shaw, Robert J.; Peddie, Catherine L.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 59-81; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

A general overview of NASA's Ultra Efficient Engine Technology (UEET) and Turbine Based Combined Cycle

(TBCC)/Revolutionary Turbine Accelerator (RTA) is presented. This paper is in viewgraph form.  
CASI  
*General Overviews; NASA Programs; Technology Utilization; Turbine Engines*

**20040000631** General Electric Co., Niskayuna, NY, USA

**Development of Advanced Seals for Industrial Gas Turbines -Abradable Seals**

Chupp, Raymond E.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 135-161; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Improved sealing has been under development for several years for GE industrial turbine applications. The work summarized in this presentation is being carried out at GE's Global Research and Center in cooperation with GE Power Systems. A team of over a dozen individuals at GE-GRC focus on developing advanced seals for several turbine locations. The focus of this presentation is the development for abradable blade tip sealing for industrial gas turbines. The presentation includes: description of how abradable seals work, where they are located in a gas turbine, types of abradable materials, method of application, and detailed information for turbine locations.

Derived from text

*Gas Turbine Engines; Seals (Stoppers); Abrasion; Blade Tips; Fabrication*

**20040000795** NASA Langley Research Center, Hampton, VA, USA

**Damage Tolerance of Integral Structure in Rotorcraft**

Forth, Scott C.; Urban, Michael R.; [2003]; 6 pp.; In English; Damage Tolerance of Integral Structure in Rotorcraft, 25-29 Jul. 2003, Corfu, Greece; Original contains color illustrations

Contract(s)/Grant(s): RTA 706-62-11-50; Copyright; Avail: CASI; [A02](#), Hardcopy

The rotorcraft industry has rapidly implemented integral structures into aircraft to benefit from the weight and cost advantages over traditionally riveted structure. The cost to manufacture an integral structure, where the entire component is machined from a single plate of material, is about one-fifth that of a riveted structure. Furthermore, the integral structure can weigh only one-half that of a riveted structure through optimal design of stiffening structure and part reduction. Finally, inspection and repair of damage in the field can be less costly than riveted structure. There are no rivet heads to inspect under, reducing inspection time, and damage can be removed or patched readily without altering the primary structure, reducing replacement or repair costs. In this paper, the authors will investigate the damage tolerance implications of fielding an integral structure manufactured from thick plate aluminum.

Author

*Rotary Wing Aircraft; Damage; Structural Weight; Stiffening; Tolerances (Mechanics)*

**20040000798** NASA Langley Research Center, Hampton, VA, USA

**Propulsion Airframe Integration Test Techniques for Hypersonic Airbreathing Configurations at NASA Langley Research Center**

Witte, David W.; Huebner, Lawrence D.; Trexler, Carl A.; Cabell, Karen F.; Andrews, Earl H., Jr.; [2003]; 22 pp.; In English; 39th AIAA/ASME/SEA/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains color illustrations

Contract(s)/Grant(s): RTA 23-713-17-10

Report No.(s): AIAA Paper 2003-4406; Copyright; Avail: CASI; [A03](#), Hardcopy

The scope and significance of propulsion airframe integration (PAI) for hypersonic airbreathing vehicles is presented through a discussion of the PAI test techniques utilized at NASA Langley Research Center. Four primary types of PAI model tests utilized at NASA Langley for hypersonic airbreathing vehicles are discussed. The four types of PAI test models examined are the forebody/inlet test model, the partial-width/truncated propulsion flowpath test model, the powered exhaust simulation test model, and the full-length/width propulsion flowpath test model. The test technique for each of these four types of PAI test models is described, and the relevant PAI issues addressed by each test technique are illustrated through the presentation of recent PAI test data.

Author

*Hypersonic Vehicles; Air Breathing Engines; Engine Airframe Integration; Aerodynamic Configurations*

**20040000850** NASA Glenn Research Center, Cleveland, OH, USA

**Vibration Based Crack Detection in a Rotating Disk, Part 1, An Analytical Study**

Gyekenyesi, Andrew L.; Sawicki, Jerzy T.; Baaklini, George Y.; September 2003; 15 pp.; In English  
Contract(s)/Grant(s): WBS 22-728-30-06

Report No.(s): NASA/TM-2003-212624/PT1; E-14182/PT1; Copyright; Avail: CASI; [A03](#), Hardcopy

This paper describes the analytical results concerning the detection of a crack in a rotating disk. The concept of the approach is based on the fact that the development of a disk crack results in a distorted strain field within the component. As a result, a minute deformation in the disk's geometry as well as a change in the system's center of mass occurs. Finite element analyses were conducted concerning a notched disk in order to define the sensitivity of the method. The notch was used to simulate an actual crack and will be the method utilized for upcoming experiments. Various notch sizes were studied. The geometric deformations and shifts of center of mass were documented as a function of rotational speed. In addition, a rotordynamic analysis of a 2-bearing, disk and shaft system was conducted. The overall response of the system was required in order to design the experimental system for operation beyond the first critical. The results of the FE analyses of the disk indicated that the overall changes in the disk's geometry and center of mass were rather small. The difference between the maximum centrifugal radial displacements between the undamaged and damaged disks at 8000 RPM was 0.00014 in. for a 0.963 in. notch length. The shift in center of mass was also of this magnitude. The next step involves running experiments to verify the analysis.

Author

*Systems Health Monitoring; Cracking (Fracturing); Rotating Disks; Rotor Dynamics; Detection; Vibration Tests*

**20040001150** NASA Langley Research Center, Hampton, VA, USA

**Flutter and Divergence Analysis using the Generalized Aeroelastic Analysis Method**

Edwards, John W.; Wieseman, Carol D.; [2003]; 19 pp.; In English; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Generalized Aeroelastic Analysis Method (GAAM) is applied to the analysis of three well-studied checkcases: restrained and unrestrained airfoil models, and a wing model. An eigenvalue iteration procedure is used for converging upon roots of the complex stability matrix. For the airfoil models, exact root loci are given which clearly illustrate the nature of the flutter and divergence instabilities. The singularities involved are enumerated, including an additional pole at the origin for the unrestrained airfoil case and the emergence of an additional pole on the positive real axis at the divergence speed for the restrained airfoil case. Inconsistencies and differences among published aeroelastic root loci and the new, exact results are discussed and resolved. The generalization of a Doublet Lattice Method computer code is described and the code is applied to the calculation of root loci for the wing model for incompressible and for subsonic flow conditions. The error introduced in the reduction of the singular integral equation underlying the unsteady lifting surface theory to a linear algebraic equation is discussed. Acknowledging this inherent error, the solutions of the algebraic equation by GAAM are termed 'exact.' The singularities of the problem are discussed and exponential series approximations used in the evaluation of the kernel function shown to introduce a dense collection of poles and zeroes on the negative real axis. Again, inconsistencies and differences among published aeroelastic root loci and the new 'exact' results are discussed and resolved. In all cases, aeroelastic flutter and divergence speeds and frequencies are in good agreement with published results. The GAAM solution procedure allows complete control over Mach number, velocity, density, and complex frequency. Thus all points on the computed root loci can be matched-point, consistent solutions without recourse to complex mode tracking logic or dataset interpolation, as in the k and p-k solution methods.

Author

*Aeroelasticity; Flutter Analysis; Mathematical Models; Divergence; Aircraft Stability*

**20040001193** NASA Langley Research Center, Hampton, VA, USA

**Performance Trades Study for Robust Airfoil Shape Optimization**

Li, Wu; Padula, Sharon; [2003]; 7 pp.; In English

Report No.(s): AIAA Paper 2003-3790; No Copyright; Avail: CASI; [A02](#), Hardcopy

From time to time, existing aircraft need to be redesigned for new missions with modified operating conditions such as required lift or cruise speed. This research is motivated by the needs of conceptual and preliminary design teams for smooth airfoil shapes that are similar to the baseline design but have improved drag performance over a range of flight conditions. The proposed modified profile optimization method (MPOM) modifies a large number of design variables to search for nonintuitive performance improvements, while avoiding off-design performance degradation. Given a good initial design, the MPOM generates fairly smooth airfoils that are better than the baseline without making drastic shape changes. Moreover, the MPOM allows users to gain valuable information by exploring performance trades over various design conditions. Four

simulation cases of airfoil optimization in transonic viscous flow are included to demonstrate the usefulness of the MPOM as a performance trades study tool. Simulation results are obtained by solving fully turbulent Navier-Stokes equations and the corresponding discrete adjoint equations using an unstructured grid computational fluid dynamics code FUN2D.

Author

*Airfoils; Shape Optimization; Mathematical Models; Robustness (Mathematics); Aircraft Performance*

**20040001394** NASA Langley Research Center, Hampton, VA, USA

**Evaluation of Alternate Concepts for Synthetic Vision Flight Displays With Weather-Penetrating Sensor Image Inserts During Simulated Landing Approaches**

Parrish, Russell V.; Busquets, Anthony M.; Williams, Steven P.; Nold, Dean E.; October 2003; 32 pp.; In English  
Contract(s)/Grant(s): WU 728-60-10-01

Report No.(s): NASA/TP-2003-212643; L-18322; No Copyright; Avail: CASI; [A03](#), Hardcopy

A simulation study was conducted in 1994 at Langley Research Center that used 12 commercial airline pilots repeatedly flying complex Microwave Landing System (MLS)-type approaches to parallel runways under Category IIIc weather conditions. Two sensor insert concepts of 'Synthetic Vision Systems' (SVS) were used in the simulated flights, with a more conventional electro-optical display (similar to a Head-Up Display with raster capability for sensor imagery), flown under less restrictive visibility conditions, used as a control condition. The SVS concepts combined the sensor imagery with a computer-generated image (CGI) of an out-the-window scene based on an onboard airport database. Various scenarios involving runway traffic incursions (taxiing aircraft and parked fuel trucks) and navigational system position errors (both static and dynamic) were used to assess the pilots' ability to manage the approach task with the display concepts. The two SVS sensor insert concepts contrasted the simple overlay of sensor imagery on the CGI scene without additional image processing (the SV display) to the complex integration (the AV display) of the CGI scene with pilot-decision aiding using both object and edge detection techniques for detection of obstacle conflicts and runway alignment errors.

Author

*Enhanced Vision; Display Devices; Landing Simulation; Aircraft Pilots; Aircraft Landing*

**20040001647** Army Aviation and Missile Command, Moffett Field, CA, USA

**An Obstacle Alerting System for Agricultural Application**

DeMaio, Joe; [2002; 13 pp.; In English; American Helicopter Society 58th Annual Forum, 11-13 Jun. 2002, Montreal, Quebec, Canada; Copyright; Avail: CASI; [A03](#), Hardcopy

Wire strikes are a significant cause of helicopter accidents. The aircraft most at risk are aerial applicators. The present study examines the effectiveness of a wire alert delivered by way of the lightbar, a GPS-based guidance system for aerial application. The alert lead-time needed to avoid an invisible wire is compared with that to avoid a visible wire. A flight simulator was configured to simulate an agricultural application helicopter. Two pilots flew simulated spray runs in fields with visible wires, invisible wires, and no wires. The wire alert was effective in reducing wire strikes. A lead-time of 3.5 sec was required for the alert to be effective. The lead-time required was the same whether the pilot could see the wire or not.

Author

*Agriculture; Global Positioning System; Computerized Simulation; Warning Systems; Wire*

**20040001677** Aerospace Corp., USA

**Liquid Engine Test Facilities Assessment**

Adams, Michael J.; Emdee, Jeffery L.; George, Daweel J.; Peinemann, Manfred; May 03, 2002; 69 pp.; In English  
Contract(s)/Grant(s): F04701-00-C-0009

Report No.(s): NASA/SE-2002-05-00041-SSC; No Copyright; Avail: CASI; [A04](#), Hardcopy

The John C. Stennis Space Center (SSC) requested The Aerospace Corporation to examine the current testing capability of all existing large liquid engine test facilities located in the USA. That information along with projected liquid rocket engine development was used to examine future liquid rocket engine testing facilities needs in the coming decade. Current domestic liquid engine test facilities capabilities, when examined against engine concepts for the coming decade, indicate there are ample facilities offering altitude simulation during test. In addition, it was observed that many contractor facilities have limited ambient test capability of larger thrust engines under current consideration. Finally, it was concluded that diminished contractor participation engine development testing will drive this activity to the government sector. Only three facilities are seen as key contributors to engine testing in the coming decade, namely John C. Stennis Space Center (SSC), Marshall Space Flight Center (MSFC), and Air Force Research Laboratory (AFRL). Past rocket engine test experience was evaluated as a

possible resource for projecting future engine test needs. A database comprised of various engine models and the level of testing performed to flight qualify those systems for their first flight was constructed. For comparison purposes in this study, development and qualification efforts were totaled and treated as one test program. Based on experience with past Air Force programs, the time on the test stand accounts for typically 50% or more of the total program time. Historical data show that the time to design and develop new engines has increased over the last 40 years, most likely due to scarcer resources in today's funding environment.

Derived from text

*Engine Tests; Liquid Propellant Rocket Engines; Test Facilities; Aerospace Systems*

## 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.*

**20040000685** Illinois Univ. at Urbana-Champaign, Savoy, IL, USA

#### **The Primary Flight Display and Its Pathway Guidance: Workload, Performance, and Situation Awareness**

Wickens, Christopher D.; Alexander, Amy L.; Hardy, Thomas J.; February 2003; 76 pp.; In English

Contract(s)/Grant(s): NAG1-02071

Report No.(s): AHFD-03-2/NASA-03-1; No Copyright; Avail: CASI; [A05](#), Hardcopy

In two experiments carried out in a high fidelity general aviation flight simulator, 42 instrument rated pilots flew a pathway-in-the-sky (tunnel) display through a series of multi-leg curved stepdown approaches through mountainous terrain. Both experiments examined how properties of the tunnel influenced flight path tracking performance, traffic awareness, terrain awareness and workload (assessed both by subjective and secondary task performance measures). Experiment 1, flown in simulated VMC, compared high and low intensity tunnels, with a less cluttered follow-me-airplane (FMA). The results revealed that both tunnels supported better flight path tracking than the FMA, because of the availability of more preview information. Increasing tunnel intensity, while reducing subjective workload, had no benefit on tracking, and degraded traffic detection performance. In Experiment 2, flown mostly in IMC, the low intensity tunnel was flown with a large (10 inch x 8 inch) and small (8 inch x 6.5 inch) display, representing a geometric field of view (GFOV) of either 30 degrees or 60 degrees. Most measures of flight path tracking performance favored the smaller display, and particularly the 60 degree GFOV, which presented a smaller appearing tunnel, and a wider range of terrain depiction. The larger GFOV also supported better terrain awareness, and yielded a lower secondary task assessment of workload. In both experiments, the final landing approach was terminated by a runway obstruction, and the tunnel guided pilots on a missed approach. In nearly all cases, pilots failed to notice an air hazard that lay in the missed approach path, but was only depicted in the outside view.

Derived from text

*Workloads (Psychophysiology); Situational Awareness; Flight Paths; Human Factors Engineering; Wind Tunnels*

**20040000697** North Dakota Univ., Grand Forks, ND, USA

#### **A Multi-Use Airborne Research Facility**

Poellot, Michael R.; [2003]; 8 pp.; In English

Contract(s)/Grant(s): NCC5-503; No Copyright; Avail: CASI; [A02](#), Hardcopy

Much of our progress in understanding the Earth system comes from measurements made in the atmosphere. Aircraft are widely used to collect in situ measurements of the troposphere and lower stratosphere, and they also serve as platforms for many remote sensing instruments. Airborne field measurement campaigns require a capable aircraft, a specially trained support team, a suite of basic instrumentation, space and power for new instruments, and data analysis and processing capabilities (e.g. Veal et al., 1977). However, these capabilities are expensive and there is a need to reduce costs while maintaining the capability to perform this type of research. To this end, NASA entered a Cooperative Agreement with the University of North Dakota (UND) to help support the operations of the UND Cessna Citation research aircraft. This Cooperative Agreement followed in form and substance a previous agreement. The Cooperative Agreement has benefited both NASA and UND. In part because of budget reductions, the NASA Airborne Science Office has elected to take advantage of outside operators of science research platforms to off-load some science requirements (Huning, 1996). UND has worked with NASA to identify those requirements that could be met more cost effectively with the UND platform. This has resulted in significant cost savings to NASA while broadening the base of researchers in the NASA science programs. At the same time, the Agreement has

provided much needed support to UND to help sustain the Citation research facility. In this report, we describe the work conducted under this Cooperative Agreement.

Derived from text

*NASA Programs; Remote Sensing; Research Facilities; Airborne Equipment*

## 07

### AIRCRAFT PROPULSION AND POWER

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

**20040000619** NASA Glenn Research Center, Cleveland, OH, USA

#### **A Compliant Casing for Transonic Axial Compressors**

Bloch, Gregory S.; Hah, Chunill; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 163-170; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A02](#), Hardcopy

A viewgraph presentation on the concept of compliant casing for transonic axial compressors is shown. The topics include: 1) Concept for compliant casing; 2) Rig and facility details; 3) Experimental results; and 4) Numerical results.

CASI

*Transonic Compressors; Turbocompressors; Casing; Fabrication*

**20040000734** Pratt and Whitney Aircraft, East Hartford, CT, USA

#### **Aero-Propulsion Technology (APT) Task V Low Noise ADP Engine Definition Study**

Holcombe, V.; October 2003; 73 pp.; In English

Contract(s)/Grant(s): NAS3-25952; WBS 22-781-30-12

Report No.(s): NASA/CR-2003-212521; E-14083; No Copyright; Avail: CASI; [A04](#), Hardcopy

A study was conducted to identify and evaluate noise reduction technologies for advanced ducted prop propulsion systems that would allow increased capacity operation and result in an economically competitive commercial transport. The study investigated the aero/acoustic/structural advancements in fan and nacelle technology required to match or exceed the fuel burned and economic benefits of a constrained diameter large Advanced Ducted Propeller (ADP) compared to an unconstrained ADP propulsion system with a noise goal of 5 to 10 EPNDB reduction relative to FAR 36 Stage 3 at each of the three measuring stations namely, takeoff (cutback), approach and sideline. A second generation ADP was selected to operate within the maximum nacelle diameter constrain of 160 deg to allow installation under the wing. The impact of fan and nacelle technologies of the second generation ADP on fuel burn and direct operating costs for a typical 3000 nm mission was evaluated through use of a large, twin engine commercial airplane simulation model. The major emphasis of this study focused on fan blade aero/acoustic and structural technology evaluations and advanced nacelle designs. Results of this study have identified the testing required to verify the interactive performance of these components, along with noise characteristics, by wind tunnel testing utilizing and advanced interaction rig.

Author

*Low Noise; Shrouded Propellers; Aeroacoustics; Turbofan Engines; Wind Tunnel Tests; Aircraft Design; Propulsion System Configurations*

**20040000741** General Electric Aircraft Engines, Cincinnati, OH, USA

#### **Ultra-High Bypass Engine Aeroacoustic Study**

Dittmar, James H., Technical Monitor; Gliebe, Philip R.; Janardan, Bangalore A.; October 2003; 109 pp.; In English

Contract(s)/Grant(s): NAS3-25269; WBS 22-781-30-12

Report No.(s): NASA/CR-2003-212525; E-14087; NAS 1.26:212525; No Copyright; Avail: CASI; [A06](#), Hardcopy

A system study was carried out to identify potential advanced aircraft engine concepts and cycles which could be capable of achieving a 5 to 10 EPNdB reduction in community noise level relative to current FAR36 Stage 3 limits for a typical large-capacity commercial transport aircraft. The study was directed toward large twin-engine aircraft applications in the 400,000 to 500,000 pound take-off gross weight class. Four single rotation fan engine designs with fan pressure ratios from 1.3 to 1.75, and two counter-rotating fan engine configurations were studied. Several engine configurations were identified which, with further technology development, could achieve the objective of 5 to 10 EPNdB noise reduction. Optimum design

fan pressure ratio is concluded to be in the range of 1.4 to 1.55 for best noise reduction with acceptable weight and Direct Operating Cost (DOC) penalties.

Author

*Aeroacoustics; Turbofan Engines; Bypass Ratio; Engine Design; Civil Aviation; Aircraft Engines*

**20040000846** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Experimental Results for an Annular Aerospike with Differential Throttling**

Ruf, Joseph H.; McDaniels, David M.; [2003]; 9 pp.; In English; 15th International Symposium on Liquid Space Propulsion, 27 Oct. 2003, Chattanooga, TN, USA; No Copyright; Avail: CASI; [A02](#), Hardcopy

Marshall Space Flight Center funded an internal study on Altitude Compensating Nozzles (ACN) for aerospike engines. The experimental hardware for the engine test is described in this viewgraph presentation, as well as the results of the experiment. The results include spike wall pressures, nozzle efficiency, and side force for four nozzle configurations.

CASI

*Aerospike Engines; Spike Nozzles; Engine Tests; Throttling*

**20040000960**

**Very Large Eddy Simulation Technique for Noise Prediction and Control in Turbomachinery and Propulsion**

Golubev, Vladimir V.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 14-17; In English; See also 20040000959; Original contains black and white illustrations Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

The summer fellowship research project focused on further developing an advanced computational technique based on Very Large Eddy Simulation (VLES) for analysis and control of major sources of noise in turbomachinery and propulsion systems, including jet noise and fan noise. Major part of the work during the 10-week tenure dealt with implementing a low-order, implicit A-stable time-stepping scheme in the existing explicit VLES code of Dr. Ray Hixon. The preliminary plan of the work also included application of a new time marching formulation to the problem of viscous gust-airfoil interaction. Other research items selected for implementation (possibly in the future) included investigating a set of new subgrid turbulent models for the code, and code application to a number of test cases, including a supersonic jet and swirling flow downstream of a rotor stage.

Author

*Noise Prediction; Noise Reduction; Turbomachinery; Jet Aircraft Noise*

**20040000972** Cleveland State Univ., Cleveland, OH, USA

**Aviation Safety Modeling and Simulation (ASMM) Propulsion Fleet Modeling: A Tool for Semi-Automatic Construction of CORBA-based Applications from Legacy Fortran Programs**

Sang, Janche; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 31-34; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Within NASA's Aviation Safety Program, NASA GRC participates in the Modeling and Simulation Project called ASMM. NASA GRC's focus is to characterize the propulsion systems performance from a fleet management and maintenance perspective by modeling and through simulation predict the characteristics of two classes of commercial engines (CFM56 and GE90). In prior years, the High Performance Computing and Communication (HPCC) program funded, NASA Glenn in developing a large scale, detailed simulations for the analysis and design of aircraft engines called the Numerical Propulsion System Simulation (NPSS). Three major aspects of this modeling included the integration of different engine components, coupling of multiple disciplines, and engine component zooming at appropriate level fidelity, require relatively tight coupling of different analysis codes. Most of these codes in aerodynamics and solid mechanics are written in Fortran. Refitting these legacy Fortran codes with distributed objects can increase these codes reusability. Aviation Safety's modeling and simulation use in characterizing fleet management has similar needs. The modeling and simulation of these propulsion systems use existing Fortran and C codes that are instrumental in determining the performance of the fleet. The research centers on building a CORBA-based development environment for programmers to easily wrap and couple legacy Fortran codes. This environment consists of a C++ wrapper library to hide the details of CORBA and an efficient remote variable scheme to facilitate data exchange between the client and the server model. Additionally, a Web Service model should also be constructed for evaluation of this technology's use over the next two- three years.

Author

*Aircraft Safety; Propulsion System Performance; Aircraft Engines; Flight Safety*

**20040001021** NASA Glenn Research Center, Cleveland, OH, USA

**Adaptive Detuning of a Multivariable Controller in Response to Turbofan Engine Degradation**

Litt, Jonathan S.; Aylward, Erin M.; October 2003; 31 pp.; In English

Contract(s)/Grant(s): WBS 22-704-04-03; DA Proj. 1L1-61102-AF-20

Report No.(s): NASA/TM-2003-212723; ARL-TR-3091; E-14247; NAS 1.15:212723; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper presents an ad hoc adaptive, multivariable controller detuning rule that compensates for thrust response variations in an aircraft gas turbine engine whose performance has been degraded through use and wear. As the engine degrades, the nominal thrust is no longer maintained due to a degradation-related shift in certain engine parameters. A relationship between the level of engine degradation and the deviation from the nominal thrust response was shown empirically to hold across the flight envelope and was therefore used to develop a general gain scheduled adaptive control methodology. The technique is shown to work very well in simulation up to the operability limits of the engine. Additionally, since the level of degradation can be estimated from sensor data, it would be feasible to implement the adaptive control algorithm on-line.

Author

*Adaptive Control; Turbofan Engines; Degradation; Algorithms; Multivariable Control; Controllers; Mathematical Models*

**20040001041** NASA Glenn Research Center, Cleveland, OH, USA

**Adaptive Gas Turbine Engine Control for Deterioration Compensation Due to Aging**

Litt, Jonathan S.; Parker, Khary I.; Chatterjee, Santanu; October 2003; 13 pp.; In English; 16th International Symposium on Airbreathing Engines, 31 Aug. - 5 Sep. 2003, Cleveland, OH, USA

Contract(s)/Grant(s): WBS 22-704-04-03; DA Proj. 1L1-61102-AF-20

Report No.(s): NASA/TM-2003-212607; ARL-TR-3034; ISABE-2003-1056; E-14165; NAS 1.15:212607; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper presents an ad hoc adaptive, multivariable controller tuning rule that compensates for a thrust response variation in an engine whose performance has been degraded through use and wear. The upset appears when a large throttle transient is performed such that the engine controller switches from low-speed to high-speed mode. A relationship was observed between the level of engine degradation and the overshoot in engine temperature ratio, which was determined to cause the thrust response variation. This relationship was used to adapt the controller. The method is shown to work very well up to the operability limits of the engine. Additionally, since the level of degradation can be estimated from sensor data, it would be feasible to implement the adaptive control algorithm on-line.

Author

*Adaptive Control; Gas Turbine Engines; Life (Durability); Multivariable Control; Degradation*

**20040001042** NASA Glenn Research Center, Cleveland, OH, USA

**Revolutionary Propulsion Systems for 21st Century Aviation**

Sehra, Arun K.; Shin, Jaiwon; October 2003; 13 pp.; In English; International Gas Turbine Congress, 2-7 Nov. 2003, Tokyo, Japan

Contract(s)/Grant(s): WBS 22-090-50-20

Report No.(s): NASA/TM-2003-212615; E-14175; NAS 1.15:212615; IGTC03-ABS-066b; No Copyright; Avail: CASI; [A03](#), Hardcopy

The air transportation for the new millennium will require revolutionary solutions to meeting public demand for improving safety, reliability, environmental compatibility, and affordability. NASA's vision for 21st Century Aircraft is to develop propulsion systems that are intelligent, virtually inaudible (outside the airport boundaries), and have near zero harmful emissions (CO<sub>2</sub> and Knox). This vision includes intelligent engines that will be capable of adapting to changing internal and external conditions to optimally accomplish the mission with minimal human intervention. The distributed vectored propulsion will replace two to four wing mounted or fuselage mounted engines by a large number of small, mini, or micro engines, and the electric drive propulsion based on fuel cell power will generate electric power, which in turn will drive propulsors to produce the desired thrust. Such a system will completely eliminate the harmful emissions. This paper reviews future propulsion and power concepts that are currently under development at NASA Glenn Research Center.

Author

*Air Transportation; Propulsion System Configurations; Turbofan Engines; Electric Propulsion*

**20040001424** Georgia Tech Research Inst., Smyrna, GA, USA

**Investigation of Pneumatic Inlet and Diffuser Blowing on a Ducted Fan Propulsor in Static Thrust Operation**

Kondor, Shayne; Englar, Robert J.; Lee, Warren J.; March 15, 2003; 18 pp.; In English

Contract(s)/Grant(s): NAG1-02093; No Copyright; Avail: CASI; [A03](#), Hardcopy

Tilting ducted fans present a solution for the lifting and forward flight propulsion requirements of VTOL aircraft. However, the geometry of the duct enshrouding the propeller has great a effect on the efficiency of the fan in various flight modes. Shroud geometry controls the velocity and pressure at the face of the fan, while maintaining a finite loading out at the tips of the fan blades. A duct tailored for most efficient generation of static lifting thrust will generally suffer from performance deficiencies in forward flight. The converse is true as well, leaving the designer with a difficult trade affecting the overall performance and sizing of the aircraft. Ideally, the shroud of a vertical lifting fan features a generous bell mouth inlet promoting acceleration of flow into the face of the fan, and terminating in a converging nozzle at the exit. Flow entering the inlet is accelerated into the fan by the circulation about the shroud, resulting in an overall increase in thrust compared to an open propeller operating under the same conditions. The accelerating shroud design is often employed in lifting ducted fans to benefit from the thrust augmentation; however, such shroud designs produce significant drag penalties in axial flight, thus are unsuitable for efficient forward flight applications. Decelerating, or diffusing, duct designs are employed for higher speed forward flight configurations. The lower circulation on the shroud tends to decelerate the flow into the face of the fan, which is detrimental to static thrust development; however, net thrust is developed on the shroud while the benefits of finite blade loading are retained. With judicious shroud design for intended flight speeds, a net increase in efficiency can be obtained over an open propeller. In this experiment, conducted under contract to NASA LaRC (contract NAG-1-02093) circulation control is being applied to a mildly diffusing shroud design, intended for improved forward flight performance, to generate circulation in the sense of an accelerating duct design. The intent is to improve static thrust performance of a ducted fan tailored for high speed axial flight, while at the same time significantly reduce the pressure signature on the ground plane. Circulation control on the fan shroud is achieved by the Coanda effect.

Author

*Pneumatics; Intake Systems; Inlet Flow; Ducted Fans; Static Thrust; Diffusers; Shrouds*

**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*.

**20040000124** Lockheed Martin Aeronautics Co., Fort Worth, TX, USA

**Validation and Verification of Intelligent and Adaptive Control Systems (VVIACS)**

Buffington, James; Sep. 2003; 21 pp.; In English

Contract(s)/Grant(s): F33615-02-C-3206; Proj-2403

Report No.(s): AD-A418390; AFRL-VA-WP-TP-2003-327; No Copyright; Avail: CASI; [A03](#), Hardcopy

No abstract available

*Adaptive Control; Proving*

**20040000923** NASA Dryden Flight Research Center, Edwards, CA, USA

**Integration of Online Parameter Identification and Neural Network for In-Flight Adaptive Control**

Hageman, Jacob J.; Smith, Mark S.; Stachowiak, Susan; October 2003; 23 pp.; In English; AIAA Atmospheric Flight Mechanics Conference, 11-14 Aug. 2003, Austin, TX, USA; Original contains color illustrations

Contract(s)/Grant(s): WU 745-20-00-SE-40

Report No.(s): NASA/TM-2003-212028; H-2543; AIAA Paper 2003-5700; No Copyright; Avail: CASI; [A03](#), Hardcopy

An indirect adaptive system has been constructed for robust control of an aircraft with uncertain aerodynamic characteristics. This system consists of a multilayer perceptron pre-trained neural network, online stability and control derivative identification, a dynamic cell structure online learning neural network, and a model following control system based on the stochastic optimal feedforward and feedback technique. The pre-trained neural network and model following control system have been flight-tested, but the online parameter identification and online learning neural network are new additions used for in-flight adaptation of the control system model. A description of the modification and integration of these two stand-alone software packages into the complete system in preparation for initial flight tests is presented. Open-loop results using both simulation and flight data, as well as closed-loop performance of the complete system in a nonlinear,

six-degree-of-freedom, flight validated simulation, are analyzed. Results show that this online learning system, in contrast to the nonlearning system, has the ability to adapt to changes in aerodynamic characteristics in a real-time, closed-loop, piloted simulation, resulting in improved flying qualities.

Author

*Measure and Integration; Independent Variables; Neural Nets; Flight Control; Adaptive Control*

**20040000971** Hartford Univ., CT, USA

### **Synthetic Jets**

Milanovic, Ivana M.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 21-25; In English; See also 20040000959; Original contains black and white illustrations Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Current investigation of synthetic jets and synthetic jets in cross-flow examined the effects of orifice geometry and dimensions, momentum-flux ratio, cluster of orifices, pitch and yaw angles as well as streamwise development of the flow field. This comprehensive study provided much needed experimental information related to the various control strategies. The results of the current investigation on isolated and clustered synthetic jets with and without cross-flow will be further analyzed and documented in detail. Presentations at national conferences and publication of peer-reviewed journal articles are also expected. Projected publications will present both the mean and turbulent properties of the flow field, comparisons made with the data available in an open literature, as well as recommendations for the future work.

Author

*Cross Flow; Jet Flow*

**20040001365** North Carolina State Univ., Raleigh, NC, USA

### **UAV Flight Control using Distributed Actuation and Sensing**

Barnwell, William G.; Heinzen, Stearns N.; Hall, Charles E., Jr.; Chokani, Ndaona; Raney, David L., Technical Monitor; October 16, 2003; 73 pp.; In English

Contract(s)/Grant(s): NAG1-01069; No Copyright; Avail: CASI; [A04](#), Hardcopy

An array of effectors and sensors has been designed, tested and implemented on a Blended Wing Body Uninhabited Aerial Vehicle (UAV). This UAV is modified to serve as a flying, controls research, testbed. This effector/sensor array provides for the dynamic vehicle testing of controller designs and the study of decentralized control techniques. Each wing of the UAV is equipped with 12 distributed effectors that comprise a segmented array of independently actuated, contoured control surfaces. A single pressure sensor is installed near the base of each effector to provide a measure of deflections of the effectors. The UAV wings were tested in the North Carolina State University Subsonic Wind Tunnel and the pressure distribution that result from the deflections of the effectors are characterized. The results of the experiments are used to develop a simple, but accurate, prediction method, such that for any arrangement of the effector array the corresponding pressure distribution can be determined. Numerical analysis using the panel code CMARC verifies this prediction method.

Author

*Flight Control; Controllers; Sensors; Pressure Measurement*

## **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 astronomical facilities see *14 Ground Support Systems and Facilities (Space)*.

**20040000008** NASA Langley Research Center, Hampton, VA, USA

### **Characterization of the Test Section Walls at the 14- by 22-Foot Subsonic Tunnel**

Lunsford, Charles B.; Graves, Sharon S.; October 2003; 20 pp.; In English

Contract(s)/Grant(s): WU 706-31-11-80

Report No.(s): NASA/TP-2003-212444; L-18315; No Copyright; Avail: CASI; [A03](#), Hardcopy

The test section walls of the NASA Langley Research Center 14- by 22-Foot Subsonic Tunnel are known to move under thermal and pressure loads. Videogrammetry was used to measure wall motion during the summer of 2002. In addition, a laser distancemeter was used to measure the relative distance between the test section walls at a single point. Distancemeter and videogrammetry results were consistent. Data were analyzed as a function of temperature and pressure to determine their

effects on wall motion. Data were collected between 50 and 100 F, 0 and 0.315 Mach, and dynamic pressures of 0 and 120 psf. The overall motion of each wall was found to be less than 0.25 in. and less than facility personnel anticipated. The results show how motion depends on the temperature and pressure inside the test section as well as the position of the boundary layer vane. The repeatability of the measurements was +/-0.06 in. This report describes the methods used to record the motion of the test section walls and the results of the data analysis. Future facility plans include the development of a suitable wall restraint system and the determination of the effects of the wall motion on tunnel calibration.

Author

*Subsonic Wind Tunnels; Wind Tunnel Walls; Video Equipment; Motion; Distance Measuring Equipment; Laser Applications*

**20040000371** NASA Marshall Space Flight Center, Huntsville, AL, USA

**NASA Earth Science Research and Applications Using UAVs**

Guillory, Anthony R.; [2003]; 1 pp.; In English; Technical Analysis and Applications Center (TAAC) 2003 UAV Conference, 28-30 Oct. 2003, Albuquerque, NM, USA; No Copyright; Avail: Other Sources; Abstract Only

The NASA Earth Science Enterprise sponsored the UAV Science Demonstration Project, which funded two projects: the Altus Cumulus Electrification Study (ACES) and the UAV Coffee Harvest Optimization experiment. These projects were intended to begin a process of integrating UAVs into the mainstream of NASA's airborne Earth Science Research and Applications programs. The Earth Science Enterprise is moving forward given the positive science results of these demonstration projects to incorporate more platforms with additional scientific utility into the program and to look toward a horizon where the current piloted aircraft may not be able to carry out the science objectives of a mission. Longer duration, extended range, slower aircraft speed, etc. all have scientific advantages in many of the disciplines within Earth Science. The challenge we now face are identifying those capabilities that exist and exploiting them while identifying the gaps. This challenge has two facets: the engineering aspects of redesigning or modifying sensors and a paradigm shift by the scientists.

Author

*Earth Sciences; Applications Programs (Computers); Electrification*

**20040000630** NASA Glenn Research Center, Cleveland, OH, USA

**Overview of NASA Glenn Seal Program**

Steinetz, Bruce M.; Proctor, Margaret P.; Dunlap, Patrick H., Jr.; Delgado, Irebert; DeMange, Jeffrey J.; Daniels, Christopher C.; Lattime, Scott B.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 35-58; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The Seal Team is divided into four primary areas. These areas include turbine engine seal development, structural seal development, acoustic seal development, and adaptive seal development. The turbine seal area focuses on high temperature, high speed shaft seals for secondary air system flow management. The structural seal area focuses on high temperature, resilient structural seals required to accommodate large structural distortions for both space- and aero-applications. Our goal in the acoustic seal project is to develop non-contacting, low leakage seals exploiting the principles of advanced acoustics. We are currently investigating a new acoustic field known as Resonant Macrosonic Synthesis (RMS) to see if we can harness the large acoustic standing pressure waves to form an effective air-barrier/seal. Our goal in the adaptive seal project is to develop advanced sealing approaches for minimizing blade-tip (shroud) or interstage seal leakage. We are planning on applying either rub-avoidance or regeneration clearance control concepts (including smart structures and materials) to promote higher turbine engine efficiency and longer service lives.

Author

*NASA Programs; Research and Development; Research Facilities; Seals (Stoppers); Teams; Aeroacoustics*

## 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*.

**20040000102** Allied Aerospace Industries, Inc., Huntsville, AL, USA

**Applying a Crew Accommodations Resource Model to Future Space Vehicle Research: A Case Study**

Blume, Jennifer Linda; [2003]; 26 pp.; In English; Huntsville Simulation Conference 2003, 29-31 Oct. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: CASI; A03, Hardcopy

Modeling for space vehicle design needs to consider: 1) The Human Factor; and 2) The Mission Factor. The Test Case of a crew resource model in this viewgraph presentation includes: 1) The Problem; 2) Crew Accommodations Resource Model; and 3) Conclusions on the model's utility for working the problem. The presentation uses the Crew Accommodations Resource Model to determine the mass and volume of supplies and equipment for a hypothetical manned Mars mission.

Derived from text

*Mission Planning; Manned Space Flight; Long Duration Space Flight; Manned Mars Missions; Consumables (Spacecrew Supplies); Space Logistics; Spacecraft Equipment*

**20040000617** NASA Glenn Research Center, Cleveland, OH, USA

#### **NASA Glenn Research Center Overview**

Campbell, Donald J.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 1-11; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Programs at the NASA Glenn Research Center are briefly outlined.

CASI

*Propulsion; Aerospace Engineering*

**20040000624** NASA Glenn Research Center, Cleveland, OH, USA

#### **NASA's Integrated Space Transportation Plan**

Cikanek, Harry; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 93-111; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Charts and illustrations are provided concerning NASA's integrated space transportation plan. The airframe and propulsion projects are outlined.

CASI

*Space Transportation; Airframes; Propulsion*

## 14

### **GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)**

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

**20040000037** NASA Stennis Space Center, Bay Saint Louis, MS, USA

#### **E-4 Test Facility Design Status**

Ryan, Harry; Canady, Randy; Sewell, Dale; Rahman, Shamim; Gilbrech, Rick; October 1, 2001; 8 pp.; In English; PERC 13th Annual Propulsion Symposium, 22-23 Oct. 2001, Huntsville, AL, USA

Report No.(s): SE-2001-10-00059-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

Combined-cycle propulsion technology is a strong candidate for meeting NASA space transportation goals. Extensive ground testing of integrated air-breathing/rocket system (e.g., components, subsystems and engine systems) across all propulsion operational modes (e.g., ramjet, scramjet) will be needed to demonstrate this propulsion technology. Ground testing will occur at various test centers based on each center's expertise. Testing at the NASA John C. Stennis Space Center will be primarily concentrated on combined-cycle power pack and engine systems at sea level conditions at a dedicated test facility, E-4. This paper highlights the status of the SSC E-4 test Facility design.

Author

*NASA Programs; Space Transportation; Test Facilities; Ground Tests; Supersonic Combustion Ramjet Engines*

**20040000905** NASA Stennis Space Center, Bay Saint Louis, MS, USA

#### **Improved Testing Capability and Adaptability Through the Use of Wireless Sensors**

Solano, Wanda M.; April 14, 2003; 9 pp.; In English; 2003 Propulsion Measurement Sensor Development Workshop, 13-15 May 2003, Huntsville, AL, USA; Original contains color illustrations

Report No.(s): SE-2003-04-00020-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

From the first Saturn V rocket booster (S-II-T) testing in 1966 and the routine Space Shuttle Main Engine (SSME) testing beginning in 1975, to more recent test programs such as the X-33 Aerospike Engine, the Integrated Powerhead Development (IPD) program, and the Hybrid Sounding Rocket (HYSR), Stennis Space Center (SSC) continues to be a premier location for

conducting large-scale testing. Central to each test program is the capability for sensor systems to deliver reliable measurements and high quality data, while also providing a means to monitor the test stand area to the highest degree of safety and sustainability. Sensor wiring is routed along piping and through cable trenches, making its way from the engine test area, through the test stand area and to the signal conditioning building before final transfer to the test control center. When sensor requirements lie outside the reach of the routine sensor cable routing, the use of wireless sensor networks becomes particularly attractive due to their versatility and ease of installation. As part of an on-going effort to enhance the testing capabilities of Stennis Space Center, the Test Technology and Development group has found numerous applications for its sensor-adaptable wireless sensor suite. While not intended for critical engine measurements or control loops, in-house hardware and software development of the sensor suite can provide improved testing capability for a range of applications including the safety monitoring of propellant storage barrels and as an experimental test-bed for embedded health monitoring paradigms.

Author

*Engine Tests; Engine Monitoring Instruments; Instrument Packages*

**20040001069** Alaska Univ., Fairbanks, AK, USA

### **ASF3**

LaBelle-Hamer, Nettie; Newcombe, Ross; Lane, Carel, Jr.; Arko, Scott; Atwood, Donald; December 2003; 27 pp.; In English Contract(s)/Grant(s): NAS5-98129; No Copyright; Avail: CASI; [A03](#), Hardcopy

This reporting period marked a change in the funding configuration from a combination of a grant and a contract from two different National Aeronautics and Space Administration (NASA) sections to one single contract. One year of this reporting was under the grant/contract configuration with the changeover occurring on 1 April 2003. Much of the work duties remained the same with some exception, notably the removal of the RADARSAT Geophysical Processor System and the removal of the commercialization line item from the contract. We chose this reporting period as a transition from the previous reporting period of 1 April to 31 March, to the current reporting period of 18 November to 17 November. The Alaska Synthetic Aperture Facility's (ASF) mission has been updated to carry us forward into the future congruent with our changed relationship with NASA. ASF will continue to evolve, and NASA will remain our primary customer. To compliment our new mission, we have a new name, the Alaska Satellite Facility (ASF), deeply rooted in the University environment and focused on satellite data products, services, and science support. We have the opportunity to reshape and rebuild ASF; we will continue to honor our heritage and Serve the science community. Our long-term goals include the commitment to continued first-rate service to our user community. This report contains input from ASF as a whole on the three major components of the NASA Contract, namely tasks devoted to the Distributed Active Archive Center (DAAC), the Receiving Ground Station (RGS), and the National Oceanics and Atmospheric Administration (NOAA).

Author

*Ground Stations; Synthetic Apertures; Radarsat; Research Facilities*

**20040001186** NASA Stennis Space Center, Bay Saint Louis, MS, USA

### **Recent Advances in Hydrogen Peroxide Propulsion Test Capability at NASA's Stennis Space Center E-Complex**

Jacks, Thomas E.; Beisler, Michele; December 1, 2003; 10 pp.; In English; 39th JANNAF Combustion Subcommittee Conference, 1-5 Dec. 2003, Colorado Springs, CO, USA; Original contains black and white illustrations Report No.(s): SE-2003-10-00088-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

In recent years, the rocket propulsion test capability at NASA's John C. Stennis Space Center's (SSC) E-Complex has been enhanced to include facilitization for hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) based ground testing. In particular, the E-3 test stand has conducted numerous test projects that have been reported in the open literature. These include combustion devices as simple as small-scale catalyst beds, and larger devices such as ablative thrust chambers and a flight-type engine (AR2-3). Consequently, the NASA SSC test engineering and operations knowledge base and infrastructure have grown considerably in order to conduct safe H<sub>2</sub>O<sub>2</sub> test operations with a variety of test articles at the component and engine level. Currently, the E-Complex has a test requirement for a hydrogen peroxide based stage test. This new development, with its unique set of requirements, has motivated the facilitization for hydrogen peroxide propellant use at the E-2 Cell 2 test position in addition to E-3. Since the E-2 Cell 2 test position was not originally designed as a hydrogen peroxide test stand, a facility modernization-improvement project was planned and implemented in FY 2002-03 to enable this vertical engine test stand to accommodate H<sub>2</sub>O<sub>2</sub>. This paper discusses the ongoing enhancement of E-Complex ground test capability, specifically at the E-3 stand (Cell 1 and Cell 2) and E-2 Cell 2 stand, that enable current and future customers considerable test flexibility and operability in conducting their peroxide based rocket R&D efforts.

Author

*Test Facilities; Hydrogen Peroxide; Ground Tests; Upgrading; Augmentation*

## 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*.

**20040000558** California Polytechnic State Univ., San Luis Obispo, CA, USA

### **StarBooster Demonstrator Cluster Configuration Analysis/Verification Program**

DeTurrís, Dianne J., et al.; June 2003; 16 pp.; In English

Contract(s)/Grant(s): NCC1-02012; Proj. 53030; No Copyright; Avail: CASI; [A03](#), Hardcopy

In order to study the flight dynamics of the cluster configuration of two first stage boosters and upper-stage, flight-testing of subsonic sub-scale models has been undertaken using two glideback boosters launched on a center upper-stage. Three high power rockets clustered together were built and flown to demonstrate vertical launch, separation and horizontal recovery of the boosters. Although the boosters fly to conventional aircraft landing, the centerstage comes down separately under its own parachute. The goal of the project has been to collect data during separation and flight for comparison with a six degree of freedom simulation. The configuration for the delta wing canard boosters comes from a design by Starcraft Boosters, Inc. The subscale rockets were constructed of foam covered in carbon or fiberglass and were launched with commercially available solid rocket motors. The first set of boosters built were 3-ft tall with a 4-ft tall centerstage, and two additional sets of boosters were made that were each over 5-ft tall with a 7.5 ft centerstage. The rocket cluster is launched vertically, then after motor burn out the boosters are separated and flown to a horizontal landing under radio-control. An on-board data acquisition system recorded data during both the launch and glide phases of flight.

Author

*Flight Tests; Models; Propulsion System Configurations; Launch Vehicles; Stage Separation; Booster Rocket Engines; Upper Stage Rocket Engines; Boostglide Vehicles*

**20040000981** NASA Glenn Research Center, Cleveland, OH, USA

### **Magnetogasdynamic Power Extraction and Flow Conditioning for a Gas Turbine**

Adamovich, Igor V.; Rich, J. William; Schneider, Steven; Blankson, Isaiah; October 2003; 20 pp.; In English; 34th Plasmadynamics and Laser Conference, 23-26 Jun. 2003, Orlando, FL, USA

Contract(s)/Grant(s): WBS 22-274-00-02-17

Report No.(s): NASA/TM-2003-212612; E-14170; AIAA Paper 2003-4289; No Copyright; Avail: CASI; [A03](#), Hardcopy

An extension of the Russian AJAX concept to a turbojet is being explored. This magnetohydrodynamic (MHD) energy bypass engine cycle incorporating conventional gas turbine technology has MHD flow conditioning at the inlet to electromagnetically extract part of the inlet air kinetic energy. The electrical power generated can be used for various on-board vehicle requirements including plasma flow control around the vehicle or it may be used for augmenting the expanding flow in the high speed nozzle by MHD forces to generate more thrust. In order to achieve this interaction, the air needs to be ionized by an external means even up to fairly high flight speeds, and the leading candidates may be classified as electrical discharge devices. The present kinetic modeling calculations suggest that the use of electron beams with characteristics close to the commercially available e-beam systems (electron energy approx. 60 keV, beam current approx. 0.2 mA/sq cm) to sustain ionization in intermediate pressure, low-temperature ( $P = 0.1$  atm,  $T = 300$  K) supersonic air flows allows considerable reduction of the flow kinetic energy (up to 10 to 20 percent in  $M = 3$  flows). The calculations also suggest that this can be achieved at a reasonable electron beam efficiency ( $\eta$  approx. 5), even if the e-beam window losses are taken into account. At these conditions, the exit NO and O atom concentrations due to e-beam initiated chemical reactions do not exceed 30 ppm. Increasing the beam current up to approx. 2 mA/sq cm, which corresponds to a maximum electrical conductivity of  $\sigma(\text{sub max})$  approx. 0.8 mho/m at the loading parameter of  $K = 0.5$ , would result in a much greater reduction of the flow kinetic energy (up to 30 to 40 percent). The MHD channel efficiency at these conditions would be greatly reduced (to  $\eta$  approx. 1) due to increased electron recombination losses in the channel. At these conditions, partial energy conversion from kinetic energy to heat would result in a significant total pressure loss ( $P(\text{sub } 0)/P(\text{sub } 0i)$  approx. 0.3). The total pressure loss can be reduced operating at the loading parameter closer to unity, at the expense of the reduced electrical power output. Raising the beam current would also result in the increase of the exit O atom concentrations (up to 600 ppm) and NO (up to 150 ppm).

Author

*Magnetohydrodynamics; Hypersonic Inlets; Launch Vehicles; Gas Dynamics; Turbojet Engines; Energy Conversion; Electron Beams; Gas Turbines*

**20040001153** NASA Langley Research Center, Hampton, VA, USA

**Cryopumping in Cryogenic Insulations for a Reusable Launch Vehicle**

Johnson, Theodore F.; Weiser, Erik S.; Grimsley, Brian W.; Jensen, Brian J.; [2003]; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Testing at cryogenic temperatures was performed to verify the material characteristics and manufacturing processes of reusable propellant tank cryogenic insulations for a Reusable Launch Vehicle (RLV). The unique test apparatus and test methods developed for the investigation of cryopumping in cryogenic insulations are described. Panel level test specimens with various types of cryogenic insulations were subjected to a specific thermal profile where the temperature varied from -262 C to 21 C. Cryopumping occurred if the interior temperature of the specimen exhibited abnormal temperature fluctuations, such as a sudden decrease in temperature during the heating phase.

Author

*Cryogenic Temperature; Cryopumping; Insulation; Reusable Launch Vehicles; Manufacturing*

**20040003800** Utah State Univ., Logan, UT, USA

**University Nanosatellite Program ION-F Constellation**

Swenson, Charles; Fullmer, Rees; Redd, Frank; May 2002; 105 pp.; In English

Contract(s)/Grant(s): F49620-99-1-0280

Report No.(s): AD-A416943; AFRL-SR-AR-TR-03-0306; No Copyright; Avail: CASI; A06, Hardcopy

The Space Engineering program at Utah State University has developed a small satellite, known as USUSat, under funding from AFOSR, AFRL, NASA and Utah State University's Space Dynamics Laboratory. This satellite was designed and significantly manufactured by students in the Mechanical and Aerospace Engineering and the Electrical and Computer Engineering Departments within the College of Engineering. USUSat is one of three spacecraft being designed for the Ionospheric Observation Nanosatellite Formation (ION-F). This formation comprises three 15 kg. spacecraft designed and built in cooperation by Utah State University, University of Washington, and Virginia Polytechnic Institute. The ION-F satellites are being designed and built by students at the three universities, with close coordination to insure compatibility for launch, deployment, and the formation flying mission. The ION-F mission is part of the U.S. Air Force Research Laboratory (AFRL) University Nanosatellite Program, which provides technology development and demonstrations for the TechSat21 Program. The University Nanosatellite Program involves 10 universities building nanosatellites for a launch in 2004 on two separate space shuttle missions. Additional support for the formation flying demonstration has been provided by NASA's Goddard Space Flight Center.

DTIC

*Artificial Satellites; Fabrication; Space Shuttle Missions; Compatibility*

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*.

**20040000092** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Spray Bar Zero-Gravity Vent System for On-Orbit Liquid Hydrogen Storage**

Hastings, L. J.; Flachbart, R. H.; Martin, J. J.; Hedayat, A.; Fazah, M.; Lak, T.; Nguyen, H.; Bailey, J. W.; October 2003; 1 pp.; In English

Report No.(s): NASA/TM-2003-212926; M-1091; Copyright; Avail: Other Sources; Abstract Only

During zero-gravity orbital cryogenic propulsion operations, a thermodynamic vent system (TVS) concept is expected to maintain tank pressure control without propellant resettling. In this case, a longitudinal spray bar mixer system, coupled with a Joule-Thompson (J-T) valve and heat exchanger, was evaluated in a series of TVS tests using the 18 cu m multipurpose hydrogen test bed. Tests performed at fill levels of 90, 50, and 25 percent, coupled with heat tank leaks of about 20 and 50 W, successfully demonstrated tank pressure control within a 7-kPa band. Based on limited testing, the presence of helium constrained the energy exchange between the gaseous and liquid hydrogen (LH2) during the mixing cycles. A transient analytical model, formulated to characterize TVS performance, was used to correlate the test data. During self-pressurization cycles following tank lockup, the model predicted faster pressure rise rates than were measured; however, once the system entered the cyclic self-pressurization/mixing/venting operational mode, the modeled and measured data were quite similar.

During a special test at the 25-percent fill level, the J-T valve was allowed to remain open and successfully reduced the bulk LH2 saturation pressure from 133 to 70 kPa in 188 min.

Author

*Liquid Hydrogen; Fluid Management; Cryogenic Fluid Storage; Microgravity; Spacecraft Equipment*

**20040000794** NASA Langley Research Center, Hampton, VA, USA

**NASA CONNECT(TradeMark): Space Suit Science in the Classroom**

Williams, William B.; Giersch, Chris; Bensen, William E.; Holland, Susan M.; [2003]; 5 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada

Contract(s)/Grant(s): RTA 772-10-08-22

Report No.(s): Paper 031CES-330; No Copyright; Avail: CASI; [A01](#), Hardcopy

NASA CONNECT's(TradeMark) program titled Functions and Statistics: Dressed for Space initially aired on Public Broadcasting Stations (PBS) nationwide on May 9, 2002. The program traces the evolution of past space suit technologies in the design of space suits for future flight. It serves as the stage to provide educators, parents, and students 'space suit science' in the classroom.

Derived from text

*Broadcasting; Space Suits; Students*

**20040000799** NASA Langley Research Center, Hampton, VA, USA

**Radiation Shielding for Space Flight**

Blattnig, Steve R.; Norbury, John W.; Norman, Ryan B.; [2003]; 5 pp.; In English; 13th Annual Wisconsin Space Conference, 14-15 Aug. 2003, Green Bay, WI, USA

Contract(s)/Grant(s): NGT1-52217; NCC1-354; 23-349-06-01; Copyright; Avail: CASI; [A01](#), Hardcopy

A safe and efficient exploration of space requires an understanding of space radiations so that human life and sensitive equipment can be protected. On the way to these sensitive sites, the radiation is modified in both quality and quantity. Many of these modifications are thought to be due to the production of pions and muons in the interactions between the radiation and intervening matter. A method to predict the effects of the presence of these particles on the transport of radiation through materials is presented.

Author

*Radiation Shielding; Space Flight; Space Exploration; Sensitivity*

**20040000863** Mississippi State Univ., Starkville, MS, USA

**Unlocking the Mystery of Columbia's Tragic Accident Through Materials Characterization**

Shah, Sandeep; Jerman, Gregory; Coston, James; October 03, 2003; 48 pp.; In English; Mississippi State University Materials Working Group Seminar, 15 Oct. 2003, Starkville, MS, USA; No Copyright; Avail: CASI; [A03](#), Hardcopy

The wing and underbelly reconstruction of Space Shuttle Columbia took place at the Shuttle Landing Facility Hangar after the accident which destroyed STS-107. Fragments were placed on a grid according to their original location on the orbiter. Some Reinforced Carbon-Carbon (RCC) panels of the left wing leading edge and other parts from both leading edges were recovered and incorporated into the reconstruction. The recovered parts were tracked on a database according to a number and also tracked on a map of the orbiter. This viewgraph presentation describes the process of failure analysis undertaken by the Materials and Processes (M&P) Problem Resolution Team. The team started with factual observations about the accident, and identified highest level questions for it to answer in order to understand where on the orbiter failure occurred, what component(s) failed, and what was the sequence of events. The finding of Columbia's MADS/OEX data recorder shifted the focus of the team's analysis to the left wing leading edge damage. The team placed particular attention on slag deposits on some of the RCC panels. The presentation lists analysis techniques, and lower level questions for the team to answer.

CASI

*Columbia (Orbiter); Accident Investigation; Carbon-Carbon Composites; Leading Edges; Wings; Failure Analysis*

## 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*.

**20040000792** NASA Glenn Research Center, Cleveland, OH, USA

### Space Communications and Data Systems Technologies for Next Generation Earth Science Measurements

Bauer, Robert A.; Reinhart, Richard C.; Hilderman, Don R.; Paulsen, Phillip E.; October 2003; 11 pp.; In English; Earth Sciences Technology Conference 2002, 11-13 Jun. 2002, Pasadena, CA, USA

Contract(s)/Grant(s): WBS 22-258-90-05

Report No.(s): NASA/TM-2003-212616; E-14176; No Copyright; Avail: CASI; [A03](#), Hardcopy

The next generation of Earth observing satellites and sensor networks will face challenges in supporting robust high rate communications links from the increasingly sophisticated onboard instruments. Emerging applications will need data rates forecast to be in the 100's to 1000's of Mbps. As mission designers seek smaller spacecraft, challenges exist in reducing the size and power requirements while increasing the capacity of the spacecraft's communications technologies. To meet these challenges, this work looks at three areas of selected space communications and data services technologies, specifically in the development of reflectarray antennas, demonstration of space Internet concepts, and measurement of atmospheric propagation effects on Ka-band signal transmitted from LEO.

Author

*Data Systems; Earth Sciences; Space Communication; Communication Networks; Technology Utilization; Antenna Design*

**20040000977** Architecture Technology Corp., Eden Prairie, MN, USA

### Proximity Networks Technology Assessment

Sands, Obed S., Technical Monitor; Salo, Timothy J.; Trent, Barry A.; Hartley, Timothy; October 2003; 51 pp.; In English  
Contract(s)/Grant(s): GS35F0038L; WBS 22-704-61-16

Report No.(s): NASA/CR-2003-212623; E-14181; No Copyright; Avail: CASI; [A04](#), Hardcopy

This report summarizes an assessment performed by Architecture Technology Corporation (ATC) of technologies applicable to wireless proximity networks used in NASA applications. NASA proximity networks are relatively small, fairly short-range, often ad hoc, wireless networks typically dedicated to tasks such as transporting in situ sensing data. The number of nodes contained within a proximity network is expected to be comparatively small, perhaps tens or hundreds of nodes at most. While short-range is relative, many proximity networks will have a physical diameter on the order of hundreds or thousands of meters (although some authorities have suggested that a few of these networks might be as large 100 to 400 km. This assessment concludes that the technologies required for micropower proximity networks are far less mature than those needed for intelligent proximity networks. As such, micropower proximity networks offer NASA the greatest potential return for its proximity network research investments. Common hardware and software platforms for micropower proximity network research, development, and deployment would enhance the opportunities for collaboration between projects, enable projects to more easily leverage the results of prior NASA funded work, and increase the overall productivity of NASA's research dollars. Live, system-level demonstrations by NASA researchers of micropower proximity networks would help focus research on identifying and solving real-world problems, as well as provide an empirical assessment of the effectiveness of proposed technologies.

Author

*Technology Assessment; Communication Networks; Wireless Communication; Artificial Intelligence; Architecture (Computers)*

**20040003743** NASA Glenn Research Center, Cleveland, OH, USA

### Three-Dimensional Simulation of Traveling-Wave Tube Cold-Test Characteristics Using CST MICROWAVE STUDIO

Chevalier, Christine T.; Herrmann, Kimberly A.; Kory, Carol L.; Wilson, Jeffrey D.; Cross, Andrew W.; Santana, Samuel; July 2003; 12 pp.; In English

Contract(s)/Grant(s): WBS 22-755-12-30

Report No.(s): NASA/TM-2003-212486; NAS 1.15:212486; E-14028; No Copyright; Avail: CASI; [A03](#), Hardcopy

The electromagnetic field simulation software package CST MICROWAVE STUDIO (MWS) was used to compute the cold-test parameters - frequency-phase dispersion, on-axis impedance, and attenuation - for a traveling-wave tube (TWT) slow-wave circuit. The results were compared to experimental data, as well as to results from MAFIA, another three-dimensional simulation code from CST currently used at the NASA Glenn Research Center (GRC). The strong

agreement between cold-test parameters simulated with MWS and those measured experimentally demonstrates the potential of this code to reduce the time and cost of TWT development.

Author

*Three Dimensional Models; Wave Propagation; Computerized 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 Safety*.

**2004000014** NASA Stennis Space Center, Bay Saint Louis, MS, USA

#### **Rockwell Automation PLC-5 Lands Stennis Space Center with a Reliable, Flexible Control System**

Epperson, Dave; August 1, 2003; 6 pp.; In English

Report No.(s): SE-2003-03-00016-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

Ever since the first rocket was launched, people have been infatuated with the vast and uncharted frontier of space. Whether it's visiting a space center or watching a shuttle launch, people are waiting to see what will be discovered next. And even though orbiting the Earth or taking soil samples from the Moon now seems effortless, decades worth of behind-the-scenes work have helped the U.S. space program get to this point. Even today, NASA must take every precaution to ensure equipment is up to the endeavor of setting foot on the moon. As part of the initial push to put the first man on the moon, NASA established the John C. Stennis Space Center, Hancock County, Mississippi in 1961 for space engine propulsion system development. Today, Stennis has three major test complexes where engine and component testing is carried out and integrated into full motion systems for space shuttles and vehicles as well as secondary testing facilities. With different products being tested throughout the facilities, Stennis was in need of an automation system that could link the operations. By integrating a control system based on a Rockwell Automation's flexible and reliable PLC-5 controller, Stennis was able to implement projects more efficiently and focus its efforts on getting the next generation of products ready for space.

Derived from text

*Automatic Control; Spacecraft Reliability; NASA Space Programs; Space Shuttles; Control Systems Design; Flexibility*

**20040000478** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Hyperbolic Injection Issues for MXER Tethers**

Sorensen, Kirk; [2003]; 8 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA

Report No.(s): AIAA Paper 2003-5221; No Copyright; Avail: CASI; [A02](#), Hardcopy

Momentum-exchange/electrodynamic reboost (MXER) tether technology is currently being pursued to dramatically lower the launch mass and cost of interplanetary scientific spacecraft. A spacecraft boosted from LEO to a high-energy orbit by a MXER tether has most of the orbital energy it needs to escape the Earth's gravity well. However, the final targeting of the spacecraft to its eventual trajectory, and some of the unique issues brought on by the tether boost, are the subjects of this paper.

Author

*Interplanetary Spacecraft; Tethering; Trajectory Planning; Spacecraft Trajectories; Acceleration (Physics)*

**20040000499** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Space Environments and Effects (SEE) Program: Spacecraft Charging Technology Development Activities**

Kauffman, B.; Hardage, D.; Minor, J.; October 07, 2003; 15 pp.; In English; 8th Spacecraft Charging Technology Development Conference, 20-24 Oct. 2003, Huntsville, AL, USA; No Copyright; Avail: CASI; [A03](#), Hardcopy

Reducing size and weight of spacecraft, along with demanding increased performance capabilities, introduces many uncertainties in the engineering design community on how materials and spacecraft systems will perform in space. The engineering design community is forever behind on obtaining and developing new tools and guidelines to mitigate the harmful effects of the space environment. Adding to this complexity is the continued push to use Commercial-off-the-shelf (COTS) microelectronics, potential usage of unproven technologies such as large solar sail structures and nuclear electric propulsion. In order to drive down these uncertainties, various programs are working together to avoid duplication, save what resources are available in this technical area and possess a focused agenda to insert these new developments into future mission designs.

This paper will introduce the SEE Program, briefly discuss past and currently sponsored spacecraft charging activities and possible future endeavors.

Author

*Aerospace Environments; Weight Reduction; Spacecraft Charging; Commercial Off-the-Shelf Products; Microelectronics; Nuclear Electric Propulsion*

**20040000626** NASA Glenn Research Center, Cleveland, OH, USA

**Third Generation RLV Structural Seal Development Programs at NASA GRC**

Dunlap, Patrick H., Jr.; Steinetz, Bruce M.; DeMange, Jeffrey J.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 247-265; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

NASA is currently developing technologies for the 3rd Generation Reusable Launch Vehicle (RLV) that is being designed to enter service around the year 2025. In particular, NASA's Glenn Research Center (GRC) is working on advanced high temperature structural seal designs including propulsion system and control surface seals. Propulsion system seals are required along the edges of movable panels in advanced engines, while control surface seals seal the edges and hinge lines of movable flaps and elevons on the vehicle. The overall goal is to develop reusable, resilient seals capable of operating at temperatures up to 2000 F. High temperature seal preloading devices (e.g., springs) are also being evaluated as a means of improving seal resiliency. In order to evaluate existing and potential new seal designs, GRC has designed and is installing several new test rigs capable of simulating the types of conditions that the seals would endure during service including temperatures, pressures, and scrubbing. Two new rigs, the hot compression test rig and the hot scrub test rig, will be used to perform seal compression and scrub tests for many cycles at temperatures up to 3000 F. Another new test rig allows simultaneous flow and scrub tests to be performed on the seals at room temperature to evaluate how the flow blocking performance of the seals varies as they accumulate damage during scrubbing. This presentation will give an overview of these advanced seal development efforts.

Author

*Reusable Launch Vehicles; Structural Design; Sealing; Control Surfaces*

**20040000627** NASA Glenn Research Center, Cleveland, OH, USA

**Update on the Development and Capabilities of Unique Structural Seal Test Rigs**

DeMange, Jeffrey J.; Dunlap, Patrick H., Jr.; Steinetz, Bruce M.; Breen, Daniel P.; Robbie, Malcolm G.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 283-298; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

High temperature structural seals are necessary in many aerospace and aeronautical applications to minimize any detrimental effects originating from undesired leakage. The NASA Glenn Research Center has been and continues to be a pioneer in the development and evaluation of these types of seals. The current focus for the development of structural seals is for the 3rd Generation Reusable Launch Vehicle (RLV), which is scheduled to replace the current space shuttle system by 2025. Specific areas of development under this program include seals for propulsion systems (such as the hypersonic air-breathing ISTAR engine concept based upon Rocket Based Combined Cycle technology) and control surface seals for spacecraft including the autonomous rescue X-38 Crew Return Vehicle and the X-37 Space Maneuver Vehicle.

Derived from text

*X-38 Crew Return Vehicle; X-37 Vehicle; Sealing; Control Surfaces; Air Breathing Engines; Reusable Launch Vehicles*

**20040000885** NASA Glenn Research Center, Cleveland, OH, USA

**Daytime Solar Heating of Photovoltaic Arrays in Low Density Plasmas**

Galofaro, J.; Vayner, B.; Ferguson, D.; October 2003; 14 pp.; In English; 34th Plasmadynamics and Lasers Conference, 23-26 Jun. 2003, Orlando, FL, USA

Contract(s)/Grant(s): WBS 22-755-60-04

Report No.(s): NASA/TM-2003-212629; AIAA Paper 2003-4177; E-14191; No Copyright; Avail: CASI; [A03](#), Hardcopy

The purpose of the current work is to determine the out-gassing rate of H<sub>2</sub>O molecules for a solar array placed under daytime solar heating (full sunlight) conditions typically encountered in a Low Earth Orbital (LEO) environment. Arc rates are established for individual arrays held at 14 C and are used as a baseline for future comparisons. Radiated thermal solar flux incident to the array is simulated by mounting a stainless steel panel equipped with resistive heating elements several centimeters behind the array. A thermal plot of the heater plate temperature and the array temperature as a function of heating time is then obtained. A mass spectrometer is used to record the levels of partial pressure of water vapor in the test chamber

after each of the 5 heating/cooling cycles. Each of the heating cycles was set to time duration of 40 minutes to simulate the daytime solar heat flux to the array over a single orbit. Finally the array is cooled back to ambient temperature after 5 complete cycles and the arc rates of the solar arrays is retested. A comparison of the various data is presented with rather some unexpected results.

Author

*Photovoltaic Cells; Solar Heating; Solar Arrays; Outgassing; Plasmas (Physics); Daytime*

**20040001047** NASA Glenn Research Center, Cleveland, OH, USA

**Angular and Range Deviations for the Earth Science Afternoon Constellation**

Welch, Bryan; November 2003; 23 pp.; In English

Contract(s)/Grant(s): WBS 22-704-60-08

Report No.(s): NASA/TM-2003-212703; E-14206; NAS 1.15:212703; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper investigates the angular spread between the five satellites that will make up the Earth Science Afternoon Constellation starting in October 2004. Simulations are performed to propagate the satellites for a time period of one year to observe the position for each satellite. Small angular spread between the satellites together with the variability in the angles suggests the use of adaptive array antennas for inter-satellite communication links.

Author

*Artificial Satellites; Position (Location)*

**20040003713** NASA Langley Research Center, Hampton, VA, USA

**Development of Structural Health Management Technology for Aerospace Vehicles**

Prosser, W. H.; [2003]; 9 pp.; In English; JANNAF 39th Combustion/27th Airbreathing Propulsion/21st Propulsion Systems Harzards/3rd Modeling and Simulation Joint Subcommittee Meeting, 1-5 Sep. 2003, Colorado Springs, CO, USA; Original contains color illustrations; No Copyright; Avail: CASI; [A02](#), Hardcopy

As part of the overall goal of developing Integrated Vehicle Health Management (IVHM) systems for aerospace vehicles, NASA has focused considerable resources on the development of technologies for Structural Health Management (SHM). The motivations for these efforts are to increase the safety and reliability of aerospace structural systems, while at the same time decreasing operating and maintenance costs. Research and development of SHM technologies has been supported under a variety of programs for both aircraft and spacecraft including the Space Launch Initiative, X-33, Next Generation Launch Technology, and Aviation Safety Program. The major focus of much of the research to date has been on the development and testing of sensor technologies. A wide range of sensor technologies are under consideration including fiber-optic sensors, active and passive acoustic sensors, electromagnetic sensors, wireless sensing systems, MEMS, and nanosensors. Because of their numerous advantages for aerospace applications, most notably being extremely light weight, fiber-optic sensors are one of the leading candidates and have received considerable attention.

Author

*Aerospace Vehicles; Systems Health Monitoring; Systems Engineering; Technology Utilization; Remote Sensors*

**20040003718** NASA Langley Research Center, Hampton, VA, USA

**Launch Vehicle Design and Optimization Methods and Priority for the Advanced Engineering Environment**

Rowell, Lawrence F.; Korte, John J.; October 2003; 35 pp.; In English

Contract(s)/Grant(s): WU 23-721-10-41

Report No.(s): NASA/TM-2003-212654; L-18337; NAS 1.15:212654; No Copyright; Avail: CASI; [A03](#), Hardcopy

NASA's Advanced Engineering Environment (AEE) is a research and development program that will improve collaboration among design engineers for launch vehicle conceptual design and provide the infrastructure (methods and framework) necessary to enable that environment. In this paper, three major technical challenges facing the AEE program are identified, and three specific design problems are selected to demonstrate how advanced methods can improve current design activities. References are made to studies that demonstrate these design problems and methods, and these studies will provide the detailed information and check cases to support incorporation of these methods into the AEE. This paper provides background and terminology for discussing the launch vehicle conceptual design problem so that the diverse AEE user community can participate in prioritizing the AEE development effort.

Author

*Launch Vehicles; Systems Engineering; Design Optimization; Space Transportation System*

## SPACECRAFT INSTRUMENTATION AND ASTRIONICS

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

**20040000874** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

### **NASA Stennis Space Center V and V Capabilities Overview**

Ryan, Robert; October 22, 2001; 29 pp.; In English; MAPPS-ASPRS Conference: Measuring the Earth-Digital Elevation Technologies and Applications, 31 Oct. - 2 Nov. 2001, Saint Petersburg, FL, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2001-10-00062-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

The objective are provide independent field measurement ground capability for satellite and aircraft mounted in-flight sensor validation. NASA Stennis is considering expanding its Verification and Validation (V&V) range to support LIDAR and digital camera characterization. Soliciting input for requirements and suggestion.

Derived from text

*Digital Cameras; Optical Radar; Aircraft Instruments*

**20040000966** Akron Univ., Akron, OH, USA

### **Development of Ultra-Low Temperature Motor Controllers: Ultra Low Temperatures Evaluation and Characterization of Semiconductor Technologies For The Next Generation Space Telescope**

Elbuluk, Malik E.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 8-9; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Electronics designed for low temperature operation will result in more efficient systems than room temperature. This improvement is a result of better electronic, electrical, and thermal properties of materials at low temperatures. In particular, the performance of certain semiconductor devices improves with decreasing temperature down to ultra-low temperature (-273 °C). The Low Temperature Electronics Program at the NASA Glenn Research Center focuses on research and development of electrical components and systems suitable for applications in deep space missions. Research is being conducted on devices and systems for use down to liquid helium temperatures (-273 °C). Some of the components that are being characterized include semiconductor switching devices, resistors, magnetics, and capacitors. The work performed this summer has focused on the evaluation of silicon-, silicon-germanium- and gallium-Arsenide-based (GaAs) bipolar, MOS and CMOS discrete components and integrated circuits (ICs), from room temperature (23 °C) down to ultra low temperatures (-263 °C).

Author

*Resistors; Capacitors; Semiconductors (Materials); Electrical Properties*

**20040001714** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Gravity Probe B: Testing Einstein with Gyroscopes**

Geveden, Rex D.; May, Todd; [2003]; 1 pp.; In English; AIAA Space Conference and Exposition, 23-25 Sep. 2003, Long Beach, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Some 40 years in the making, NASA's historic Gravity Probe B (GP-B) mission is scheduled to launch aboard a Delta II in 2003. GP-B will test two extraordinary predictions from Einstein's General Relativity: geodetic precession and the Lense-Thirring effect (frame-dragging). Employing tiny, ultra-precise gyroscopes, GP-B features a measurement accuracy of 0.5 milli-arc-seconds per year. The extraordinary measurement precision is made possible by a host of breakthrough technologies, including electro-statically suspended, super-conducting quartz gyroscopes; virtual elimination of magnetic flux; a solid quartz star-tracking telescope; helium microthrusters for drag-free control of the spacecraft; and a 2400 liter superfluid helium dewar. This paper will provide an overview of the science, key technologies, flight hardware, integration and test, and flight operations of the GP-B space vehicle. It will also examine some of the technical management challenges of a large-scale, technology-driven, Principal Investigator-led mission.

Author

*Gravity Probe B; Gyroscopes; Measure and Integration; Drag Reduction*

## 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*.

**20040000363** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Transient Mathematical Modeling for Liquid Rocket Engine Systems: Methods, Capabilities, and Experience**

Martin, Michael A.; Nguyen, Huy H.; Greene, William D.; Seymout, David C.; September 08, 2003; 17 pp.; In English; 5th International Symposium on Liquid Space Propulsion, 27-30 Oct. 2003, Chattanooga, TN, USA; No Copyright; Avail: CASI; [A03](#), Hardcopy

The subject of mathematical modeling of the transient operation of liquid rocket engines is presented in overview form from the perspective of engineers working at the NASA Marshall Space Flight Center. The necessity of creating and utilizing accurate mathematical models as part of liquid rocket engine development process has become well established and is likely to increase in importance in the future. The issues of design considerations for transient operation, development testing, and failure scenario simulation are discussed. An overview of the derivation of the basic governing equations is presented along with a discussion of computational and numerical issues associated with the implementation of these equations in computer codes. Also, work in the field of generating usable fluid property tables is presented along with an overview of efforts to be undertaken in the future to improve the tools use for the mathematical modeling process.

Author

*Liquid Propellant Rocket Engines; Mathematical Models; Engine Design; Computer Programs*

**20040000467** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Electron Radiation Effects on Candidate Solar Sail Material**

Edwards, David L.; Hollerman, William A.; Hubbs, Whitney S.; Gray, Perry A.; Wertz, George E.; Hoppe, David T.; Nehls, Mary K.; Semmel, Charles L.; [2003]; 15 pp.; In English; Copyright; Avail: CASI; [A03](#), Hardcopy

Solar sailing is a unique form of propulsion where a spacecraft gains momentum from incident photons. Solar sails are not limited by reaction mass and provide continual acceleration, reduced only by the lifetime of the lightweight film in the space environment and the distance to the Sun. Once thought to be difficult or impossible, solar sailing has come out of science fiction and into the realm of possibility. Any spacecraft using this propulsion method would need to deploy a thin sail that could be as large as many kilometers in extent. The availability of strong, ultra lightweight, and radiation resistant materials will determine the future of solar sailing. The National Aeronautics and Space Administration's (NASA) Marshall Space Flight Center (MSFC) is concentrating research into the utilization of ultra lightweight materials for spacecraft propulsion. The Space Environmental Effects Team at MSFC is actively characterizing candidate solar sail material to evaluate the thermo-optical and mechanical properties after exposure to space environmental effects. This paper will describe the irradiation of candidate solar sail materials to energetic electrons, in vacuum, to determine the hardness of several candidate sail materials.

Author

*Electron Radiation; Radiation Effects; Solar Sails; Spacecraft Construction Materials*

**20040000579** Toledo Univ., OH, USA

### **Computational Simulation of Composite Behavior**

Keith, Theo G., Jr.; Mital, Subodh; December 2003; 3 pp.; In English  
Contract(s)/Grant(s): NCC3-524; No Copyright; Avail: CASI; [A01](#), Hardcopy

Significant improvements in aerospace and terrestrial propulsion and power systems for the next century will require revolutionary advances in materials and structures. Much effort is being dedicated to improving performance, reliability and service life of propulsion systems. To achieve these goals, the development of a new class of high temperature materials and transition-to-use technologies has been identified as a national need.

Derived from text

*Computation; Propulsion System Configurations; Refractory Materials; Service Life; Simulation*

**20040000621** NASA Glenn Research Center, Cleveland, OH, USA

### **Turbine Engine Clearance Control Systems: Current Practices and Future Directions**

Lattime, Scott B.; Steinetz, Bruce M.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 113-134; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This presentation reviews the following: (i) Cause and effect of gas turbine blade tip seal wear (ii) Current clearance control practices (iii) Present approaches under investigation at GRC.

Author

*Engine Control; Turbine Engines; Wear; Turbine Blades*

**20040000739** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Leak Location and Classification in the Space Shuttle Main Engine Nozzle by Infrared Testing**

Russell, Samuel S.; Walker, James L.; Lansing, Mathew; [2003]; 1 pp.; In English; ASNT Fall Conference and Quality Testing Show 2003, 13-17 Oct. 2003, Pittsburgh, PA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Space Shuttle Main Engine (SSME) is composed of cooling tubes brazed to the inside of a conical structural jacket. Because of the geometry there are regions that can't be inspected for leaks using the bubble solution and low-pressure method. The temperature change due escaping gas is detectable on the surface of the nozzle under the correct conditions. The methods and results presented in this summary address the thermographic identification of leaks in the Space Shuttle Main Engine nozzles. A highly sensitive digital infrared camera is used to record the minute temperature change associated with a leak source, such as a crack or pinhole, hidden within the nozzle wall by observing the inner 'hot wall' surface as the nozzle is pressurized. These images are enhanced by digitally subtracting a thermal reference image taken before pressurization, greatly diminishing background noise. The method provides a nonintrusive way of localizing the tube that is leaking and the exact leak source position to within a very small axial distance. Many of the factors that influence the inspectability of the nozzle are addressed; including pressure rate, peak pressure, gas type, ambient temperature and surface preparation.

Author

*Space Shuttle Main Engine; Nozzle Walls; Leakage; Thermography*

**20040000772** Michigan Univ., Ann Arbor, MI, USA

**Grid Erosion Modeling of the NEXT Ion Thruster Optics**

Ernhoff, Jerold W.; Boyd, Iain D.; Soulas, George, Technical Monitor; September 2003; 16 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAG3-2497; WBS 22-800-50-01

Report No.(s): NASA/CR-2003-212595; AIAA Paper 2003-4868; E-14152; No Copyright; Avail: CASI; A03, Hardcopy

Results from several different computational studies of the NEXT ion thruster optics are presented. A study of the effect of beam voltage on accelerator grid aperture wall erosion shows a non-monotonic, complex behavior. Comparison to experimental performance data indicates improvements in simulation of the accelerator grid current, as well as very good agreement with other quantities. Also examined is the effect of ion optics choice on the thruster life, showing that TAG optics provide better margin against electron backstreaming than NSTAR optics. The model is used to predict the change in performance with increasing accelerator grid voltage, showing that although the current collected on the accel grid downstream face increases, the erosion rate decreases. A study is presented for varying doubly-ionized Xenon current fraction. The results show that performance data is not extremely sensitive to the current fraction.

Author

*Ion Propulsion; Ion Optics*

**20040000780** NASA Glenn Research Center, Cleveland, OH, USA

**Discharge Characterization of 40 cm-Microwave ECR Ion Source and Neutralizer**

Foster, John E.; Patterson, Michael J.; Britton, Melissa; October 2003; 23 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): WBS 22-755-70-04

Report No.(s): NASA/TM-2003-212590; AIAA Paper 2003-5012; E-14147; NAS 1.15:212590; Copyright; Avail: CASI; A03, Hardcopy

Discharge characteristics of a 40 cm, 2.45 GHz Electron Cyclotron Resonance (ECR) ion thruster discharge chamber and neutralizer were acquired. Thruster bulk discharge plasma characteristics were assessed using a single Langmuir probe. Total extractable ion current was measured as a function of input microwave power and flow rate. Additionally, radial ion current density profiles at the thruster's exit plane were characterized using five equally spaced Faraday probes. Distinct low and high density operating modes were observed as discharge input power was varied from 0 to 200 W. In the high mode, extractable ion currents as high as 0.82 A were measured. Neutralizer emission current was characterized as a function of flow rate and

microwave power. Neutralizer extraction currents as high as 0.6 A were measured.

Author

*Ion Engines; Neutralizers; Electron Cyclotron Resonance*

**2004000789** NASA Glenn Research Center, Cleveland, OH, USA

**Performance Evaluation of the NEXT Ion Engine Wear Test**

Soulas, George C.; Domonkos, Matthew T.; Kamhawi, Hani; Patterson, Michael J.; Gardner, Michael M.; October 2003; 21 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): WBS 22-800-50-01

Report No.(s): NASA/TM-2003-212550; E-14116; AIAA Paper 2003-4863; Copyright; Avail: CASI; [A03](#), Hardcopy

The status of the NEXT 2000 hour wear test is presented. This test is being conducted with a 40 cm engineering model ion engine, designated EM1, at a beam current higher than listed on the NEXT throttle table. Pretest performance assessments demonstrated that EM1 satisfies all thruster performance requirements. As of 7/3/03, the ion engine has accumulated 406 hours of operation at a thruster input power of 6.9 kW. Overall ion engine performance, which includes thrust, thruster input power, specific impulse, and thrust efficiency, has been steady to date with no indications of performance degradation. Images of the downstream discharge cathode, neutralizer, and accelerator aperture surfaces have exhibited no significant erosion to date.

Author

*Ion Engines; Wear Tests; Solar Electric Propulsion; NASA Space Programs; Spacecraft Performance; Thrust*

**2004000790** NASA Glenn Research Center, Cleveland, OH, USA

**Performance Evaluation of the NEXT Ion Engine**

Soulas, George C.; Domonkos, Matthew T.; Patterson, Michael J.; October 2003; 24 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): WBS 22-800-50-01

Report No.(s): NASA/TM-2003-212551; AIAA Paper 2003-5278; E-14117; No Copyright; Avail: CASI; [A03](#), Hardcopy

The performance test results of three NEXT ion engines are presented. These ion engines exhibited peak specific impulse and thrust efficiency ranges of 4060 4090 s and 0.68 0.69, respectively, at the full power point of the NEXT throttle table. The performance of the ion engines satisfied all project requirements. Beam flatness parameters were significantly improved over the NSTAR ion engine, which is expected to improve accelerator grid service life. The results of engine inlet pressure and temperature measurements are also presented. Maximum main plenum, cathode, and neutralizer pressures were 12,000 Pa, 3110 Pa, and 8540 Pa, respectively, at the full power point of the NEXT throttle table. Main plenum and cathode inlet pressures required about 6 hours to increase to steady-state, while the neutralizer required only about 0.5 hour. Steady-state engine operating temperature ranges throughout the power throttling range examined were 179 303 C for the discharge chamber magnet rings and 132 213 C for the ion optics mounting ring.

Author

*Ion Engines; Performance Tests*

**2004000861** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Current and Future Rocket Propulsion Testing at NASA Stennis Space Center**

Ryan, H. M.; Rahman, S.; Gilbrech, R.; October 2000; 8 pp.; In English

Report No.(s): SE-2000-10-00015-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

Year 2000 has been an active one for large-scale propulsion testing at the NASA John C. Stennis Space Center. This paper highlights several of the current-year test programs conducted at the Stennis Space Center (SSC) including the X-33 Aerospike Engine, Ultra Low Cost Engine (ULCE) program, and the Hybrid Sounding Rocket (HYSR) program. Future directions in propulsion test are also introduced including the development of a large-scale Rocket Based Combined Cycle (RBCC) test facility.

Author

*NASA Programs; Spacecraft Propulsion; Sounding Rockets; Rocket Test Facilities; Rocket-Based Combined-Cycle Engines*

**2004000869** NASA Glenn Research Center, Cleveland, OH, USA

**Testing and Analysis of NEXT Ion Engine Discharge Cathode Assembly Wear**

Domonkos, Matthew T.; Foster, John E.; Soulas, George C.; Nakles, Michael; October 2003; 19 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): WBS 22-800-50-01

Report No.(s): NASA/TM-2003-212552; AIAA Paper 2003-4864; E-14118; Copyright; Avail: CASI; [A03](#), Hardcopy

Experimental and analytical investigations were conducted to predict the wear of the discharge cathode keeper in the NASA Evolutionary Xenon Thruster. The ion current to the keeper was found to be highly dependent upon the beam current, and the average beam current density was nearly identical to that of the NSTAR thruster for comparable beam current density. The ion current distribution was highly peaked toward the keeper orifice. A deterministic wear assessment predicted keeper orifice erosion to the same diameter as the cathode tube after processing 375 kg of xenon. A rough estimate of discharge cathode assembly life limit due to sputtering indicated that the current design exceeds the qualification goal of 405 kg. Probabilistic wear analysis showed that the plasma potential and the sputter yield contributed most to the uncertainty in the wear assessment. It was recommended that fundamental experimental and modeling efforts focus on accurately describing the plasma potential and the sputtering yield.

Author

*Ion Engines; Cathodes; Ion Currents; Beam Currents; Wear; Engine Tests*

**20040000955** NASA Glenn Research Center, Cleveland, OH, USA

**Catalyzed Combustion of Bipropellants for Micro-Spacecraft Propulsion**

Schneider, Steven J.; Sung, Chih-Jen; Boyarko, George A.; October 2003; 19 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): WBS 22-755-04-08

Report No.(s): NASA/TM-2003-212613; E-14171; AIAA Paper 2003-4924; No Copyright; Avail: CASI; **A03**, Hardcopy

This paper addresses the need to understand the physics and chemistry involved in propellant combustion processes in micro-scale combustors for propulsion systems on micro-spacecraft. These spacecraft are planned to have a mass less than 50 kilograms with attitude control estimated to be in the 10 milli-Newton thrust class. These combustors are anticipated to be manufactured using Micro Electrical Mechanical Systems (MEMS) technology and are expected to have diameters approaching the quenching diameter of the propellants. Combustors of this size are expected to benefit significantly from surface catalysis processes. Miniature flame tube apparatus is chosen for this study because microtubes can be easily fabricated from known catalyst materials and their simplicity in geometry can be used in fundamental simulations for validation purposes. Experimentally, we investigated the role of catalytically active surfaces within 0.4 and 0.8 mm internal diameter microtubes, with special emphases on ignition processes in fuel rich gaseous hydrogen and gaseous oxygen. Flame thickness and reaction zone thickness calculations predict that the diameters of our test apparatus are below the quenching diameter of the propellants in sub-atmospheric tests. Temperature and pressure rise in resistively heated platinum and palladium microtubes was used as an indication of exothermic reactions. Specific data on mass flow versus preheat temperature required to achieve ignition are presented. With a plug flow model, the experimental conditions were simulated with detailed gas-phase chemistry, thermodynamic properties, and surface kinetics. Computational results generally support the experimental findings, but suggest an experimental mapping of the exit temperature and composition is needed.

Author

*Catalysts; Liquid Rocket Propellants; Propellant Combustion; Spacecraft Propulsion; Miniaturization; Fabrication*

**20040000967** Bar-Ilan Univ., Ramat-Gan, Israel

**New Endcaps for Improved Oxidation Resistance in PMR Polyimides**

Frimer, Aryeh A.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 10-13; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; **A01**, Hardcopy

A polyimide is a polymer composed of alternating units of diamine and dianhydride, linked to each other via an imide bond. PMR polyimides, commonly used in the aerospace industry, are generally capped at each end by an endcap (such as the nadic endcap used in PMR 15) which serves a double function: (1) it limits the number of repeating units and, hence, the average molecular weight of the various polymer chains (oligomers), thereby improving processibility; (2) Upon further treatment (curing), the endcap crosslinks the various oligomer strands into a tough heat-resistant piece. It is this very endcap, so important to processing, that accounts for much of the weight loss in the polymer on aging in air at elevated temperatures. Understanding this degradation provides clues for designing new endcaps to slow down degradation, and prolong the lifetime of the material.

Author

*Polyimides; Synthesis (Chemistry)*

**20040000968** Louisiana State Univ., LA, USA

**Toward the Active Control of Heat Transfer in the Hot Gas Path of Gas Turbines**

Oertling, Jeremiah E.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 29-30; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

The work at NASA this summer has focused on assisting the Professor's project, namely 'Toward the Active Control of Heat Transfer in the Hot Gas Path of Gas Turbines.' The mode of controlling the Heat Transfer that the project focuses on is film cooling. Film cooling is used in high temperature regions of a gas turbine and extends the life of the components exposed to these extreme temperatures. A 'cool' jet of air is injected along the surface of the blade and this layer of cool air shields the blade from the high temperatures. Cool is a relative term. The hot gas path temperatures reach on the order of 1500 to 2000 K. The 'cool' air is on the order of 700 to 1000 K. This cooler air is bled off of an appropriate compressor stage. The next parameter of interest is the jet's position and orientation in the flow-field.

Derived from text

*Active Control; Heat Transfer; Flow Distribution; Gas Turbines; Coolers*

**20040000969** Wisconsin Univ., Madison, WI, USA

**Simulation, Model Verification and Controls Development of Brayton Cycle PM Alternator: Testing and Simulation of 2 KW PM Generator with Diode Bridge Output**

Stankovic, Ana V.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 37-38; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Professor Stankovic will be developing and refining Simulink based models of the PM alternator and comparing the simulation results with experimental measurements taken from the unit. Her first task is to validate the models using the experimental data. Her next task is to develop alternative control techniques for the application of the Brayton Cycle PM Alternator in a nuclear electric propulsion vehicle. The control techniques will be first simulated using the validated models then tried experimentally with hardware available at NASA. Testing and simulation of a 2KW PM synchronous generator with diode bridge output is described. The parameters of a synchronous PM generator have been measured and used in simulation. Test procedures have been developed to verify the PM generator model with diode bridge output. Experimental and simulation results are in excellent agreement.

Author

*Electric Generators; Brayton Cycle; Control Systems Design; Simulation*

**20040000978** Colorado State Univ., Fort Collins, CO, USA

**NEXT Ion Optics Simulation via ffx**

Soulas, George, Technical Monitor; Farnell, Cody C.; Williams, John D.; Wilbur, Paul J.; September 2003; 15 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAG3-1801; WBS 22-800-50-01

Report No.(s): NASA/CR-2003-212594; E-14151; AIAA Paper 2003-4869; No Copyright; Avail: CASI; [A03](#), Hardcopy

Simulations of the erosion processes for two proposed sets of ion thruster grids for the NEXT project are presented. Structural failure and electron backstreaming due to accelerator grid erosion are discussed as two possible failure mechanisms of these grid sets. The TAG grid set was seen to outperform the NSTAR grid set both in terms of margin against electron backstreaming and accelerator grid mass loss for a variety of operating points. An investigation into the possibility of reducing the accelerator grid voltage magnitude for the TAG grid set showed improved propellant throughput capability.

Author

*Ion Optics; Simulation; Ion Engines; Erosion*

**20040001619** Louisiana Tech Univ., Ruston, LA, USA

**Thermal Insulation System for Large Flame Buckets**

Callens, E. Eugene, Jr.; Gamblin, Tonya Pleshette; October 1996; 260 pp.; In English

Contract(s)/Grant(s): NAS13-580; Proj-31-4136-59060

Report No.(s): NASA/SE-1998-01-00003-SSC; No Copyright; Avail: CASI; [A12](#), Hardcopy

The objective of this study is to investigate the use of thermal protection coatings, single tiles, and layered insulation systems to protect the walls of the flame buckets used in the testing of the Space Shuttle Main Engine, while reducing the cost

and maintenance of the system. The physical behavior is modeled by a plane wall boundary value problem with a convective frontface condition and a backface condition designed to provide higher heat rates through the material.

Author

*Space Shuttle Main Engine; Thermal Protection*

## 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*.

**20040000235** California Univ., Los Angeles, CA

**[Activities of California Univ., Dept. of Chemistry and Biochemistry]**

Carter, Emily A.; Nov. 2002; 11 pp.; In English

Contract(s)/Grant(s): F49620-00-1-0054

Report No.(s): AD-A418427; AFRL-SR-AR-TR-03-0352; No Copyright; Avail: CASI; [A03](#), Hardcopy

The report summarizes the accomplishments by E. A. Carter during Dec. 1, 1999 to Nov. 30, 2002. New theories for describing the structure of electrons in condensed matter were developed: (i) a quantum mechanical embedding theory allows treatment of localized electronic excited states of adsorbates or impurities on and in metals; (ii) the most advanced kinetic energy density functional was derived, which allows for a linear scaling treatment of metallic electronic structure. Of more immediate interest to the Air Force are insights into the nature of metal-ceramic and ceramic-ceramic interfaces relevant to understanding the failure of thermal barrier coatings (TBC's). Alumina-nickel interfaces in the TBC's are predicted to be the weak links in these multicomponent/multilayered coatings. These fundamental insights led to proposed changes in the composition of the alloy bond coat lying between the metal engine component and the thermal insulating ceramic. In particular, promotion of open shell/covalent character at interfaces was suggested as a design principle to increase adhesion. To this end, early transition metals doped at the alumina-nickel alloy interface were predicted dramatically increase adhesion, and replacement of alumina by silica also starkly increased adhesion to both the nickel substrate and the zirconia top coat of the TBC.

DTIC

*Quantum Theory; Electronic Structure; Coatings*

## 24

### COMPOSITE MATERIALS

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

**20040000216** Aerospace Corp., El Segundo, CA

**The Evaluation of Aluminum Foil-Interlayered High- Modulus K13CU Pitch Fiber-Siloxane-Modified Resin Composite Panels**

Zaldivar, R. J.; Casteneda, R.; Jul. 15, 2003; 15 pp.; In English

Contract(s)/Grant(s): F04701-00-C-0009

Report No.(s): AD-A418426; TR-2003(8565)-5; SMC-TR-04-03; No Copyright; Avail: CASI; [A03](#), Hardcopy

A contractor is currently fabricating flat panels of high-modulus fiber K13CU/siloxane-modified polycyanurate matrix resin composites. Mechanical testing at a commercial lab showed that the interlaminar shear strengths and the flat-wise tensile properties were below that expected. We evaluated the degree of consolidation and cure to verify that incorporated foil layers were not causing premature failure. A number of composite panels were analyzed using dynamic mechanical analysis and optical microscopy. The measured glass-transition temperatures ( $T_g$ 's) of the samples all suggested that they were properly cured. A solvent exposure test developed in our laboratory also corroborated these results. Optical micrographs of cross-sections for the different composites indicated good consolidation and no observable foil debonds. All of the samples exhibited similar failure modes from our testing. The focus of the lower-than-expected strengths was then placed on the sample preparation procedure for mechanical testing. Sample preparation of the test specimens at the testing laboratory was identified

as the cause for the lower-than-expected strengths. Subsequent tests on articles with proper sample preparation yielded acceptable mechanical strengths.

DTIC

*Siloxanes; Metal Foils; Aluminum*

**20040000578** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Microcrack Quantification in Composite Materials by a Neural Network Analysis of Ultrasound Spectral Data**

Walker, James L.; Russell, Samuel S.; Suits, Michael W.; [2003]; 1 pp.; In English; ASNT Fall Conference and Quality Testing Show, 13-17 Oct. 2003, Pittsburgh, PA, USA; No Copyright; Avail: Other Sources; Abstract Only

Intra-ply microcracking in unlined composite pressure vessels can be very troublesome to detect and when linked through the thickness can provide leak paths that may hinder mission success. The leaks may lead to loss of pressure/propellant, increased risk of explosion and possible cryo-pumping into air pockets within the laminate. Ultrasonic techniques have been shown capable of detecting the presence of microcracking and in this work they are used to quantify the level of microcracking. Resonance ultrasound methods are utilized with artificial neural networks to build a microcrack prediction/measurement tool. Two networks are presented, one unsupervised to provide a qualitative measure of microcracking and one supervised which provides a quantitative assessment of the level of microcracking. The resonant ultrasound spectroscopic method is made sensitive to microcracking by tuning the input spectrum to the higher frequency (shorter wavelength) components allowing more significant interaction with the defects. This interaction causes the spectral characteristics to shift toward lower amplitudes at the higher frequencies. As the density of the defects increases more interactions occur and more drastic amplitude changes are observed. Preliminary experiments to quantify the level of microcracking induced in graphite/epoxy composite samples through a combination of tensile loading and cryogenic temperatures are presented. Both unsupervised (Kohonen) and supervised (radial basis function) artificial neural networks are presented to determine the measurable effect on the resonance spectrum of the ultrasonic data taken from the samples.

Author

*Ultrasonics; Neural Nets; Cryogenics; Microcracks; Graphite-Epoxy Composites; Pressure Vessels; Emission Spectra*

**20040000733** Pennsylvania State Univ., University Park, PA, USA

**Composite-Based High Performance Electroactive Polymers For Remotely Controlled Mechanical Manipulations in NASA Applications**

Zhang, Q. M.; December 18, 2003; 17 pp.; In English

Contract(s)/Grant(s): NAG1-03008; No Copyright; Avail: CASI; [A03](#), Hardcopy

This program supported investigation of an all-polymer percolative composite which exhibits very high dielectric constant (less than 7,000). The experimental results show that the dielectric behavior of this new class of percolative composites follows the prediction of the percolation theory and the analysis of the conductive percolation phenomena. The very high dielectric constant of the all-polymer composites which are also very flexible and possess elastic modulus not very much different from that of the insulation polymer matrix makes it possible to induce a high electromechanical response under a much reduced electric field (a strain of 2.65% with an elastic energy density of 0.18 J/cu cm can be achieved under a field of 16 MV/m). Data analysis also suggests that in these composites, the non-uniform local field distribution as well as interface effects can significantly enhance the strain responses. Furthermore, the experimental data as well as the data analysis indicate that the conduction loss in these composites will not affect the strain hysteresis.

Author

*Dielectric Properties; Electroactive Polymers; High Polymers; Modulus of Elasticity; Manipulators*

**20040000773** NASA Langley Research Center, Hampton, VA, USA

**Effect of Elevated Temperature and Loading Rate on Delamination Fracture Toughness**

Reeder, J. R.; Allen, D. H.; Bradley, W. L.; [2003]; 8 pp.; In English; ICCM 14th International Conference on Composite Materials, 14-18 Jul. 2003, San Diego, CA, USA; Original contains color and black and white illustrations

Contract(s)/Grant(s): RTA 762-30-71-81; Copyright; Avail: CASI; [A02](#), Hardcopy

The effects of temperature and loading rate on delamination growth were studied. The delamination fracture toughness of IM7/K3B was measured at 149 C, 177 C, and 204 C. At each temperature the tests were performed with a variety of loading rates so that the delamination initiated over the range of time from 0.5 sec to 24 hrs. The double cantilever beam (DCB) test was used to measure fracture toughness. The results showed that the delamination resistance is a complicated function of both time and temperature with the effect of temperature either increasing or decreasing the fracture toughness depending on the

time scale. The results also showed that the fracture toughness changed by as much as a factor of three as the time scale changed over the five orders of magnitude tested.

Author

*Fracture Strength; Thermoplastic Resins; Resin Matrix Composites; Time Temperature Parameter; Loading Rate*

## 25

### INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

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

**20030098053** Ohio Univ., Athens, OH

#### **Metachromatic Materials**

Van Patten, P. G.; Jan. 2002; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAD19-01-1-0598

Report No.(s): AD-A415613; PGVP-ARO-04022003; ARO-42187.3-PH-YIP; No Copyright; Avail: CASI; **A03**, Hardcopy

The primary goal of the work performed under this contract was to study the feasibility of using metal nanoparticles as contrast agents (ink) in full-color, flexible, reflective, low-power, electronic displays. The concept is based on the tunability of the plasmon absorption peak in metal nanoparticle ensembles. Well-separated, nanometer-sized fragments of Au, Ag, or Cu have intense plasmon absorptions in the visible part of the spectrum. The extinction coefficient, the frequency of maximum absorbance, and the full width at half maximum of the plasmon peak all depend on the sizes of the nanoparticles. As the nanoparticles increase in size from 2 to 20 nanometers, the peak becomes sharper and more intense. The spectral position of the peak remains relatively unchanged over this size range. As particles are brought into close proximity--less than 3 diameters between their respective centers--the position of the plasmon peak red-shifts, leading to a dramatic change in color. The magnitude of the shift and the color change is proportional to the extinction coefficient of the nanoparticles. Because larger particles have larger extinction coefficients and smaller widths at half maximum, they are expected to be best-suited for metachromatic (color-changing) applications. To prove the possibility of using this plasmon shift in an electronic display, the authors set out to develop a scheme to electrically control the distribution of (and distances between) metal nanoparticles in soft matrices. One of the most intriguing possibilities was the use of supported bilayer lipid membranes (BLMs) as two-dimensional fluids to confine the nanoparticles without completely eliminating their mobility. Previous studies at Stanford University showed that BLMs could be patterned under certain conditions and that the patterning resulted in diffusional barriers to molecules attached to the membranes. The authors set out to reproduce these results in their laboratory.

DTIC

*Metal Matrix Composites; Nanoparticles; Electronic Equipment; Nanotechnology; Color Vision*

**20040000165** Cornell Univ., Ithaca, NY

#### **Chemical Flame Suppression by Phosphorus-Containing Compounds**

Fisher, E. M.; Gillett, J. W.; Gouldin, F. C.; Jayaweera, T. M.; MacDonald, M. A.; Apr. 29, 1999; 32 pp.; In English

Contract(s)/Grant(s): DASW01-98-C-0015

Report No.(s): AD-A418404; No Copyright; Avail: CASI; **A03**, Hardcopy

Several techniques were used to aid in the assessment of PCCs as flame suppressants: GC/MS with chemical derivatization, a qualitative toxicology assessment of the byproducts, measurements of the global extinction strain rate, emission spectroscopy. We also developed two important new capabilities: (1) laser-induced fluorescence (LIF) to measure concentrations of OH (a key flame radical) as a measure of suppressant effectiveness and as a means of understanding the mechanism of flame suppression, and (2) droplet generation and feed systems to enable the future evaluation of low-vapor-pressure PCCs as liquids or aqueous solutions. Diethyl methylphosphonate and dimethyl phosphonate were tested as vapor-phase additives. Their effect on the global extinction strain rates of the methane/air flames indicated that they had flame-suppression effectivenesses very similar to those of the PCCs tested previously. The following stable byproducts were identified in a methane/air flame doped with DMMP: methyl methylphosphonate, P(=1-)(-CH<sub>3</sub>)(-OCH<sub>3</sub>)(-OH); dimethyl phosphate, P(=0)(-OCH<sub>3</sub>)<sub>2</sub>(-OH); monomethyl phosphate, P(=O)(-OCH<sub>3</sub>)(-OH)<sub>2</sub>; methylphosphonic acid, P(=O)(-CH<sub>3</sub>)(-OH)<sub>2</sub>; phosphonic acid, P(=O)(-H)(-OH)<sub>2</sub>; phosphorous acid, P(-OH)<sub>3</sub>; orthophosphoric acid, P(=O)(-OH)<sub>3</sub>, none of which is highly neurotoxic. A continuum emission and features associated with PO and PH were identified in emission spectra in

DMMP-doped methane/air flames. Preliminary OH LIF and electrospray results are presented.

DTIC

*Toxicology; Flames; Phosphorus Compounds*

**2004000303** California Univ., Berkeley, CA

**A Versatile Route to Functionalized Block Copolymers by Nitroxide Mediated ‘Living’ Free Radical Polymerization**

Benoit, Didier; Rivera, Felix, Jr.; Piotti, Marcelo; Rees, Ian; Hedrick, James L.; Jan. 1999; 3 pp.; In English

Contract(s)/Grant(s): DAAG55-97-1-0126; DMR-9808677

Report No.(s): AD-A418459; ARO-37254.93-CH-MUR; No Copyright; Avail: CASI; [A01](#), Hardcopy

We have recently shown that replacement of TEMPO as the mediating nitroxide in ‘living’ free radical polymerizations by alpha-hydrogen derivatives leads to monomer selection and functional group compatibility approaching that of ATRP based systems. The ability of these new alkoxyamines, such as 1, to mediate the homopolymerization of a wide variety of monomers should permit a much greater range of well defined random, block, and star copolymers to be prepared under simplified conditions.

DTIC

*Polymerization; Copolymers; Free Radicals; Nitrogen Oxides*

**2004000340** Cornell Univ., Ithaca, NY, USA

**Flame Inhibition by Phosphorus-Containing Compounds**

Fisher, E. M.; Gouldin, F. C.; Jayaweera, T. M.; MacDonald, M. A.; Mar. 1998; 55 pp.; In English

Contract(s)/Grant(s): MDA972-97-M-0013

Report No.(s): AD-A418454; No Copyright; Avail: CASI; [A04](#), Hardcopy

This project investigated phosphorus-containing compounds (PCCs) as alternatives to halon fire suppressants. The flame suppression effectiveness of two PCCs, dimethyl methylphosphonate and trimethyl phosphate, was evaluated by determining their effect on the global extinction strain rate in opposed-jet flames. A novel method for approaching extinction was devised and validated for use in extinction measurements involving low-vapor-pressure additives. Effectiveness was determined for nonpremixed methane vs. air and propane vs. air flames, methane/air premixed flames, and a variety of nonpremixed methane/nitrogen vs. oxygen/nitrogen flames. For all the flames tested, these PCCs showed very high flame suppression effectiveness. Their effectiveness was two to four times higher than literature values for CF<sub>3</sub>Br in nonpremixed methane vs. air flames. For the limited range of PCCs tested, the chemical form of the parent compound appeared to have little effect on flame suppression properties. The effectiveness of PCCs increases as flame temperature decreases. Effectiveness per mole PCC at the flame location is somewhat higher for oxidant-side delivery than for fuel-side delivery. PCCs show promise as halon replacements. Further research is needed to investigate their mechanisms of action, to determine important toxicological and materials compatibility properties, and to devise effective ways to deliver them to fires.

DTIC

*Phosphorus Compounds; Inhibition; Flames*

**2004000341** Air Force Research Lab., Wright-Patterson AFB, OH, USA

**Concurrent Research on High Gravity (g) Combustion and Enabling Materials**

Zelina, Joseph; Kerans, R. J.; Sep. 2003; 6 pp.; In English

Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A418471; AFRL-PR-WP-TM-2003-2116; No Copyright; Avail: CASI; [A02](#), Hardcopy

A gas turbine engine has been proposed that uses a near constant temperature (NCT) cycle and Inter-Turbine Burner (ITB) to provide large amounts of power extraction from the low-pressure turbine. This level of energy is achieved with a modest temperature rise across the ITB. The additional energy can be used to power a large fan for an ultra-high bypass ratio transport aircraft, or to drive an alternator for large amounts of electrical power extraction. Conventional gas turbine engines cannot drive ultra-large diameter fans without the use of excessive turbine temperatures, and cannot meet high power extraction demands without a loss of engine thrust. Reducing the size of the main combustor and ITB is essential to reducing or maintaining overall engine weight and size for the NCT cycle. Concepts for an ultra-compact combustor (UCC) are being explored experimentally. The basic combustor design involves flame-holding in a cavity within which the flow is strongly swirled. Experimental results at atmospheric pressure indicate that the combustion system flame holding zone operated at 95

- 99 percent combustion efficiency over a wide range of operating conditions. Flame lengths were extremely short, at about 50 percent those of conventional systems.

DTIC

*Ceramic Matrix Composites; Combustion; Gravitation*

**20040000587** Woods Hole Research Center, MA, USA

#### **Biogeochemical Cycles in Degraded Lands**

Davidson, Eric A.; Vieira, Ima Celia G.; ReisdCarvalho, Claudio Jose; DeaneDeAbreuSa, Tatiana; deSpozaMoutinho, Paulo R.; Figueiredo, Ricardo O.; Stone, Thomas A.; [2003]; 12 pp.; In English

Contract(s)/Grant(s): NCC5-332; SBIR-00.00-0000

Report No.(s): ND-02; Copyright; Avail: CASI; [A03](#), Hardcopy

The objectives of this project were to define and describe the types of landscapes that fall under the broad category of 'degraded lands' and to study biogeochemical cycles across this range of degradation found in secondary forests. We define degraded land as that which has lost part of its capacity of renovation of a productive ecosystem, either in the context of agroecosystems or as native communities of vegetation. This definition of degradation permits evaluation of biogeochemical constraints to future land uses.

Derived from text

*Biogeochemistry; Degradation; Ecosystems*

**20040000686** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Mapping Soil pH Buffering Capacity of Selected Fields**

Weaver, A. R.; Kissel, D. E.; Chen, F.; West, L. T.; Adkins, W.; Rickman, D.; Luvall, J. C.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Soil pH buffering capacity, since it varies spatially within crop production fields, may be used to define sampling zones to assess lime requirement, or for modeling changes in soil pH when acid forming fertilizers or manures are added to a field. Our objective was to develop a procedure to map this soil property. One hundred thirty six soil samples (0 to 15 cm depth) from three Georgia Coastal Plain fields were titrated with calcium hydroxide to characterize differences in pH buffering capacity of the soils. Since the relationship between soil pH and added calcium hydroxide was approximately linear for all samples up to pH 6.5, the slope values of these linear relationships for all soils were regressed on the organic C and clay contents of the 136 soil samples using multiple linear regression. The equation that fit the data best was  $b$  (slope of pH vs. lime added) =  $0.00029 - 0.00003 * \% \text{ clay} + 0.00135 * \% \text{ O/C}$ ,  $r(\text{exp } 2) = 0.68$ . This equation was applied within geographic information system (GIS) software to create maps of soil pH buffering capacity for the three fields. When the mapped values of the pH buffering capacity were compared with measured values for a total of 18 locations in the three fields, there was good general agreement. A regression of directly measured pH buffering capacities on mapped pH buffering capacities at the field locations for these samples gave an  $r(\text{exp } 2)$  of 0.88 with a slope of 1.04 for a group of soils that varied approximately tenfold in their pH buffering capacities.

Author

*Soil Mapping; Ph; Soil Sampling; Soil Science; Crop Growth; Fertilizers; Manures*

**20040000693** NASA Johnson Space Center, Houston, TX, USA

#### **Microencapsulated Bioactive Agents and Method of Making**

Morrison, Dennis R., Inventor; Mosier, Benjamin, Inventor; May 06, 2003; 23 pp.; In English

Patent Info.: Filed 6 Dec. 2000; US-Patent-6,558,698; US-Patent-Appl-SN-733391; US-Patent-Appl-SN-079766; US-Patent-Appl-SN-349169; NASA-CASE-MS-C-22936-2; No Copyright; Avail: CASI; [A03](#), Hardcopy

The invention is directed to microcapsules encapsulating an aqueous solution of a protein, drug or other bioactive substance inside a semi-permeable membrane. The microcapsules are formed by interfacial coacervation where shear forces are limited to 0-100 dynes per square centimeter. The resulting uniform microcapsules can then be subjected to dewatering in order to cause the internal solution to become supersaturated with the dissolved substance. This dewatering allows controlled nucleation and crystallization of the dissolved substance. The crystal-filled microcapsules can be stored, keeping the encapsulated crystals in good condition for further direct use in x-ray crystallography or as injectable formulations of the dissolved drug, protein or other bioactive substance.

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

*Encapsulating; Crystallography; Activity (Biology); Agents*

**2004000887** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Multispectral In-situ Measurements of Organic Matter and Chlorophyll Fluorescence in Seawater: Documenting the Intrusion of the Mississippi River Plume in the West Florida Shelf**

DelCastillo, Carlos E.; Coble, Paula G.; Conmy, Robyn N.; Mueller-Karger, Frank E.; Vanderbloomen, Lisa; Vargo, Gabriel A.; December 4, 2000; 24 pp.; In English

Contract(s)/Grant(s): NAG5-6301

Report No.(s): SE-2000-12-0024-SSC; Copyright; Avail: CASI; [A03](#), Hardcopy

We performed multispectral in-situ fluorescence measurement of colored dissolved organic matter and chlorophyll in surface water of the West Florida Shelf using West Labs Spectral absorption and Fluorescence Instrument (SAFIre). Continuous measurements underway allowed us to simultaneously map the dispersion of riverine organic material and chlorophyll on the shelf. By using two fluorescence emission ratios we were able to differentiate between riverine and marine CDOM. Our data also showed unusually high concentrations of CDOM offshore. These were attributed to an intrusion of the Mississippi River Plume. We performed limited comparisons between in-situ chlorophyll concentrations measured with SAFIre and chlorophyll values obtained from SeaWiFS satellite data using OC4 and MODIS algorithm. Our results show that, although both algorithms overestimated chlorophyll, MODIS performed better than OC4, particularly in areas with high CDOM concentrations. Analysis of the relationship between chlorophyll and CDOM concentrations within the study area showed regional variability caused by differences in river source.

Author

*Absorption Spectra; In Situ Measurement; Chlorophylls; Fluorescence; Dissolved Organic Matter*

**2004000974** Centenary Coll. of Louisiana, Shreveport, LA, USA

**Optical and Probe Diagnostics Applied to Reacting Flows**

Ticich, Thomas M.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 39-41; In English; See also 2004000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

We plan to explore three major threads during the fellowship period. The first interrogates the flame synthesis of carbon nanotubes using aerosol catalysts. Laser light scattering will reveal changes in particle size at various heights above the burner. Analysis of the flame gas by mass spectroscopy will reveal the chemical composition of the mixture. Finally, absorption measurements will map the nanotube concentration within the flow. The second thread explores soot oxidation kinetics. Cavity ring-down absorption measurements of the carbonaceous aerosol can provide a measure of the mass concentration with time and, hence, an oxidation rate. Spectroscopic and direct probe measurements will provide the temperature of the system needed for subsequent modeling. The third thread will explore the details of turbulent flame dynamics. Laser induced incandescence will be applied to measurements of soot volume fraction in a 2-d configuration. Analysis of seed tracer particles by planar laser light MIE scattering will reveal the elemental fuel mixture fraction in the flames. Cavity ring-down spectroscopy, a pulsed transient absorption method, will determine the instantaneous mass loading and its fluctuation. Finally, fluorescence measurements will investigate the formation of PAH's in these flames.

Author

*Carbon Nanotubes; Flames; Combustion Chemistry; Soot; Oxidation; Nanostructure Growth; Reaction Kinetics; Turbulent Flames*

**26**

**METALS AND METALLIC MATERIALS**

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

**20030068868** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Aluminum Alloy and Article Cast Therefrom**

Lee, Jonathan A., Inventor; Chen, Po-Shou, Inventor; July 15, 2003; 9 pp.; In English

Patent Info.: Filed 11 Jul. 2002; US-Patent-6,592,687; US-Patent-Appl-SN-196389; US-Patent-Appl-SN-606108; US-Patent-Appl-SN-218675; US-Patent-Appl-SN-152469; No Copyright; Avail: CASI; [A02](#), Hardcopy

A cast article from an aluminum alloy, which has improved mechanical properties at elevated temperatures, has the following composition in weight percent: Silicon 14 - 25.0, Copper 5.5 - 8.0, Iron 0.05 - 1.2, Magnesium 0.5 - 1.5, Nickel 0.05 - 0.9, Manganese 0.05 - 1.0, Titanium 0.05 - 1.2, Zirconium 0.05 - 1.2, Vanadium 0.05 - 1.2, Zinc 0.05 - 0.9, Phosphorus 0.001 - 0.1, and the balance is Aluminum, wherein the silicon-to-magnesium ratio is 10 - 25, and the copper-to-magnesium

ratio is 4 - 15. The aluminum alloy contains a simultaneous dispersion of three types of Al<sub>3</sub>X compound particles (X=Ti, V, Zr) having a L1<sub>2</sub> crystal structure, and their lattice parameters are coherent to the aluminum matrix lattice. A process for producing this cast article is also disclosed, as well as a metal matrix composite, which includes the aluminum alloy serving as a matrix and containing up to about 60% by volume of a secondary filler material.

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

*Aluminum Alloys; Mechanical Properties; Cast Alloys; Metal Matrix Composites*

**2004000042** NASA Glenn Research Center, Cleveland, OH, USA

### **Superalloy Lattice Block Structures**

Whittenberger, J. D.; Nathal, M. V.; Hebsur, M. G.; Kraus, D. L.; [2003]; 4 pp.; In English; 10th International Symposium on Superalloys (2004), Seven Springs, PA, USA; No Copyright; Avail: CASI; [A01](#), Hardcopy

In their simplest form, lattice block panels are produced by direct casting and result in lightweight, fully triangulated truss-like configurations which provide strength and stiffness [2]. The earliest realizations of lattice block were made from Al and steels, primarily under funding from the US Navy [3]. This work also showed that the mechanical efficiency (eg., specific stiffness) of lattice block structures approached that of honeycomb structures [2]. The lattice architectures are also less anisotropic, and the investment casting route should provide a large advantage in cost and temperature capability over honeycombs which are limited to alloys that can be processed into foils. Based on this early work, a program was initiated to determine the feasibility of extending the high temperature superalloy lattice block [3]. The objective of this effort was to provide an alternative to intermetallics and composites in achieving a lightweight high temperature structure without sacrificing the damage tolerance and moderate cost inherent in superalloys. To establish the feasibility of the superalloy lattice block concept, work was performed in conjunction with JAMCORP, Inc. Billerica, MA, to produce a number of lattice block panels from both IN71 8 and Mar-M247.

Author

*Bend Tests; Heat Resistant Alloys*

**20040000106** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **High Strength Discontinuously Reinforced Aluminum For Rocket Applications**

Pandey, A. B.; Shah, S. R.; Shadoan, M.; August 28, 2003; 10 pp.; In English; TMS Materials Science and Technology 2003, 9-12 Nov. 2003, Chicago, IL, USA

Contract(s)/Grant(s): NAS8-01108; Copyright; Avail: CASI; [A02](#), Hardcopy

This study presents results on the development of a new aluminum alloy with very high strength and ductility. Five compositions of Al-Mg-Sc-Gd-Zr alloy were selected for this purpose. These alloys were also reinforced with 15 volume percent silicon-carbide and boron-carbide particles to produce Discontinuously Reinforced Aluminum (DRA) materials. Matrix alloys and DRA were processed using a powder metallurgy process. The helium gas atomization produced very fine powder with cellular-dendritic microstructure. The microstructure of matrix alloys showed fine Al<sub>3</sub>Sc based precipitate which provides significant strengthening in these alloys. DRA showed uniform distribution of reinforcement in aluminum matrix. DRA materials were tested at -320 F, 75 F in air and 75 F in gaseous hydrogen environments and matrix alloys were tested at 75 F in air. DRA showed high strengths in the range of 89-111 ksi (614-697 MPa) depending on alloy compositions and test environments. Matrix alloys had a good combination of strength, 84-89 ksi (579-621 MPa) and ductility, 4.5-6.5%. The properties of these materials can further be improved by proper control of processing parameters.

Author

*Aluminum Alloys; Silicon Carbides; Boron Carbides; Reinforcing Materials; Cermets; Metal Matrix Composites*

**20040000552** General Electric Aircraft Engines, Cincinnati, OH, USA

### **Superalloy Lattice Block**

Whittenberger, J. Daniel, Technical Monitor; Ott, Eric A.; November 2003; 48 pp.; In English

Contract(s)/Grant(s): NAS3-01135; WBS 22-714-04-06

Report No.(s): NASA/CR-2003-212719; E-14243; No Copyright; Avail: CASI; [A03](#), Hardcopy

Robust, lightweight component designs are critical to aircraft gas turbine engine performance, efficiency and application. Lightweight, superalloy lattice block structures composed of an open core with three-dimensional trusses have been examined as an alternative to bulk, fully dense, high-temperature static structures due to their strength, stiffness, and reduced weight. An assessment of the producibility and capability of these structures for aircraft gas turbine engine components suggests that the complexity of lattice block structure geometry may impose constraints upon the manufacturing method, design, and sizes of

component structures produced. Preliminary analysis of an exhaust nozzle flap component indicates that weight reductions of up to about 30% may be achieved over conventional designs by integrating lattice block elements, but limitations in design analysis tools for these complex structures has prevented consideration of truss buckling in this analysis. Based on an application-focused assessment, recommendations are made regarding additional technical development needs envisioned before implementation of lattice block structures would be possible for aircraft gas turbine engine components.

Author

*Metallicity; Lattice Energy; High Temperature; Turbine Engines; Heat Resistant Alloys; Design Analysis; Block Diagrams*

**20040000628** Advanced Components and Materials, Inc., East Greenwich, RI, USA

#### **High Temperature Metallic Seal Development**

Datta, Amit; More, D. Greg; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 309-323; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

Based on the ASTM stress relaxation studies, UHT seals have been fabricated using a candidate superalloy, an oxide dispersion strengthened (ODS) alloy and a proprietary composite structure. Seal characterization tests are being conducted in the temperature range 1500 F to 1800 F by monitoring the change in the seal free height as a function of the exposure time. Results of an advanced superalloy seal, obtained so far, will be presented and compared with those of standard Waspaloy seals. An innovative knowledge based seal design and application engineering software has also been developed by Advanced Products. This Integrated Product Engineering (IPE) approach will be explained and demonstrated.

Author

*High Temperature; Seals (Stoppers); Fabrication; Heat Resistant Alloys; Metals*

**20040000672** Ohio Aerospace Inst., Brook Park, OH, USA

#### **Mechanical Behavior of Advanced Materials for Aerospace Applications**

Telesman, Ignancy, Technical Monitor; Kantzos, Peter; Shannon, Brian; [2003]; 31 pp.; In English  
Contract(s)/Grant(s): NCC3-480; No Copyright; Avail: CASI; [A03](#), Hardcopy

The purpose of this study was to determine whether High Cycle Fatigue (HCF) loading has any deleterious synergistic effect on life when combined with the typical Low Cycle Fatigue (LCF) loading present in engine disks. This interaction is particularly important in the rim region of blisk applications, where fatigue initiations from vibratory stresses (HCF) may be propagated to the disk by LCF. The primary effort in this study was focused on determining and documenting initiation sites and damage mechanisms. Under LCF loading conditions the failures were predominantly surface initiated, while HCF loading favored internal initiations. Deleterious HCF/LCF interactions would always result in a transition from internal to surface initiations. The results indicated that under the relative stress conditions evaluated there was no interaction between HCF and LCF. In FY99 this effort was extended to investigate several other loading conditions (R-ratio effects) as well as interactions between LCF and two-hour tensile dwells. The results will be published as a NASA Technical Memorandum.

Author

*Fatigue (Materials); Thermodynamic Cycles; Mechanical Properties*

**20040000682** NASA Glenn Research Center, Cleveland, OH, USA

#### **1100 to 1500 K Slow Plastic Compressive Behavior of NiAl-xCr Single Crystals**

Whittenberger, J. Daniel; Darolia, Ram; September 2003; 33 pp.; In English

Contract(s)/Grant(s): WBS 22-708-31-04

Report No.(s): NASA/TM-2003-212488; E-14033; Copyright; Avail: CASI; [A03](#), Hardcopy

The compressive properties of near  $\langle 001 \rangle$  and  $\langle 111 \rangle$  oriented NiAl-2Cr single crystals and near  $\langle 011 \rangle$  oriented NiAl-6Cr samples have been measured between 1100 and 1500 K. The 2Cr addition produced significant solid solution strengthening in NiAl, and the  $\langle 111 \rangle$  and  $\langle 001 \rangle$  single crystals possessed similar strengths. The 6Cr crystals were not stronger than the 2Cr versions. At 1100 and 1200 K plastic flow in all three Cr-modified materials was highly dependent on stress with exponents  $> 10$ . The  $\langle 011 \rangle$  oriented 6Cr alloy exhibited a stress exponent of about 8 at 1400 and 1500 K; whereas both  $\langle 001 \rangle$  and  $\langle 111 \rangle$  NiAl-2Cr crystals possessed stress exponents near 3 which is indicative of a viscous dislocation glide creep mechanism. While the Cottrell-Jaswon solute drag model predicted creep rates within a factor of 3 at 1500 K for  $\langle 001 \rangle$ -oriented NiAl-2Cr; this mechanism greatly over predicted creep rates for other orientations and at 1400 K for  $\langle 001 \rangle$  crystals.

Author

*Nickel Alloys; Aluminum Alloys; Chromium Alloys; Compressibility*

**20040000862** Hendrix Coll., Conway, AR, USA

**Detection of Metallic Compounds in Rocket Plumes Using Ion Probes**

Dunn, Robert W.; January 05, 1998; 30 pp.; In English

Contract(s)/Grant(s): NAG13-40

Report No.(s): SE-1998-01-00001-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

This grant experimentally verified that ion probes can consistently detect metallic compounds in a hybrid rocket plume. Two electrostatic detection methods were tested. The first method used an unbiased ion probe. It responded to collisions or near collisions with charged particulates. The amplitude of the response to metallic ions always exceeded that of the combustion products. The second device was a cylindrical Gaussian surface that surrounded, but did not touch, the plume. A charge imbalance in the plume induced a current in cylinder that was detected by a sensitive amplifier. The probe was more sensitive to metallic compounds than the cylinder. However, the Gaussian cylinder demonstrated sufficient sensitivity to warrant serious future consideration. Since the cylinder is nonintrusive, it is particularly attractive. Apparently, ions formed during combustion transfer to the metallic impurities. The formation of these metallic ions slows the ion recombination rate and helps preserve charges in the plume. The electrostatic detectors, in turn, respond to the charges carried by the metallic impurities.

Author

*Ion Probes; Rocket Exhaust; Detection; Hybrid Propellant Rocket Engines; Metal Compounds*

**20040000965** Centenary Coll. of Louisiana, Shreveport, LA, USA

**Metal Nanoparticle Catalysts for Carbon Nanotube Growth**

Pierce, Benjamin F.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 42-43; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Work this summer involved and new and unique process for producing the metal nanoparticle catalysts needed for carbon nanotube (CNT) growth. There are many applications attributed to CNT's, and their properties have deemed them to be a hot spot in research today. Many groups have demonstrated the versatility in CNT's by exploring a wide spectrum of roles that these nanotubes are able to fill. A short list of such promising applications are: nanoscaled electronic circuitry, storage media, chemical sensors, microscope enhancement, and coating reinforcement. Different methods have been used to grow these CNT's. Some examples are laser ablation, flame synthesis, or furnace synthesis. Every single approach requires the presence of a metal catalyst (Fe, Co, and Ni are among the best) that is small enough to produce a CNT. Herein lies the uniqueness of this work. Microemulsions (containing inverse micelles) were used to generate these metal particles for subsequent CNT growth. The goal of this summer work was basically to accomplish as much preliminary work as possible. I strived to pinpoint which variable (experimental process, metal product, substrate, method of application, CVD conditions, etc.) was the determining factor in the results. The resulting SEM images were sufficient for the appropriate comparisons to be made. The future work of this project consists of the optimization of the more promising experimental procedures and further exploration onto what exactly dictated the results.

Derived from text

*Carbon Nanotubes; Catalysts; Metal Particles; Nanoparticles; Nanostructure Growth*

**27**

**NONMETALLIC MATERIALS**

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials*.

**20040000304** California Univ., Berkeley, CA

**Amphiphilic Linear-branched Copolymers and Their Fluorinated Dendritic Analogs**

Yu, Dong; Frechet, Jean M.; Jan. 1996; 3 pp.; In English

Contract(s)/Grant(s): DAAG55-97-1-0126

Report No.(s): AD-A418460; ARO-37254.92-CH-MUR; No Copyright; Avail: CASI; [A01](#), Hardcopy

Copolymers of PEG and analogs of second generation dendrimer have been synthesized and characterized. Normal polyether dendrimers can be replaced by other branched structures with similar physical properties. Incorporation of fluorinated chains enhance the hydrophobicity of the dendrimer. Attachment of long alkyl chains to dendrimers to achieve the

same goal is under investigation and applications of the amphiphilic copolymers are being explored.

DTIC

*Copolymers; Fluorination; Dendrimers*

**2004000868** NASA Glenn Research Center, Cleveland, OH, USA

**Measurements of Erosion Wear Volume Loss on Bare and Coated Polymer Matrix Composites**

Miyoshi, Kazuhisa; Sutter, James K.; Mondry, Richard J.; Bowman, Cheryl; Ma, Kong; Horan, Richard A.; Naik, Subhash K.; Cupp, Randall J.; September 2003; 22 pp.; In English; 28th Annual International Conference and Exposition on Advanced Ceramics and Composites, 25-30 Jan. 2004, Cocoa Beach, FL, USA

Contract(s)/Grant(s): WBS 22-708-31-14

Report No.(s): NASA/TM-2003-212628; E-14047-1; NAS 1.15:212628; No Copyright; Avail: CASI; [A03](#), Hardcopy

An investigation was conducted to examine the erosion behavior of uncoated and coated polymer matrix composite (PMC) specimens subjected to solid particle impingement using air jets. The PMCs were carbon-Kevlar (DuPont, Wilmington, DE) fiber-epoxy resin composites with a temperature capability up to 393 K (248 F). Tungsten carbide-cobalt (WC-Co) was the primary topcoat constituent. Bondcoats were applied to the PMC substrates to improve coating adhesion; then, erosion testing was performed at the University of Cincinnati. All erosion tests were conducted with Arizona road-dust (ARD), impinging at angles of 20 and 90 on both uncoated and two-layer coated PMCs at a velocity of 229 m/s and at a temperature of 366 K (200 F). ARD contains primarily 10- $\mu$ m aluminum oxide powders. Vertically scanning interference microscopy (noncontact, optical profilometry) was used to evaluate surface characteristics, such as erosion wear volume loss and depth, surface topography, and surface roughness. The results indicate that noncontact, optical interferometry can be used to make an accurate determination of the erosion wear volume loss of PMCs with multilayered structures while preserving the specimens. The two-layered (WC-Co topcoat and metal bondcoat) coatings on PMCs remarkably reduced the erosion volume loss by a factor of approximately 10. The tenfold increase in erosion resistance will contribute to longer PMC component lives, lower air friction, reduced related breakdowns, decreased maintenance costs, and increased PMC reliability. The decrease in the surface roughness of the coated vanes will lead to lower air friction and will subsequently reduce energy consumption. Eventually, the coatings could lead to overall economic savings.

Author

*Air Jets; Coatings; Erosion; Polymer Matrix Composites; Wear; Measuring Instruments; Interferometry*

**2004000970** Wisconsin Univ., Platteville, WI, USA

**Development of Probabilistic Life Prediction Methodologies and Testing Strategies for MEMS**

Jadaan, Osama M.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 18-20; In English; See also 2004000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

This effort is to investigate probabilistic life prediction methodologies for MicroElectroMechanical Systems (MEMS) and to analyze designs that determine stochastic properties of MEMS. This includes completion of a literature survey regarding Weibull size effect in MEMS and strength testing techniques. Also of interest is the design of a proper test for the Weibull size effect in tensile specimens. The Weibull size effect is a consequence of a stochastic strength response predicted from the Weibull distribution. Confirming that MEMS strength is controlled by the Weibull distribution will enable the development of a probabilistic design methodology for MEMS - similar to the GRC developed CARES/Life program for bulk ceramics. Another potential item of interest is analysis and modeling of material interfaces for strength as well as developing a strategy to handle stress singularities at sharp corners, fillets, and material interfaces. The ultimate objective of this effort is to further develop and verify the ability of the Ceramics Analysis and Reliability Evaluation of Structuredlife (CARES/Life) code to predict the time-dependent reliability of MEMS structures subjected to multiple transient loads. Along these lines work may also be performed on transient fatigue life prediction methodologies.

Author

*Microelectromechanical Systems; Life (Durability); Prediction Analysis Techniques*

## 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*.

**20040001757** NASA Langley Research Center, Hampton, VA, USA

### **Coherent Anti-Stokes Raman Scattering (CARS) as a Probe for Supersonic Hydrogen-Fuel/Air Mixing**

Danehy, P. M.; O'Byrne, S.; Cutler, A. D.; Rodriguez, C. G.; [2003]; 21 pp.; In English

Contract(s)/Grant(s): RTOP 713-10-66-01; Copyright; Avail: CASI; [A03](#), Hardcopy

The dual-pump coherent anti-Stokes Raman spectroscopy (CARS) method was used to measure temperature and the absolute mole fractions of N<sub>2</sub>, O<sub>2</sub> and H<sub>2</sub> in a supersonic non-reacting fuel-air mixing experiment. Experiments were conducted in NASA Langley Research Center's Direct Connect Supersonic Combustion Test Facility. Under normal operation of this facility, hydrogen and air burn to increase the enthalpy of the test gas and O<sub>2</sub> is added to simulate air. This gas is expanded through a Mach 2 nozzle and into a combustor model where fuel is then injected, mixes and burns. In the present experiment the O<sub>2</sub> of the test gas is replaced by N<sub>2</sub>. The lack of oxidizer inhibited combustion of the injected H<sub>2</sub> fuel jet allowing the fuel/air mixing process to be studied. CARS measurements were performed 427 mm downstream of the nozzle exit and 260 mm downstream of the fuel injector. Maps were obtained of the mean temperature, as well as the N<sub>2</sub>, O<sub>2</sub> and H<sub>2</sub> mean mole fraction fields. A map of mean H<sub>2</sub>O vapor mole fraction was also inferred from these measurements. Correlations between different measured parameters and their fluctuations are presented. The CARS measurements are compared with a preliminary computational prediction of the flow.

Author

*Raman Spectroscopy; Supersonic Combustion; Test Facilities; Hydrogen Fuels; Gas Mixtures; Coherent Scattering; Computational Fluid Dynamics; Air Flow*

## SPACE PROCESSING

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

**20040000164** NASA Glenn Research Center, Cleveland, OH, USA

### **Bubble Experiments on the Hydrodynamic Focusing Bioreactor-Space (HFB-S)**

Niederhaus, Charles; Nahra, Henry; Gonda, Steve; Lupo, Pamela; Kleis, Stanley; Geffert, Sandra; Kizito, John; Robinson, Stewart; July 21, 2002; 1 pp.; In English; Gordon Conference on Gravitational Effects on Physico-Chemical Systems, 27 Jul. - 1 Aug. 2003, New London, CT, USA

Contract(s)/Grant(s): RTOP 101-51-11; No Copyright; Avail: CASI; [A01](#), Hardcopy

The Hydrodynamic Focusing Bioreactor-Space (HFB-S) is being developed as a drop-in replacement for the Rotating Wall Perfused Vessel (RWPV) bioreactor currently planned for use on the International Space Station (ISS). Only the vessel itself is proposed for change, the supporting hardware will remain the same. These bioreactors are used for the growth of three-dimensional tissue culture that cannot be done in normal gravity labs. The bioreactors provide a continual supply of oxygen for cell growth, as well as periodic replacement of cell culture media with nutrients. The RWPV has had many successful flights on the space shuttle, but longer duration missions onboard the Mir Space Station resulted in bubbles inside the vessel that were detrimental to the science. It is believed that procedural changes can prevent bubble formation, but the HFB-S must not only provide a mechanism of bubble removal, but must also meet strict requirements for a low-shear environment and uniform oxygen concentration distribution for optimum cell tissue growth. A detailed technical objective (DTO) flight on the space shuttle to fully evaluate the HFB-S is currently in the planning stages. Ground-based activities are also underway to quantify the characteristics of the HFB-S. Computational studies are being used to predict the internal fluid flow and cell trajectories. These computations will be compared to ground-based flow visualization experiments. Comparative studies of ground-based cell growth between the RWPV and the HFB-S are also in progress. These studies have shown that the HFB-S functions well as a bioreactor in normal gravity. Bubble motion and bubble removal are being studied using computational predictions as well as experimental validation.

Derived from text

*Bioreactors; Bubbles; Hydrodynamics; Microgravity*

**20040000941** NASA Glenn Research Center, Cleveland, OH, USA

**A Treatment of Measurements of Heptane Droplet Combustion Aboard MSL-1**

Ackerman, M. D.; Colantonio, R. O.; Crouch, R. K.; Dryer, F. L.; Haggard, J. B.; Linteris, G. T.; Marchese, A. J.; Nayagam, V.; Voss, J. E.; Williams, F. A., et al.; October 2003; 49 pp.; In English; Original contains color illustrations  
Contract(s)/Grant(s): WBS 22-101-42-02

Report No.(s): NASA/TM-2003-212553; E-14119; Copyright; Avail: CASI; [A03](#), Hardcopy

Results of measurements on the burning of free n-heptane droplets (that is, droplets without fiber supports) performed in Spacelab during the flights of the first Microgravity Science Laboratory (MSL-1) are presented. The droplet combustion occurred in oxidizing atmospheres which were at an ambient temperature within a few degrees of 300 K. A total of 34 droplets were burned in helium-oxygen atmospheres having oxygen mole fractions ranging from 20 to 50 percent, at pressures from 0.25 to 1.00 bar. In addition, four droplets were burned in air at 1.00 bar, bringing the total number of droplets for which combustion data were secured to 38; two of these four air tests were fiber-supported to facilitate comparisons with other fiber-support experiments, results of which also are given here. Initial diameters of free droplets ranged from about 1 to 4 mm. The primary data obtained were histories of droplet diameters, recorded in backlight on 35 mm film at 80 frames per second, and histories of flame diameters, inferred from emissions through a narrow-band interference filter centered at the 310 micron OH chemiluminescent ultraviolet band, recorded at 30 frames per second by a intensified-array camera. These data are reported here both in raw form and in a smoothed form with estimated error bars. In addition, summaries are presented of measured burning-rate constants, final droplet diameters, and final flame diameters. Both diffusive and radiative extinctions were exhibited under different conditions. Although some interpretations are reported and conclusions drawn concerning the combustion mechanisms, the principal intent of this report is to provide a complete, documented data set for future analysis.

Author

*Heptanes; Drops (Liquids); Microgravity; Combustion Physics; Spaceborne Experiments*

**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*.

**20040000010** Case Western Reserve Univ., OH, USA

**2002 NASA Faculty Fellowship Program at Glenn Research Center**

Prahl, Joseph M.; Heyward, Ann O.; Montegani, Francis J.; [2003]; 102 pp.; In English  
Contract(s)/Grant(s): NCC3-978; No Copyright; Avail: CASI; [A06](#), Hardcopy

While several objectives are served with this program, the central mechanism involved is the conduct of research assignments by faculty in direct support of NASA programs. In general, the results of the research will be assimilated by NASA program managers into an overall effort and will ultimately find their way into the literature. Occasionally, specific assignments result directly in reports for publication or conference presentation. Taken as a body, the assignments represent a large intellectual contribution by the academic community to NASA programs. It is appropriate therefore to summarize the research that was accomplished. The remainder of this report consists of research summaries arranged alphabetically by participant name. For each summary, the faculty fellow is briefly identified and the assignment prepared by the GRC host organization is given. This is followed by a brief narrative, prepared by the fellow, of the research performed. Narratives provided by the accompanying students immediately follow the narratives of their professors.

Author

*NASA Programs; University Program; Students; Research*

**20040000484** NASA Glenn Research Center, Cleveland, OH, USA

**MEMS Stirling Cooler Development Update**

Moran, Matthew E.; Wesolek, Danielle; [2003]; 27 pp.; In English; IAPG Mechanical Working Group Meeting, 30 Apr. - 1 May 2003, Morgantown, WV, USA; Copyright; Avail: CASI; [A03](#), Hardcopy

This presentation provides an update on the effort to build and test a prototype unit of the patented MEMS Stirling cooler concept. A micro-scale regenerator has been fabricated by Polar Thermal Technologies and is currently being integrated into

a Stirling cycle simulator at Johns Hopkins University Applied Physics Laboratory. A discussion of the analysis, design, assembly, and test plans for the prototype will be presented.

Author

*Microelectromechanical Systems; Coolers*

## 32

### COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 *Space Communications, Spacecraft Communications, Command and Tracking*; for search and rescue, see 03 *Air Transportation and Safety*, and 16 *Space Transportation and Safety*.

**20040000327** Air Force Research Lab., Wright-Patterson AFB, OH

#### **Development and Testing of a Network-Centric, Multi-UAV Command and Control Scheme Using a Variable Autonomy Control System (VACS)**

Pineiro, Luis A.; Duggan, Dave; Oct. 2003; 9 pp.; In English; Original contains color illustrations

Report No.(s): AD-A418473; AFRL-VA-WP-TP-2003-339; No Copyright; Avail: CASI; [A02](#), Hardcopy

A simplified command and control scheme was developed to reduce the cost and complexity of managing and controlling UAVs using a Variable Autonomy Control System (VACS). VACS allows for autonomous route following capability while allowing dynamic real-time control to deviate from pre-planned routes. This degree of flexibility permits the accomplishment of a wide variety of tasks, while reducing human workload requirements significantly below that of existing UAV systems. A network-centric approach to communications facilitates simultaneous control of multiple UAVs from a single command and control station. The network-centric command and control scheme allows a single operator to effectively manage and employ multiple vehicles, as opposed to multiple operators per vehicle, thus reducing the need for large amounts of equipment and personnel. Furthermore, the VACS design facilitates manned and unmanned systems interoperability. This paper describes the system's architecture and design, as well as the system's capabilities, which were evaluated recently in a series of flight demonstrations.

DTIC

*Command and Control; Man Machine Systems; Network Control; Dynamic Control*

**20040000336** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Passive Tracking System and Method**

Arndt, G. Dickey, Inventor; Ngo, Phong H., Inventor; Chen, Henry A., Inventor; Phan, Chau T., Inventor; Bourgeois, Brian A., Inventor; Dusl, Jon, Inventor; Hill, Brent W., Inventor; September 09, 2003; 25 pp.; In English

Patent Info.: Filed 14 Nov. 2001; US-Patent-6,618,010; US-Patent-Appl-SN-994989; NASA-Case-MS-C-23193-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

Systems and methods are disclosed for passively determining the location of a moveable transmitter utilizing a pair of phase shifts at a receiver for extracting a direction vector from a receiver to the transmitter. In a preferred embodiment, a phase difference between the transmitter and receiver is extracted utilizing a noncoherent demodulator in the receiver. The receiver includes an antenna array with three antenna elements, which preferably are patch antenna elements spaced apart by one-half wavelength. Three receiver channels are preferably utilized for simultaneously processing the received signal from each of the three antenna elements. Multipath transmission paths for each of the three receiver channels are indexed so that comparisons of the same multipath component are made for each of the three receiver channels. The phase difference for each received signal is determined by comparing only the magnitudes of received and stored modulation signals to determine a winning modulation symbol.

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

*Transmitters; Antenna Arrays; Tracking (Position); Receivers*

**20040000763** Defence Science and Technology Organisation, Edinburgh, Australia

#### **The Radio Frequency Interference Detection Algorithms for the Jindalee Facility Alice Springs Passive Channel Evaluator**

Northey, Brett J.; Whitham, Philip S.; October 2003; 36 pp.; In English; Original contains color illustrations

Report No.(s): DSTO-TR-1505; DODA-AR-012-914; Copyright; Avail: Other Sources

To maximise target signal to noise ratio, the Jindalee Facility Alice Springs (JFAS) Over-the-Horizon Radar (OTHR)

requires frequency channels that are free from radio frequency interference (RFI). Prior to 2000, to achieve this objective the radar operators were reliant on Clear Channel Advice (CCA) which is derived primarily from the Frequency Management System's (FMS) Spectrum Monitor (SM). Due to limitations of the SM, the operators were forced to use an HF communications receiver to check CCA, which could be a time consuming and inaccurate process. As part of a major upgrade of the FMS in 1999, a Passive Channel Evaluator (PCE) subsystem was added to remove or reduce the need to use the communications receiver. This report contains a description of the signal processing algorithms used to determine if PCE data contains RFI and the results of testing these algorithms with the JFAS radar.

Author

*Radio Frequency Interference; Over-the-Horizon Radar; Frequency Measurement; Signal Processing; Algorithms*

**20040000771** NASA Langley Research Center, Hampton, VA, USA

**Low Cost Coherent Doppler Lidar Data Acquisition and Processing**

Barnes, Bruce W.; Koch, Grady J.; [2003]; 4 pp.; In English; 12th Coherent Laser Radar Conference, 16-21 Jun. 2003, Bar Harbor, ME, USA; Original contains color illustrations

Contract(s)/Grant(s): RTA 755-15-00; No Copyright; Avail: CASI; [A01](#), Hardcopy

The work described in this paper details the development of a low-cost, short-development time data acquisition and processing system for a coherent Doppler lidar. This was done using common laboratory equipment and a small software investment. This system provides near real-time wind profile measurements. Coding flexibility created a very useful test bed for new techniques.

Author

*Doppler Radar; Data Acquisition; Wind Profiles; Low Cost*

**20040000781** Analex Corp., Brook Park, OH, USA

**Measured Radiation Patterns of the Boeing 91-Element ICAPA Antenna With Comparison to Calculations**

Lambert, Kevin M.; Burke, Thomas, Technical Monitor; October 2003; 21 pp.; In English

Contract(s)/Grant(s): NAS3-01145; WBS 22-322-20-04

Report No.(s): NASA/CR-2003-212603; E-14161; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report presents measured antenna patterns of the Boeing 91-Element Integrated Circuit Active Phased Array (ICAPA) Antenna at 19.85 GHz. These patterns were taken in support of various communication experiments that were performed using the antenna as a testbed. The goal here is to establish a foundation of the performance of the antenna for the experiments. An independent variable used in the communication experiments was the scan angle of the antenna. Therefore, the results presented here are patterns as a function of scan angle, at the stated frequency. Only a limited number of scan angles could be measured. Therefore, a computer program was written to simulate the pattern performance of the antenna at any scan angle. This program can be used to facilitate further study of the antenna. The computed patterns from this program are compared to the measured patterns as a means of validating the model.

Author

*Antenna Arrays; Antenna Radiation Patterns*

**20040001419** NASA Langley Research Center, Hampton, VA, USA

**Investigations of Relatively Easy To Construct Antennas With Efficiency in Receiving Schumann Resonances: Preparations for a Miniaturized Reconfigurable ELF Receiver**

Farmer, Brian W.; Hannan, Robert C.; October 2003; 11 pp.; In English

Contract(s)/Grant(s): WU 23-781-20-13

Report No.(s): NASA/TM-2003-212647; L-18332; No Copyright; Avail: CASI; [A03](#), Hardcopy

Relatively little is known about the cavity between the Earth and the ionosphere, which opens opportunities for technological advances and unique ideas. One effective means to study this cavity is with extremely low frequency (ELF) antennas. Possible applications of these antennas are global weather prediction, earthquake prediction, planetary exploration, communication, wireless transmission of power, or even a free energy source. The superconducting quantum interference device (SQUID) and the coil antenna are the two most acceptable receivers discovered for picking up ELF magnetic fields. Both antennas have the potential for size reduction, allowing them to be portable enough for access to space and even for personal wear. With improvements of these antennas and signal processing, insightful analysis of Schumann resonance (SR)

can give the science community a band of radio frequency (RF) signals for improving life here on Earth and exploring beyond.  
Author  
*Earth Ionosphere; Antennas*

### 33

## ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment; and microelectronics and integrated circuitry. for related information see also *60 Computer Operations and Hardware*; and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar*.

**20040000128** Pennsylvania State Univ., University Park, PA

### **Photoelectron Spectrometer and Cluster Source for the Production and Analysis of Cluster Assembled Nanoscale Materials**

Castleman, A. W., Jr.; May 2003; 21 pp.; In English

Contract(s)/Grant(s): F49620-01-1-0380

Report No.(s): AD-A418392; No Copyright; Avail: CASI; **A03**, Hardcopy

The overall objective of our presently funded AFOSR program is to lay the scientific foundation for designing strategies to be employed for the formation of cluster assembled materials (CAMs) of nanoscale dimensions that possess selected properties. Studies thus far have yielded information on reactivity and are providing insight on methods of producing building blocks having the desired stoichiometry, size, and properties. Fundings from studies of relaxation dynamics are yielding insights into electronic characteristics which influence the properties of CAMs that may function as catalysts, or alternatively find application as new optical and electronic materials, or ones potentially useful as sensors.

DTIC

*Spectrometers; Photoelectrons; Clusters*

**20040000252** Naval Research Lab., Washington, DC

### **Ion and Electron Currents to Electrodes in Pulsed Electron Beam-Produced Plasmas**

Leonhardt, Darrin; Walton, Scott; Fernsler, Richard; Meger, Robert A.; Muratore, Chris; Nov. 7, 2003; 23 pp.; In English

Report No.(s): AD-A418436; NRL/MR/6750--03-8718; No Copyright; Avail: CASI; **A03**, Hardcopy

Electron and ion currents to various electrodes in pulsed, electron beam-produced plasmas were measured in a number of laboratory systems. These experiments showed variations in the measured currents that depended on gas type, cathode material, magnetic field geometry, and electrode impedance. Explanations of these observations are given on a per case basis, after a careful evaluation and comparison of all other experimental factors.

DTIC

*Electron Beams; Electrodes; Ion Currents*

**20040000275** NASA Langley Research Center, Hampton, VA, USA

### **Method of Fabricating a Piezoelectric Composite Apparatus**

Wilkie, W. Keats, Inventor; Bryant, Robert, Inventor; Fox, Robert L., Inventor; Hellbaum, Richard F., Inventor; High, James W., Inventor; Jalink, Antony, Jr., Inventor; Little, Bruce D., Inventor; Mirick, Paul H., Inventor; October 07, 2003; 14 pp.; In English

Patent Info.: Filed 29 Oct. 1999; US-Patent-6,629,341; US-Patent-Appl-SN-430677; NASA-Case-LAR-15816-1; No Copyright; Avail: CASI; **A03**, Hardcopy

A method for fabricating a piezoelectric macro-fiber composite actuator comprises providing a piezoelectric material that has two sides and attaching one side upon an adhesive backing sheet. The method further comprises slicing the piezoelectric material to provide a plurality of piezoelectric fibers in juxtaposition. A conductive film is then adhesively bonded to the other side of the piezoelectric material, and the adhesive backing sheet is removed. The conductive film has first and second conductive patterns formed thereon which are electrically isolated from one another and in electrical contact with the piezoelectric material. The first and second conductive patterns of the conductive film each have a plurality of electrodes to form a pattern of interdigitated electrodes. A second film is then bonded to the other side of the piezoelectric material. The second film may have a pair of conductive patterns similar to the conductive patterns of the first film.

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

*Piezoelectric Actuators; Fiber Composites; Fabrication*

**20040000321** Naval Academy, Annapolis, MD

**Thermophotovoltaic Emitter Material Selection and Design**

Saxton, Patrick C.; May 7, 1997; 114 pp.; In English

Report No.(s): AD-A418470; No Copyright; Avail: CASI; [A06](#), Hardcopy

Direct energy conversion is an attractive option for the Navy because it eliminates the need for complex machinery and reduces maintenance concerns by eliminating moving parts. Thermophotovoltaic (TPV) generators offer all of the advantages of direct energy conversion, and can be run from waste heat. Current TPV generators are either inefficient or impractical. The focus of this research is to further technical understanding of the material issues involved in designing a TPV generator. Much like a solar power system, TPV generators use photocells to collect radiant energy and produce electric power. In this system, radiation is collected from a high temperature emitter material which emits photons with a wide spectrum of energies, the peak in the spectrum being directly related to the material temperature. Current TPV cell technology dictates that the emitter material needs to withstand 1300 deg. C in a combustion gas atmosphere and achieve an emissivity of at least 0.90. Initial material screening included ceramics, refractories, metallics, and ceramic matrix composites. Candidate materials were selected based on available published data. Thermal shock and oxidation experiments were conducted, and materials were evaluated for emissivity in conjunction with NASA Lewis Research Center. Machinability, thermal conductivity, and thermal expansion properties were also considered. The most viable emitter candidates were determined to be C/SiC with a SiC overcoat and SiC/Si.

DTIC

*Electric Generators; Photovoltaic Effect; Thermodynamic Properties*

**20040000379** Universities Space Research Association, Huntsville, AL, USA

**Photoluminescence of CdTe Crystals Grown by Physical-Vapor Transport**

Palosz, W.; Graszka, K.; Boyd, P. R.; Cui, Y.; Wright, G.; Roy, U. N.; Burger, A.; Journal of Electronic Materials; 2003; Volume 32, No. 7, pp. 747-751; In English

Contract(s)/Grant(s): DE-FG08-98NV-13407; NCC8-133; NCC8-145; NCC5-286; DAAD19-02-1-0003; Copyright; Avail: Other Sources

High-quality CdTe crystals with resistivities higher than  $10(\exp 8)$   $\Omega$  cm were grown by the physical-vapor transport (PVT) technique. Indium, aluminum, and the transition-metal scandium were introduced at the nominal level of about 6 ppm to the source material. Low-temperature photoluminescence (PL) has been employed to identify the origins of PL emissions of the crystals. The emission peaks at 1.584 eV and 1.581 eV were found only in the In-doped crystal. The result suggests that the luminescence line at 1.584 eV is associated with Cd-vacancy/In complex. The intensity of the broadband centered at 1.43 eV decreases strongly with introduction of Sc.

Author

*Photoluminescence; Doped Crystals; Indium; Cadmium Tellurides*

**20040000791** NASA Glenn Research Center, Cleveland, OH, USA

**Advanced Electrical Materials and Component Development**

Schwarze, Gene E.; October 2003; 15 pp.; In English; First International Energy Conversion Engineering Conference, 17-21 Aug. 2003, Portsmouth, VA, USA

Contract(s)/Grant(s): WBS 22-755-12-12

Report No.(s): NASA/TM-2003-212614; E-14174; No Copyright; Avail: CASI; [A03](#), Hardcopy

The primary means to develop advanced electrical components is to develop new and improved materials for magnetic components (transformers, inductors, etc.), capacitors, and semiconductor switches and diodes. This paper will give a description and status of the internal and external research sponsored by NASA Glenn Research Center on soft magnetic materials, dielectric materials and capacitors, and high quality silicon carbide (SiC) atomically smooth substrates. The rationale for and the benefits of developing advanced electrical materials and components for the PMAD subsystem and also for the total power system will be briefly discussed.

Author

*Magnetic Materials; Dielectrics; Nanotechnology; Electric Power*

**20040000793** NASA Langley Research Center, Hampton, VA, USA

**Characterization of Effluents Given Off by Wiring Insulation**

Yost, William T.; Cramer, K. Elliott; Perey, Daniel F.; [2003]; 7 pp.; In English; 30th Annual Review of Progress in Quantitative Nondestructive Evaluation, 27 Jul. - 1 Aug. 2003, Green Bay, WI, USA

Contract(s)/Grant(s): 23-762-60-61; No Copyright; Avail: CASI; [A02](#), Hardcopy

When an insulated wire is heated, the insulation emits a variety of effluents. This paper discusses the basis of emissions of effluents from wiring insulation. Several species are emitted at relatively low temperatures, while others are emitted when the wire reaches higher temperatures. We isolate the emissions by relative molecular weight of the effluents and measure the effluent concentration both as a function of time (temperature held constant) and by wire temperature. We find that the Law of Mass Action describes and predicts the time-dependence of the emission of a specific effluent caused by the heating. The binding energy is determined by performing an Arrhenius Plot on the temperature data. These dependencies are discussed and working equations are derived. Data collected from 20 gauge wire (MIL-W-22759/11-20) is used to illustrate and confirm the validity of the theory.

Author

*Effluents; Insulation; Wiring; Time Temperature Parameter; Binding Energy*

**20040000962** Cleveland State Univ., Cleveland, OH, USA

### **Robust Synchronization Schemes for Dynamic Channel Environments**

Xiong, Fugin; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 44-46; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Professor Xiong will investigate robust synchronization schemes for dynamic channel environment. A sliding window will be investigated for symbol timing synchronizer and an open loop carrier estimator for carrier synchronization. Matlab/Simulink will be used for modeling and simulations.

Derived from text

*Synchronism; Channels (Data Transmission); Electrical Engineering; Robustness (Mathematics); Dynamic Control*

**20040001034** NASA Glenn Research Center, Cleveland, OH, USA

### **Electrical Devices and Circuits for Low Temperature Space Applications**

Patterson, R. L.; Hammond, A.; Dickman, J. E.; Gerber, S.; Overton, E.; Elbuluk, M.; October 2003; 10 pp.; In English; International Workshop on Thermal Detectors for Space Based Planetary, Solar and Earth Science Applications, 19-20 Jun. 2003, Adelphi, MD, USA

Contract(s)/Grant(s): WBS 22-297-60-17

Report No.(s): NASA/TM-2003-212600; E-14159; NAS 1.15:212600; No Copyright; Avail: CASI; [A02](#), Hardcopy

The environmental temperature in many NASA missions, such as deep space probes and outer planetary exploration, is significantly below the range for which conventional commercial-off-the-shelf electronics is designed. Presently, spacecraft operating in the cold environment of such deep space missions carry a large number of radioisotope or other heating units in order to maintain the surrounding temperature of the on-board electronics at approximately 20 C. Electronic devices and circuits capable of operation at cryogenic temperatures will not only tolerate the harsh environment of deep space but also will reduce system size and weight by eliminating or reducing the heating units and their associate structures; thereby reducing system development cost as well as launch costs. In addition, power electronic circuits designed for operation at low temperatures are expected to result in more efficient systems than those at room temperature. This improvement results from better behavior in the electrical and thermal properties of some semiconductor and dielectric materials at low temperatures. An on-going research and development program on low temperature electronics at the NASA Glenn Research Center focuses on the development of efficient electrical systems and circuits capable of surviving and exploiting the advantages of low temperature environments. An overview of the program will be presented in this paper. A description of the low temperature test facilities along with selected data obtained from in-house component testing will also be discussed. On-going research activities that are being performed in collaboration with various organizations will also be presented.

Author

*Circuits; Cryogenic Temperature; Aerospace Environments; NASA Space Programs; Electrical Properties; Electronics*

## 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*.

**20040000557** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

### **Computational Analysis of Cryogenic Flow Through a Control Valve**

Danes, Russell; Woods, Jody; Sulyma, Peter; June 25, 2003; 25 pp.; In English; Proceedings of FEDSM'03 4th ASME-JSME Joint Fluids Engineering Conference, 6-11 Jul. 2003, Honolulu, HI, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2003-06-00044-SSC; Copyright; Avail: CASI; **A03**, Hardcopy

The initial efforts to develop the capability to model valves used in rocket engine component testing at Stennis Space Center are documented. An axisymmetric model of a control valve with LN<sub>2</sub> as the working fluid was developed. The goal was to predict the effect of change in the plug/sear region of the valve prior to testing. The valve flow coefficient was predicted for a range of plug positions. Verification of the calculations was carried out to quantify the uncertainty in the numerical answer. The modeled results compared well qualitatively to experimental trends. Additionally, insights into the flow processes in the valve were obtained. Benefits from the verification process included the ability to use coarser grids and insight into ways to reduce computational time by using double precision accuracy and non-integer grid ratios. Future valve modeling activities will include shape optimization of the valve/seat region and dynamic grid modeling.

Author

*Control Valves; Cryogenics; Rocket Engines; Engine Tests; Computational Fluid Dynamics; Computational Grids; Mathematical Models*

**20040000604** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Modified Laser Flash Method for Thermal Properties Measurements and the Influence of Heat Convection**

Lin, Bochuan; Zhu, Shen; Ban, Heng; Li, Chao; Scripa, Rosalia N.; Su, Ching-Hua; Lehoczky, Sandor L.; [2003]; 1 pp.; In English; Proceedings of IMECE2003: 2003 ASME International Mechanical Engineering Congress and R&D EXPO, 15-21 Nov. 2003, Washington, DC, USA

Contract(s)/Grant(s): NAS8-02096; Copyright; Avail: Other Sources; Abstract Only

The study examined the effect of natural convection in applying the modified laser flash method to measure thermal properties of semiconductor melts. Common laser flash method uses a laser pulse to heat one side of a thin circular sample and measures the temperature response of the other side. Thermal diffusivity can be calculated based on a heat conduction analysis. For semiconductor melt, the sample is contained in a specially designed quartz cell with optical windows on both sides. When laser heats the vertical melt surface, the resulting natural convection can introduce errors in calculation based on heat conduction model alone. The effect of natural convection was studied by CFD simulations with experimental verification by temperature measurement. The CFD results indicated that natural convection would decrease the time needed for the rear side to reach its peak temperature, and also decrease the peak temperature slightly in our experimental configuration. Using the experimental data, the calculation using only heat conduction model resulted in a thermal diffusivity value is about 7.7% lower than that from the model with natural convection. Specific heat capacity was about the same, and the difference is within 1.6%, regardless of heat transfer models.

Author

*Computational Fluid Dynamics; Conductive Heat Transfer; Convective Heat Transfer; Semiconductors (Materials); Melts (Crystal Growth); Thermodynamic Properties*

**20040000620** Akron Univ., Akron, OH, USA

### **Numerical Simulation of Motion of HP/LP Assembly of Finger Seals and Design Considerations**

Braun, M. Jack; Pierson, Hazel M.; Kudriavtsev, V. V.; Choy, Fred K.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 171-225; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; **A04**, Hardcopy

The work concerns the development of the Finger Seal concept and design criteria that ensure finger aerodynamic lifting, while maintaining seal integrity. The FS is a compliant passive-adaptive seal meant to mitigate (and eventually replace) the

shortcomings of the entire class of rigid seals used today (labyrinth, honeycomb, mechanical face seals) in the gas turbines and compressors.

Author

*Three Dimensional Models; Hydrodynamics; Seals (Stoppers); Fabrication; Numerical Analysis; Computerized Simulation*

**20040000689** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Origin of Stability in Sedimentation**

Segre, P. N.; [2003]; 1 pp.; In English; Division of Fluid Dynamics 56th Annual Meeting, 23-25 Sep.2003, Rutherford, NJ, USA; No Copyright; Avail: Other Sources; Abstract Only

Velocity fluctuations and particle concentrations are studied in a liquid fluidized bed to investigate the origin of steady state sedimentation. Both the velocity fluctuations and the particle concentrations are found to strongly depend on height. A flux balance model shows why the bed is stable: velocity fluctuations drive a downward particle flux that is compensated by an upward particle flux stemming from an excess flow velocity due to the stratification in concentration. Our results show that in steady state the magnitudes of the fluctuations are related to the degree of stratification.

Author

*Sediments; Steady State; Stratification; Flow Velocity; Stability*

**20040000800** NASA Langley Research Center, Hampton, VA, USA

**N<sub>2</sub>/O<sub>2</sub>/H<sub>2</sub> Dual-Pump Cars: Validation Experiments**

OByrne, S.; Danehy, P. M.; Cutler, A. D.; [2003]; 9 pp.; In English; 20th International Congress on Instrumentation in Aerospace Facilities, 25-29 Aug. 2003, Goettingen, Germany

Contract(s)/Grant(s): RTA 713-10-66-01; Copyright; Avail: CASI; [A02](#), Hardcopy

The dual-pump coherent anti-Stokes Raman spectroscopy (CARS) method is used to measure temperature and the relative species densities of N<sub>2</sub>, O<sub>2</sub> and H<sub>2</sub> in two experiments. Average values and root-mean-square (RMS) deviations are determined. Mean temperature measurements in a furnace containing air between 300 and 1800 K agreed with thermocouple measurements within 26 K on average, while mean mole fractions agree to within 1.6 % of the expected value. The temperature measurement standard deviation averaged 64 K while the standard deviation of the species mole fractions averaged 7.8% for O<sub>2</sub> and 3.8% for N<sub>2</sub>, based on 200 single-shot measurements. Preliminary measurements have also been performed in a flat-flame burner for fuel-lean and fuel-rich flames. Temperature standard deviations of 77 K were measured, and the ratios of H<sub>2</sub> to N<sub>2</sub> and O<sub>2</sub> to N<sub>2</sub> respectively had standard deviations from the mean value of 12.3% and 10% of the measured ratio.

Author

*Hydrogen; Nitrogen; Oxygen; Root-Mean-Square Errors; Temperature Measurement; Raman Spectroscopy*

**20040000961** Brown Univ., MA, USA

**Active Control of Jets in Cross-Flow for Film Cooling Applications**

Nikitopoulos, Dimitris E.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 26-28; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Jets in cross-flow have applications in film cooling of gas turbine vanes, blades and combustor liners. Their cooling effectiveness depends on the extent to which the cool jet-fluid adheres to the cooled component surface. Lift-off of the cooling jet flow or other mechanisms promoting mixing, cause loss of cooling effectiveness as they allow the hot 'free-stream' fluid to come in contact with the component surface. The premise of this project is that cooling effectiveness can be improved by actively controlling (e.g. forcing, pulsing) the jet flow. Active control can be applied to prevent/delay lift-off and suppress mixing. Furthermore, an actively controlled film-cooling system coupled with appropriate sensory input (e.g. temperature or heat flux) can adapt to spatial and temporal variations of the hot-gas path. Thus, it is conceivable that the efficiency of film-cooling systems can be improved, resulting in coolant fluid economy. It is envisioned that Micro Electro-Mechanical Systems (MEMS) will play a role in the realization of such systems. As a first step, a feasibility study will be conducted to evaluate the concept, identify actuation and sensory elements and develop a control strategy. Part of this study will be the design of a proof-of-concept experiment and collection of necessary data.

Author

*Jet Flow; Jet Control; Gas Turbine Engines*

**20040001046** NASA Glenn Research Center, Cleveland, OH, USA

**Suppression of Buoyancy in Gaseous Media at High Temperatures**

Gokoglu, Suleyman A.; Kuczmarski, Maria A.; November 2003; 15 pp.; In English; Fourth International Symposium on Scale Modeling, 17-19 Sep. 2003, Cleveland, OH, USA

Contract(s)/Grant(s): WBS 22-101-42-09

Report No.(s): NASA/TM-2003-212695; E-14197; NAS 1.15:212695; No Copyright; Avail: CASI; [A03](#), Hardcopy

Consider a rectangular box filled with a fluid having a heated bottom and a cold top surface, and insulated side-walls (Benard problem). As the temperature difference between the horizontal top and bottom surfaces increases, a critical condition, defined quantitatively by the Rayleigh number, is reached beyond which density stratification can no longer be sustained by conduction and the fluid disrupts from its stable, quiescent state into an unstable, convective mode in which lighter and heavier gas mix. This paper suggests that such a statement is not necessarily true for gaseous media under normalized temperature differences that are much larger than justifiable for the Boussinesq approximation! In fact, there may be situations where a system cannot ever be made unstable with respect to the onset on buoyant convection no matter how large the temperature (density) difference becomes at a given pressure even under normal gravity! This unexpected behavior is primarily attributed to highly temperature-sensitive kinematic viscosity which counteracts the tendency toward instability and dampens convection by making the gas more viscous at higher temperatures. This compensation of the buoyant force by the viscous force exhibits itself by the formation of a peak hot-surface temperature beyond which a system will tend to be more stable as the hot-surface temperature increases.

Author

*Buoyancy; Stability; Gases*

**20040001148** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA, NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Progress in Valve Modeling at Stennis Space Center**

Daines, Russell L.; Woods, Jody L.; Sulyma, Peter; December 04, 2003; 17 pp.; In English; 14th Annual Symposium on Propulsion, 10-11 Dec. 2002, State College, PA, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-12-00081-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

Understanding valve behavior will aid testing of rocket components at Stennis Space Center. The authors of this viewgraph presentation have developed a computational model for a cryogenic liquid control valve, and a gas pressure regulator valve. The model is a compressible/incompressible pressure-based FDNS code from Marshall Space Flight Center (MSFC). It is a k-epsilon turbulence model with wall functions.

CASI

*Computational Fluid Dynamics; K-Epsilon Turbulence Model; Valves; Flow Regulators; Pressure Regulators*

**20040001429** NASA Langley Research Center, Hampton, VA, USA

**Algorithmic Enhancements to the VULCAN Navier-Stokes Solver**

Litton, D. K.; Edwards, J. R.; White, J. A.; [2003]; 15 pp.; In English; 16th AIAA Computational Fluid Dynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA

Contract(s)/Grant(s): NAG1-02052

Report No.(s): AIAA Paper 2003-3979; Copyright; Avail: CASI; [A03](#), Hardcopy

VULCAN (Viscous Upwind aLgorithm for Complex flow ANalysis) is a cell centered, finite volume code used to solve high speed flows related to hypersonic vehicles. Two algorithms are presented for expanding the range of applications of the current Navier-Stokes solver implemented in VULCAN. The first addition is a highly implicit approach that uses subiterations to enhance block to block connectivity between adjacent subdomains. The addition of this scheme allows more efficient solution of viscous flows on highly-stretched meshes. The second algorithm addresses the shortcomings associated with density-based schemes by the addition of a time-derivative preconditioning strategy. High speed, compressible flows are typically solved with density based schemes, which show a high level of degradation in accuracy and convergence at low Mach numbers ( $M$  less than or equal to 0.1). With the addition of preconditioning and associated modifications to the numerical discretization scheme, the eigenvalues will scale with the local velocity, and the above problems will be eliminated. With these additions, VULCAN now has improved convergence behavior for multi-block, highly-stretched meshes and also can solve the Navier-Stokes equations for very low Mach numbers.

Author

*Algorithms; Navier-Stokes Equation; Viscous Flow; Discretization (Mathematics); Upwind Schemes (Mathematics)*

**20040001712** NASA Marshall Space Flight Center, Huntsville, AL, USA, Universities Space Research Association, Huntsville, AL, USA

**Stability Analysis of Flow Induced by the Traveling Magnetic Field**

Mazuruk, Konstantin; [2003]; 1 pp.; In English; Microgravity Transport Processes in Fluid, Thermal, Biological and Materials Sciences Conference III, 14-19 Sep. 2003, Davos, Switzerland

Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Other Sources; Abstract Only

Re-circulating flow in molten metal columns can be conveniently induced by the axisymmetric traveling magnetic field. A number of applications can benefit from this technique, such as mixing under microgravity environment, or crystal growth from metallic melts. For small magnetic field excitations, the flow is laminar and stationary. As the imposed field increases, a more complex flow will set up in the cylindrical column. Conditions for stable laminar flow are of importance for practical applications. In this work, a linear stability analysis is performed in order to determine the onset of the bifurcation in the system. Here the analysis is restricted to the axisymmetric modes and the low-frequency regime.

Author

*Stability Tests; Flow Characteristics; Magnetic Fields; Melts (Crystal Growth)*

**20040001721** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Design Development Analyses in Support of a Heatpipe-Brayton Cycle Heat Exchanger**

Steeve, Brian; VanDyke, Melissa; Majumdar, Alok; Nguyen, Dalton; Corley, Melissa; Guffee, Ray M.; Kapernick, Richard J.; [2003]; 1 pp.; In English; Space Technology and Applications International Forum, 2-5 Feb. 2003, Albuquerque, NM, USA; No Copyright; Avail: Other Sources; Abstract Only

One of the power systems under consideration for nuclear electric propulsion or as a planetary surface power source is a heatpipe-cooled reactor coupled to a Brayton cycle. In this system, power is transferred from the heatpipes to the Brayton gas via a heat exchanger attached to the heatpipes. This paper discusses the fluid, thermal and structural analyses that were performed in support of the design of the heat exchanger to be tested in the SAFE-100 experimental program at Marshall Space Flight Center. A companion paper, 'Mechanical Design and Fabrication of a SAFE-100 Heat Exchanger for use in NASA's Advanced Propulsion Thermal-hydraulic Simulator', presents the fabrication issues and prototyping studies that, together with these analyses, led to the development of this heat exchanger. An important consideration throughout the design development of the heat exchanger was its capability to be utilized for higher power and temperature applications. This paper also discusses this aspect of the design and presents designs for specific applications that are under consideration.

Author

*Design Analysis; Fabrication; Heat Exchangers; Brayton Cycle*

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### 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*.

**20030053086** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Video Image Stabilization and Registration**

Hathaway, David H., Inventor; Meyer, Paul J., Inventor; May 06, 2003; 13 pp.; In English

Patent Info.: Filed May 10, 2002; US-Patent-6,560,375; US-Patent-Appl-SN-143539; US-Patent-Appl-SN-364919; US-Patent-Appl-SN-099056; NASA-Case-MFS-31243-2-CON; No Copyright; Avail: CASI; A03, Hardcopy

A method of stabilizing and registering a video image in multiple video fields of a video sequence provides accurate determination of the image change in magnification, rotation and translation between video fields, so that the video fields may be accurately corrected for these changes in the image in the video sequence. In a described embodiment, a key area of a key video field is selected which contains an image which it is desired to stabilize in a video sequence. The key area is subdivided into nested pixel blocks and the translation of each of the pixel blocks from the key video field to a new video field is determined as a precursor to determining change in magnification, rotation and translation of the image from the key video field to the new video field.

Author

*Image Motion Compensation; Pattern Registration; Image Rotation; Magnification; Video Data; Field of View*

**2004000044** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Experimental Evaluation of White Light Fabry-Perot Interferometry Fiber-Optic Strain Gages when Measuring Small Strains**

St.Cyr, William; Figueroa, Fernando; VanDyke, David; McVay, Greg; Mitchell, Mark; January 10, 2002; 17 pp.; In English  
Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-01-00001-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

An experimental study was conducted to evaluate whether fiber optic strain gages (FOSG) are 'better' sensors than typical foil gages. A particularly attractive feature of FOSG was their specified resolution of 0.01% of full-scale (0.1 micro strain for 1000 micro strain full-scale). This feature would make FOSG practical tank level sensors, by measuring very small strains on the support structure of a tank. A specific application in mind was to measure liquid oxygen tank level, with support beams that were predicted to contract approximately 11 micro strain as the tank goes from empty to full. Among various fiber optic technologies currently available, Fabry-Perot Interferometry using white light was selected. This technology exhibits highly desirable feature such as absolute strain measurement, linearity over its full-scale, and temperature compensation. However, experiment results suggest that the resolution is 0.8 micro strain, at best, calibration from one sensor to another can be off by 2.4 - 11.2%, and that temperature compensation is not fully predictable, with errors of up to 3.5 micro strain over an 11C range. Hence, when compared with classic foil gages, FOSG possess less accuracy, similar resolution and repeatability (precision), and superior linearity over their entire operating range. They are immune to EMI and their signals suffer minimal degradation over long distances. It is also expected that drift with time will be minimal in FOSG whereas the gage factor of foil sensors changes over time when exposed to varying environmental conditions. In conclusion, FOSG are 'better' than foil gages as long as the application allows calibration of individual units as installed for operation.

Author

*Experimentation; Evaluation; Fabry-Perot Interferometers; Fiber Optics; Strain Measurement*

**2004000083** Raytheon Information Technology and Scientific Services, Wallops Island, VA, USA

**GEOSAT Follow-On (GFO) Altimeter Document Series, Volume 5, Version 1**

Lockwood, Dennis W.; Conger, A. M.; August 2003; 210 pp.; In English

Contract(s)/Grant(s): NAS5-00181

Report No.(s): NASA/TM-2003-212236/VOL5/VER1; Rept-2003-03167-0/VOL5/VER1; No Copyright; Avail: CASI; [A10](#), Hardcopy

This document is a compendium of the WFF GFO Software Development Team's knowledge regarding of GDO CAL/VAL Data. It includes many elements of a requirements document, a software specification document, a software design document, and a user's guide. In the more technical sections, this document assumes the reader is familiar with GFO and its CAL/VAL Data.

Author

*Geosat Satellites; Software Engineering; Program Verification (Computers); Calibrating; Satellite Altimetry*

**20040000100** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Total Ozone from the Ozone Monitoring System (OMI) using TOMS and DOAS Methods**

Veefkind, J. P.; Bhartia, P. K.; Gleason, J.; deHaan, J. F.; Wellemeyer, C.; Levelt, P. F.; [2003]; 1 pp.; In English; EGS-AGU-EUG Joint Assembly 2003, 7-11 Apr. 2003, Nice, France; No Copyright; Avail: Other Sources; Abstract Only

The Ozone Monitoring Instrument (OMI) is the Dutch-Finnish contribution to NASA's EOS-Aura satellite scheduled for launch in January 2004. OMI is an imaging spectrometer that will measure the back-scattered Solar radiance in the wavelength range of 270 to 500 nm. The instrument provides near global coverage in one day with a spatial resolution of 13x24 square kilometers. OMI is a new instrument, with a heritage from TOMS, SBW, GOME, GOMOS and SCIAMACHY. OMI'S unique capabilities for measuring important trace gases and aerosols with a small footprint and daily global coverage, in conjunction with the other Aura instruments, will make a major contribution to our understanding of stratospheric and tropospheric chemistry and climate change. OMI will provide data continuity with the 23-year ozone record of TOMS. There are three ozone products planned for OMI: total column ozone, ozone profile and tropospheric column ozone. We are developing two different algorithms for total column ozone: one similar to the algorithm currently being used to process the TOMS data, and the other an improved version of the differential optical absorption spectroscopy (DOAS) method, which has been applied to GOME and SCIAMACHY data. The main reasons for starting with two algorithms for total ozone have to do with heritage and past experience; our long-term goal is to combine the two to develop a more accurate and reliable total ozone product for OMI. We will compare the performance of these two algorithms by applying both of them to the GOME data. We will examine

where and how the results differ, and use the extensive TOMS-Dobson comparison studies to assess the performance of the DOAS algorithm.

Author

*Imaging Spectrometers; Total Ozone Mapping Spectrometer; Algorithms; NASA Space Programs; Data Acquisition*

**20040000136** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Near-Real-Time Detection and Monitoring of Dust Events by Satellite (SeaWiFS, MODIS, and TOMS)**

Hsu, N. Christina; Tsay, Si-Chee; Herman, Jay R.; Kaufman, Yoram; [2002]; 1 pp.; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Over the last few years satellites have given us increasingly detailed information on the size, location, and duration of dust events around the world. These data not only provide valuable feedback to the modelling community as to the fidelity of their aerosol models but are also finding increasing use in near real-time applications. In particular, the ability to locate and track the development of aerosol dust clouds on a near real-time basis is being used by scientists and government to provide warning of air pollution episodes over major urban area. This ability has also become a crucial component of recent coordinated campaigns to study the characteristics of tropospheric aerosols such as dust and their effect on climate. One such recent campaign was ACE-Asia, which was designed to obtain the comprehensive set of ground, aircraft, and satellite data necessary to provide a detailed understanding of atmospheric aerosol particles over the Asian-Pacific region. As part of ACE-Asia, we developed a near real-time data processing and access system to provide satellite data from the polar-orbiting instruments Earth Probe TOMS (in the form of absorbing aerosol index) and SeaWiFS (in the form of aerosol optical thickness, AOT, and Angstrom exponent). The results were available via web access. The location and movement information provided by these data were used both in support of the day-to-day flight planning of ACE-Asia and as input into aerosol transport models. While near real-time SeaWiFS data processing can be performed using either the normal global data product or data obtained via direct broadcast to receiving stations close to the area of interest, near real-time MODIS processing of data to provide aerosol retrievals is currently only available using its direct broadcast capability. In this paper, we will briefly discuss the algorithms used to generate these data. The retrieved aerosol optical thickness and Angstrom exponent from SeaWiFS will be compared with those obtained from various AERONET sites over the Asian-Pacific region. The TOMS aerosol index will also be compared with AERONET aerosol optical thickness over different aerosol conditions, and comparisons between the MODIS and SeaWiFS data will also be presented. Finally, we will discuss the climate implication of our studies using the combined satellite and AERONET observations.

Author

*Real Time Operation; Sea-Viewing Wide Field-of-View Sensor; Total Ozone Mapping Spectrometer; MODIS (Radiometry); Detection; Dust Storms*

**20040000189** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**New Results from Space and Field Observations on the Aerosol Direct and Indirect Radiative Forcing**

Kaufman, Yoram J.; Remer, Lorraine; Tanre, Didier; Boucher, Olivier; Chin, Mian; Dubovik, Oleg; Holben, Brent; [2002]; 1 pp.; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

New space observations from the MODIS instrument on board the Terra satellite and analysis of POLDER data flown on the ADEOS satellite, show in great details the spatial and seasonal variability of the global aerosol system. These spaceborne instruments distinguish fine aerosol from man-made regional pollution and biomass burning from mostly natural coarse dust and sea salt aerosol. E.g. fine regional pollution in and around the Indian sub-continent, Europe and North America; smoke from biomass burning in Southern Africa and Southern America; coarse dust from West Africa and mixed dust pollution and smoke from West and central Africa and East Asia. These regions were also studied extensively in focused field experiments and by the distributed AERONET network. The results generate the first climatologies of the aerosol system, are used to derive the aerosol radiative effects and to estimate the anthropogenic component. The measurements are also used to evaluate each other and constrain aerosol transport models.

Author

*Aerosols; Climatology; Satellite Observation; Satellite Instruments*

**20040000286** Vanguard Research, Inc., Scotts Valley, CA, USA

**Irradiance Calibration of Space-Based Infrared Sensors**

Walker, Russell; Cohen, Martin; Jul. 1999; 28 pp.; In English

Contract(s)/Grant(s): F19628-98-C-0047; Proj-MSX8

Report No.(s): AD-A418443; AFRL-VS-TR-2000-1516; No Copyright; Avail: CASI; A03, Hardcopy

The purpose of this work is to develop a basis for irradiance calibration of space-based sensors. It is an extension of previous work that fully defines the context of calibration, and the concepts of spectral composites and templates. We discuss two areas of work carried out during the past year; our accomplishments and failures; and our plans for the future. The two areas are: 1) A description of the Celestial Background Experiment CBO6 2) Production of the preliminary Air Force Bright Spectral Catalog.

DTIC

*Infrared Detectors; Irradiance; Calibrating; Failure*

**20040000339** NASA Johnson Space Center, Houston, TX, USA

**Detector Apparatus and Method**

Arndt, G. Dickey, Inventor; Ngo, Phong H., Inventor; Carl, James R., Inventor; Byerly, Kent A., Inventor; Dusl, John, Inventor; May 06, 2003; 16 pp.; In English

Patent Info.: Filed 30 Oct. 2001; No Copyright; Avail: CASI; [A03](#), Hardcopy

Transceiver and methods are included that are especially suitable for detecting metallic materials, such as metallic mines, within an environment. The transceiver includes a digital waveform generator used to transmit a signal into the environment and a receiver that produces a digital received signal. A tracking module preferably compares an in-phase and quadrature transmitted signal with an in-phase and quadrature received signal to produce a spectral transfer function of the magnetic transceiver over a selected range of frequencies. The transceiver initially preferably creates a reference transfer function which is then stored in a memory. Subsequently measured transfer functions will vary depending on the presence of metal in the environment which was not in the environment when the reference transfer function was determined. The system may be utilized in the presence of other antennas, metal, and electronics which may comprise a plastic mine detector for detecting plastic mines. Despite the additional antennas and other metallic materials that may be in the environment due to the plastic mine detector, the magnetic transceiver remains highly sensitive to metallic material which may be located in various portions of the environment and which may be detected by sweeping the detector over ground that may contain metals or mines.

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

*Mine Detectors; Transmitter Receivers; Waveforms; Transfer Functions*

**20040000480** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Highlights of 10-Year Remote Sensing Industry Analysis**

Rabin, Ron; March 19, 2002; 62 pp.; In English; National States Geographic Information Council Mid-Year Conference, 22-24 Mar. 2002, Dallas, TX, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00025-SSC; No Copyright; Avail: CASI; [A04](#), Hardcopy

A background and highlights of a 10 year remote sensing industry analysis are provided. Included are the following: Training, educational analysis, staff levels, and end-users analysis, market drivers, market segments, application areas, spatial resolution needs, use of image types.

Derived from text

*Remote Sensing; Market Research*

**20040000525** NASA Stennis Space Center, Bay Saint Louis, MS, USA, Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**NASA IKONOS Multispectral Radiometric Calibration and 3-Year Temporal Stability Assessment**

Pagnutti, Mary; Carver, David; Holekamp, Kara; Ryan, Robert; Zononi, Vicki; Thome, Kurtis; Schiller, Stephen; Aaran, David; September 12, 2003; 4 pp.; In English; ISPRS Commission I/Working Group 2 International Workshop on Radiometric and Geometric Calibration, 2-5 Dec. 2003, Gulfport, MS, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2003-09-00085-SSC; Copyright; Avail: Other Sources; Abstract Only

Radiometric calibration of commercial imaging satellite products is required to ensure that science and application communities can place confidence in the imagery they use and can fully understand its properties. Inaccurate radiometric calibrations can lead to erroneous decisions and invalid conclusions and can limit intercomparisons with other system. In addition, the user community has little or no insight into the design and operation of commercial sensors or into the methods involved in generating commercial products. To address this calibration need, the NASA Stennis Space Center (SSC) Earth Science Applications (ESA) Directorate established a commercial satellite imaging radiometric calibration team consisting of

three independent groups: NASA, SSC,ESA, the University of Arizona Remote Sensing Group, and South Dakota State University. Each group determined the absolute radiometric calibration coefficients of the Space Imaging IKONOS 4-band, 4 m multispectral product covering the visible through near-infrared spectral region. For a three year period beginning in 2000, each team employed some variant of a reflectance-based vicarious calibration approach, requiring ground-based measurements coincident with IKONOS image acquisitions and radiative transfer calculations. Several study sites throughout the USA were employed that covered nearly the entire dynamic range of the IKONOS sensor. IKONOS at-sensor radiance values were compared to those estimated by each independent group to determine the IKONOS sensor's radiometric accuracy and stability. Over 10 individual vicariously determined at-sensor radiance estimates were used each year. When combined, these estimates provided a high-precision radiometric gain calibration coefficient. No significant calibration offset was observed. The results of this evaluation provide the scientific community with an independent assessment of the IKONOS sensor's absolute calibration and temporal stability over the 3-year period. While the techniques and method described in this paper reflect those developed at the NASA SSC, the results of the entire team are included.

Derived from text

*Calibrating; Imaging Techniques; Radiometers; Remote Sensing*

**20040000597** NASA Stennis Space Center, Bay Saint Louis, MS, USA, Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

#### **Methods for LWIR Radiometric Calibration and Characterization**

Ryan, Robert; Pagnutti, Mary; Zaroni, Vicki; Harrington, Gary; Howell, Dane; Stewart, Randy; October 18, 2002; 8 pp.; In English; 15th William T. Pecora Memorial Remote Sensing Symposium/Land Satellite Information IV Conference, 8-15 Nov. 2002, Denver, CO, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-10-00072-SSC; Copyright; Avail: CASI; [A02](#), Hardcopy

The utility of a thermal remote sensing system increases with its ability to retrieve surface temperature or radiance accurately. The radiometer measures the water surface radiant temperature. Combining these measurements with atmospheric pressure, temperature, and water vapor profiles, a top-of-the-atmosphere radiance estimate can be calculated with a radiative transfer code to compare to the sensor's output. A novel approach has been developed using an uncooled infrared camera mounted on a boom, to quantify buoy effects.

Author

*Radiometers; Water Temperature; Radiance*

**20040000598** Lockheed Martin Corp., Bay Saint Louis, MS, USA

#### **Nulling Infrared Radiometer for Measuring Temperature**

Ryan, Robert; May 02, 2002; 3 pp.; In English; Original contains color and black and white illustrations

Report No.(s): NASA/NP-2002-06-00025-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A nulling, self-calibrating infrared radiometer is being developed for use in noncontact measurement of temperature in any of a variety of industrial and scientific applications. This instrument is expected to be especially well-suited to measurement of ambient or near-ambient temperature and, even more specifically, for measuring the surface temperature of a natural body of water. Although this radiometer would utilize the long-wavelength infrared (LWIR) portion of the spectrum (wavelengths of 8 to 12  $\mu$ m), its basic principle of operation could also be applied to other spectral bands (corresponding to other temperature ranges) in which the atmosphere is transparent and in which design requirements for sensitivity and temperature-measurement accuracy could be satisfied.

Author

*Infrared Radiometers; Photometers; Temperature Measurement*

**20040000698** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Limited Angle Reconstruction Method for Reconstructing Terrestrial Plasmaspheric Densities from EUV Images**

Newman, Timothy; Santhanam, Naveen; Zhang, Huijuan; Gallagher, Dennis; [2003]; 1 pp.; In English; The Applied Information Systems Research Program (AISRP), 28-29 Oct. 2003, Pittsburgh, PA, USA; Copyright; Avail: Other Sources; Abstract Only

A new method for reconstructing the global 3D distribution of plasma densities in the plasmasphere from a limited number of 2D views is presented. The method is aimed at using data from the Extreme Ultra Violet (EUV) sensor on NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite. Physical properties of the plasmasphere are

exploited by the method to reduce the level of inaccuracy imposed by the limited number of views. The utility of the method is demonstrated on synthetic data.

Author

*Extreme Ultraviolet Radiation; Plasma Density; Auroras; Image Satellite*

**20040000731** NASA Stennis Space Center, Bay Saint Louis, MS, USA, Lockheed Martin Corp., Bay Saint Louis, MS, USA  
**Hyperspectral Thermal Fabry-Perot Modeling**

Ryan, Robert; Blonski, Slawomir; Zandoni, Vicki; Stanley, Tom; April 1, 1999; 2 pp.; In English; International Symposium on Spectral Sensing Research, 31 Oct. - 4 Nov. 1999, Las Vegas, NV, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2003-05-00035-SSC; Copyright; Avail: CASI; [A01](#), Hardcopy

Fabry-Perot interferometers are simple elegant, tunable filters that can be used to make compact hyperspectral thermal imaging systems. To foster the development of these sensors, software tools for the design and simulation of tunable Fabry-Perot infrared imagers have been developed. The tools are provided at three levels: basic, design, and system. Basic tools describe a nearly ideal Fabry-Perot filter with perfectly flat and parallel mirrors in collimated space. Design tools that take into account non-ideal behavior such as mirror and collimation defects calculate free spectral range, finesse, and spectral width of the interferometer. System tools help analyze an integration of the Fabry-Perot filter into a camera system. They include spectral convolution, first-order optical layout, and an estimation of signal-to-noise ratio. The complete set of tools allows for simulations of system operation and performance with various illumination sources. Spectral images generated in such simulations were used to examine applicability of Fabry-Perot systems in remote sensing of atmospheric gases including detection of environmental pollutants and hazardous gases. Different operating conditions and system configurations are presented.

Author

*Fabry-Perot Interferometers; Image Converters; Infrared Imagery; Thermal Mapping; Remote Sensing; Mirrors*

**20040000844** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Facility Monitoring: A Qualitative Theory for Sensor Fusion**

Figueroa, Fernando; August 07, 2001; 2 pp.; In English; 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 Jul. 2001, Salt Lake City, UT, USA

Report No.(s): NASA/SE-2000-12-00026-SSC; No Copyright; Avail: Other Sources; Abstract Only

Data fusion and sensor management approaches have largely been implemented with centralized and hierarchical architectures. Numerical and statistical methods are the most common data fusion methods found in these systems. Given the proliferation and low cost of processing power, there is now an emphasis on designing distributed and decentralized systems. These systems use analytical/quantitative techniques or qualitative reasoning methods for data fusion. Based on other work by the author, a sensor may be treated as a highly autonomous (decentralized) unit. Each highly autonomous sensor (HAS) is capable of extracting qualitative behaviors from its data. For example, it detects spikes, disturbances, noise levels, off-limit excursions, step changes, drift, and other typical measured trends. In this context, this paper describes a distributed sensor fusion paradigm and theory where each sensor in the system is a HAS. Hence, given the rich qualitative information from each HAS, a paradigm and formal definitions are given so that sensors and processes can reason and make decisions at the qualitative level. This approach to sensor fusion makes it possible the implementation of intuitive (effective) methods to monitor, diagnose, and compensate processes/systems and their sensors. This paradigm facilitates a balanced distribution of intelligence (code and/or hardware) to the sensor level, the process/system level, and a higher controller level. The primary application of interest is in intelligent health management of rocket engine test stands.

Author

*Management Methods; Numerical Analysis; Statistical Analysis; Multisensor Fusion*

**20040000886** NASA Glenn Research Center, Cleveland, OH, USA

**The Integration of Fieldbus Devices to an Existing DCS**

Sadhukhan, Debashis; Dunn, Craig M.; October 2003; 12 pp.; In English; ISA Expo 2003, 21-23 Oct. 2003, Houston, TX, USA

Report No.(s): NASA/TM-2003-212630; ETC03-P026; E-14192; Copyright; Avail: CASI; [A03](#), Hardcopy

Existing analog strain gauge transducers and signal conditioners were replaced with new Foundation Fieldbus Transmitters in the Distributed Control System, DCS, at the NASA Glenn Research Center (GRC). The reasons for

implementing this upgrade and an evaluation of the results of the project are the subjects of this paper. Problems and advantages with the original transducers and the newly installed transmitters are described and compared. Detail of the physical network layer between the Foundation Fieldbus Transmitters, Programmable Logic Controllers (PLCs), Multipurpose Micro-Processor (MMPs) and the operator workstations are illustrated. The complex nature of the facility and methods of future control of the associated processes are also discussed.

Author

*Systems Integration; Transmitters; Programmable Logic Devices; Control Systems Design*

**20040000975** Bucknell Univ., Lewisburg, PA, USA, NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Improved Prediction of Momentum and Scalar Fluxes Using MODIS Imagery**

Crago, Richard D.; Jasinski, Michael F.; November 8, 2003; 8 pp.; In English

Contract(s)/Grant(s): NAG5-8699; No Copyright; Avail: CASI; A02, Hardcopy

There are remote sensing and science objectives. The remote sensing objectives are: To develop and test a theoretical method for estimating local momentum aerodynamic roughness length,  $z(\text{sub } 0\text{m})$ , using satellite multispectral imagery. To adapt the method to the MODIS imagery. To develop a high-resolution (approx. 1km) gridded dataset of local momentum roughness for the continental USA and southern Canada, using MODIS imagery and other MODIS derived products. The science objective is: To determine the sensitivity of improved satellite-derived (MODIS-) estimates of surface roughness on the momentum and scalar fluxes, within the context of 3-D atmospheric modeling.

Derived from text

*Numerical Analysis; Imaging Spectrometers; Roughness; Estimating; Aerodynamic Characteristics; Three Dimensional Models*

**20040001403** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Extraction of Qualitative Features from Sensor Data Using Windowed Fourier Transform**

Amini, Abolfazl M.; Figueroa, Fenando; September 26, 2003; 2 pp.; In English; SPIE Defense and Security Symposium, 12-16 Apr. 2003, Orlando, FL, USA

Contract(s)/Grant(s): NAG13-98003

Report No.(s): SE-2003-08-00063-SSC; No Copyright; Avail: Other Sources; Abstract Only

In this paper, we use Matlab to model the health monitoring of a system through the information gathered from sensors. This implies assessment of the condition of the system components. Once a normal mode of operation is established any deviation from the normal behavior indicates a change. This change may be due to a malfunction of an element, a qualitative change, or a change due to a problem with another element in the network. For example, if one sensor indicates that the temperature in the tank has experienced a step change then a pressure sensor associated with the process in the tank should also experience a step change. The step up and step down as well as sensor disturbances are assumed to be exponential. An RC network is used to model the main process, which is step-up (charging), drift, and step-down (discharging). The sensor disturbances and spike are added while the system is in drift. The system is allowed to run for a period equal to three time constant of the main process before changes occur. Then each point of the signal is selected with a trailing data collected previously. Two trailing lengths of data are selected, one equal to two time constants of the main process and the other equal to two time constants of the sensor disturbance. Next, the DC is removed from each set of data and then the data are passed through a window followed by calculation of spectra for each set. In order to extract features the signal power, peak, and spectrum are plotted vs time. The results indicate distinct shapes corresponding to each process. The study is also carried out for a number of Gaussian distributed noisy cases.

Author

*Quality; Data Acquisition; Pressure Sensors*

**20040001411** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**In-Flight Edge Response Measurements for High Spatial Resolution Remote Sensing Systems**

Blonski, Slawomir; Pagnutti, Mary; Ryan, Robert; Zaroni, Vicki; December 03, 2001; 2 pp.; In English; International Society of Optical Engineering (SPIE) Conference, 7-11 Jul. 2002, Seattle, WA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2001-11-00066-SSC; No Copyright; Avail: Other Sources; Abstract Only

In-flight measurement of spatial resolution were conducted as part of the ASA Scientific Data Purchase (SDP) Validation and Verification (V&V) process. Characterization included remote sensing systems with ground sample distance (GSD) of 1

meter or less, such as the panchromatic imager on-board the ICONOS satellite and the airborne ADAR System 5500 multispectral instrument. Final image products were used to evaluate the effect of both the image acquisition system (e.g., optics, electronics, motion, jitter, atmosphere) and image post-processing (e.g., resampling, modulation transfer function (MTF) compensator). Spatial resolution was characterized by full width at half maximum (FWHM) of an edge response-derived line spread function. This was found to be a more robust measure of spatial resolution than the value of NTF at Nyquist frequency. The edge responses were analysed using the tilted-edge technique that overcomes the spatial sampling limitations of the digital imaging systems. As an enhancement to existing algorithms, the slope of the edge response and the orientation of the edge target were determined by a single computational process. Adjacent black and white square panels, either painted on a flat surface or deployed as traps, formed the ground-based edge targets used in the tests. Orientation of the deployable tarps was optimized beforehand, based on simulations of the imaging system. Numerous edge target images were analyzed for each of the tested sensors. The effect of such factors as acquisition geometry, temporal variability, MTF compensation, and GSD on spatial resolution were investigated.

Author

*Remote Sensing; High Resolution; Spatial Resolution; Modulation Transfer Function; In-Flight Monitoring*

**20040001643** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Analysis of Ceramic Color by Special Reflectance**

Giardino, Marco; Miller, Richard; Kuzio, Rachel; Muirhead, Dean; February 1998; 31 pp.; In English

Report No.(s): SE-1998-01-0004-SSC; Copyright; Avail: CASI; [A03](#), Hardcopy

Radiometric and visual techniques are compared as quantitative methods for determining pottery color. An analysis of fifty-two prehistoric sherds selected at random from a multicomponent site indicates that there is an increase in the accuracy and efficiency in determining color using a spectroradiometer over subjective visual observations. Further, radiometric data can be transformed to CIE chromacity coordinates and Munsell color from spectral reflectance curves and analysed directly to access quantitative accuracy.

Author

*Ceramics; Color*

**20040001648** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**CRSP Hyperspectral Stripe Array Targets: Preliminary Results and Analysis**

Terrie, Gregory; Jenner, Jeff; Tate, Steve; Muston, Shaun; Schaefer, Jason; Grant, Brennan; Sellers, Richard; February 16, 2000; 26 pp.; In English

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2000-02-00001-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

Objectives of this program: Assess the capability of a spaceborne hyperspectral sensor/algorithm system to perform target detection; Provide information to guide the design and construction of surrogate targets and stripe arrays; Target development cost of less than 50,000.

Derived from text

*Imaging Techniques; Resolution; Targets*

**20040001665** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Pressure-Application Device for Testing Pressure Sensors**

March 21, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2002-04-00017-SSC; NAS 1.83:04-00017-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A portable pressure-application device has been designed and built for use in testing and calibrating piezoelectric pressure transducers in the field. The device generates pressure pulses of known amplitude. A pressure pulse (in contradistinction to a steady pressure) is needed because in the presence of a steady pressure, the electrical output of a piezoelectric pressure transducer decays rapidly with time. The device includes a stainless- steel compressed-air-storage cylinder of 500 cu cm volume. A manual hand pump with check valves and a pressure gauge are located at one end of the cylinder. A three-way solenoid valve that controls the release of pressurized air is located at the other end of the cylinder. Power for the device is provided by a 3.7-V cordless-telephone battery. The valve is controlled by means of a pushbutton switch, which activates a 5 V to +/-15 V DC-to-DC converter that powers the solenoid. The outlet of the solenoid valve is connected to the pressure transducer to be tested. Before the solenoid is energized, the transducer to be tested is at atmospheric pressure. When the solenoid is actuated by the push button, pressurized air from inside the cylinder is applied to the transducer. Once the

pushbutton is released, the cylinder pressure is removed from the transducer and the pressurized air applied to the transducer is vented, bringing the transducer back to atmospheric pressure. Before this device was used for actual calibration, its accuracy was checked with a NIST (National Institute of Standards and Technology) traceable calibrator and commercially calibrated pressure transducers. This work was done by Wanda Solano of Stennis Space Center and Greg Richardson of Lockheed Martin Corp.

Author

*Test Equipment; Pressure Sensors; Calibrating; Piezoelectric Transducers*

**20040004033** Naval Postgraduate School, Monterey, CA

**Demonstration of a Near and Mid-Infrared Detector Using Multiple Step Quantum Wells**

Touse, Michael P.; Sep. 2003; 77 pp.; In English; Original contains color illustrations

Report No.(s): AD-A418301; No Copyright; Avail: CASI; **A05**, Hardcopy

In this thesis a device was designed to ultimately detect a laser designator operating at 1.06 micron and infrared radiation near 10 micron simultaneously. The final design consisted of 25 quantum step wells 80 micron wide. The peak IR absorption coefficient was 1800 /cm at 11.1 micron with a bandwidth of 1.6 micron.

DTIC

*Absorptivity; Infrared Absorption; Infrared Radiation*

### 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*.

**20030068301** NASA Langley Research Center, Hampton, VA, USA

**Method for Balancing Detector Output to a Desired Level of Balance at a Frequency**

Sachse, Glenn W., Inventor; June 03, 2003; 20 pp.; In English

Patent Info.: Filed 28 Dec. 1999; US-Patent-6,574,031; US-Patent-Appl-SN-476347; US-Patent-Appl-SN-019473; US-Patent-Appl-SN-067917; NASA-Case-LAR-15361-2; No Copyright; Avail: CASI; **A03**, Hardcopy

A multi-gas sensor is provided which modulates a polarized light beam over a broadband of wavelengths between two alternating orthogonal polarization components. The two orthogonal polarization components of the polarization modulated beam are directed along two distinct optical paths. At least one optical path contains one or more spectral discrimination elements, with each spectral discrimination element having spectral absorption features of one or more gases of interest being measured. The two optical paths then intersect, and one orthogonal component of the intersected components is transmitted and the other orthogonal component is reflected. The combined polarization modulated beam is partitioned into one or more smaller spectral regions of interest where one or more gases of interest has an absorption band. The difference in intensity between the two orthogonal polarization components is then determined in each partitioned spectral region of interest as an indication of the spectral emission/absorption of the light beam by the gases of interest in the measurement path. The spectral emission/absorption is indicative of the concentration of the one or more gases of interest in the measurement path. More specifically, one embodiment of the present invention is a gas filter correlation radiometer which comprises a polarizer, a polarization modulator, a polarization beam splitter, a beam combiner, wavelength partitioning element, and detection element. The gases of interest are measured simultaneously and, further, can be measured independently or non-independently. Furthermore, optical or electronic element are provided to balance optical intensities between the two optical paths.

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

*Gas Detectors; Light Beams; Polarized Light; Output; Polarizers; Frequency Distribution*

**20040000207** Institute of Industrial Technology TNO, Eindhoven, Netherlands

**First Phase of Investigation to the Properties of Vibration Damper Body Fastening DAF YAZ/YMZ 2300**

Lont, M. A.; Havinga, J. S.; March 12, 2003; 16 pp.; In Dutch

Contract(s)/Grant(s): A02/KL/118; TNO Proj. 007.62316

Report No.(s): TD-2002-0088; TNO-021-1363/LON/HAV; Copyright; Avail: Other Sources

A near accident lead to an investigation of vibration damper body fastenings of the DAF YAZ/YMZ 2300. On this type it is theonly fastening and there is no backup when all vibration dampers fail. Three fabrication types were used. The

mechanical properties of all types are sufficient. IN the rubber properties large difference were measured. However, the main reason for failure was corrosion and dis-bonding between the rubber and steel body of the damper.

Author

*Vibration Isolators; Failure*

**20040000331** NASA Kennedy Space Center, Cocoa Beach, FL, USA

**Liquid Galvanic Coatings for Protection of Imbedded Metals**

MacDowell, Louis G., Inventor; Curran, Joseph J., Inventor; September 30, 2003; 10 pp.; In English

Patent Info.: Filed 15 Oct. 2001; No Copyright; Avail: CASI; [A02](#), Hardcopy

Coating compositions and methods of their use are described herein for the reduction of corrosion in imbedded metal structures. The coatings are applied as liquids to an external surface of a substrate in which the metal structures are imbedded. The coatings are subsequently allowed to dry. The liquid applied coatings provide galvanic protection to the imbedded metal structures. Continued protection can be maintained with periodic reapplication of the coating compositions, as necessary, to maintain electrical continuity. Because the coatings may be applied using methods similar to standard paints, and because the coatings are applied to external surfaces of the substrates in which the metal structures are imbedded, the corresponding corrosion protection may be easily maintained. The coating compositions are particularly useful in the protection of metal-reinforced concrete.

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

*Coatings; Corrosion Prevention; Metals*

**20040000332** NASA Langley Research Center, Hampton, VA, USA

**Fast-Acting Valve**

Wojciechowski, Bogdan V., Inventor; Pegg, Robert J., Inventor; September 16, 2003; 24 pp.; In English

Patent Info.: Filed 27 Jul. 2000; US-Patent-6,619,322; US-Patent-Appl-SN-628100; NASA-Case-LAR-15642-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

A fast-acting valve includes an annular valve seat that defines an annular valve orifice between the edges of the annular valve seat, an annular valve plug sized to cover the valve orifice when the valve is closed, and a valve-plug holder for moving the annular valve plug on and off the annular valve seat. The use of an annular orifice reduces the characteristic distance between the edges of the valve seat. Rather than this distance being equal to the diameter of the orifice, as it is for a conventional circular orifice, the characteristic distance equals the distance between the inner and outer radii (for a circular annulus). The reduced characteristic distance greatly reduces the gap required between the annular valve plug and the annular valve seat for the valve to be fully open, thereby greatly reducing the required stroke and corresponding speed and acceleration of the annular valve plug. The use of a valve-plug holder that is under independent control to move the annular valve plug between its open and closed positions is important for achieving controllable fast operation of the valve.

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

*Valves; Ring Structures; Orifices*

**20040000616** NASA Glenn Research Center, Cleveland, OH, USA

**2002 NASA Seal/Secondary Air System Workshop, Volume 1**

Steinetz, Bruce M., Editor; Hendricks, Robert C., Editor; September 2003; 350 pp.; In English; 2002 NASA Seal/Secondary Air System Workshop, 23-24 Oct. 2002, Cleveland, OH, USA; See also 20040000617 - 20040000632

Contract(s)/Grant(s): WBS 22-708-87-06; WBS 22-713-82-31

Report No.(s): NASA/CP-2003-212458/VOL1; E-13997-1/VOL1; NAS 1.55:212458/VOL1; No Copyright; Avail: CASI; [A15](#), Hardcopy

The 2002 NASA Seal/Secondary Air System Workshop covered the following topics: (i) Overview of NASA's perspective of aeronautics and space technology for the 21st century; (ii) Overview of the NASA-sponsored Ultra-Efficient Engine Technology (UEET), Turbine-Based Combined-Cycle (TBCC), and Revolutionary Turbine Accelerator (RTA) programs; (iii) Overview of NASA Glenn's seal program aimed at developing advanced seals for NASA's turbomachinery, space propulsion, and reentry vehicle needs; (iv) Reviews of sealing concepts, test results, experimental facilities, and numerical predictions; and (v) Reviews of material development programs relevant to advanced seals development. The NASA UEET and TBCC/RTA program overviews illustrated for the reader the importance of advanced technologies, including seals, in meeting future turbine engine system efficiency and emission goals. For example, the NASA UEET program goals include an 8- to 15-percent reduction in fuel burn, a 15-percent reduction in CO<sub>2</sub>, a 70-percent reduction in NO<sub>x</sub>, CO, and unburned hydrocarbons, and

a 30-dB noise reduction relative to program baselines. The workshop also covered several programs NASA is funding to investigate advanced reusable space vehicle technologies (X-38) and advanced space ram/scramjet propulsion systems. Seal challenges posed by these advanced systems include high-temperature operation, resiliency at the operating temperature to accommodate sidewall flexing, and durability to last many missions.

Author

*Conferences; Seals (Stoppers); Turbine Engines; Turbomachinery*

**20040000694** NASA Johnson Space Center, Houston, TX, USA

#### **Inflatable Vessel and Method**

Raboin, Jasen L., Inventor; Valle, Gerard D., Inventor; Edeen, Gregg A., Inventor; delaFuente, Horacio M., Inventor; Schneider, William C., Inventor; Spexarth, Gary R., Inventor; Pandya, Shalini Gupta, Inventor; Johnson, Christopher J., Inventor; April 15, 2003; 41 pp.; In English

Patent Info.: Filed 2 Apr. 2001; US-Patent-6,547,189; US-Patent-Appl-SN-826403; US-Patent-Appl-SN-236785; US-Patent-Appl-SN-217325; NASA-Case-MS-C-23092-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

An inflatable module comprising a structural core and an inflatable shell, wherein the inflatable shell is sealingly attached to the structural core. In its launch or pre-deployed configuration, the wall thickness of the inflatable shell is collapsed by vacuum. Also in this configuration, the inflatable shell is collapsed and efficiently folded around the structural core. Upon deployment, the wall thickness of the inflatable shell is inflated; whereby the inflatable shell itself, is thereby inflated around the structural core, defining therein a large enclosed volume. A plurality of removable shelves are arranged interior to the structural core in the launch configuration. The structural core also includes at least one longeron that, in conjunction with the shelves, primarily constitute the rigid, strong, and lightweight load-bearing structure of the module during launch. The removable shelves are detachable from their arrangement in the launch configuration so that, when the module is in its deployed configuration and launch loads no longer exist, the shelves can be rearranged to provide a module interior arrangement suitable for human habitation and work. In the preferred embodiment, to provide efficiency in structural load paths and attachments, the shape of the inflatable shell is a cylinder with semi-toroidal ends.

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

*Inflatable Structures; Modules; Cylindrical Shells; Toroidal Shells*

**20040000696** NASA Johnson Space Center, Houston, TX, USA

#### **Method of Constructing a Microwave Antenna**

Arndt, G. Dickey, Inventor; Carl, James, Inventor; Ngo, Phong, Inventor; January 28, 2003; 14 pp.; In English; Avail: CASI; [A03](#), Hardcopy

A method, simulation, and apparatus are provided that are highly suitable for treatment of benign prostatic hyperplasia (BPH). A catheter is disclosed that includes a small diameter disk loaded monopole antenna surrounded by fusion material having a high heat of fusion and a melting point preferably at or near body temperature. Microwaves from the antenna heat prostatic tissue to promote necrosing of the prostatic tissue that relieves the pressure of the prostatic tissue against the urethra as the body reabsorbs the necrosed or dead tissue. The fusion material keeps the urethra cool by means of the heat of fusion of the fusion material. This prevents damage to the urethra while the prostatic tissue is necrosed. A computer simulation is provided that can be used to predict the resulting temperature profile produced in the prostatic tissue. By changing the various control features of the catheter and method of applying microwave energy a temperature profile can be predicted and produced that is similar to the temperature profile desired for the particular patient.

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

*Microwave Antennas; Methodology; Computerized Simulation*

**20040000854** Louisiana Tech Univ., Ruston, LA, USA

#### **Design of Transpiration Cooled Thermal Protection Systems**

Callens, E. Eugene, Jr.; Vinet, Robert F.; March 1999; 167 pp.; In English

Contract(s)/Grant(s): NAS13-580

Report No.(s): SE-1999-03-00012-SSC; No Copyright; Avail: CASI; [A08](#), Hardcopy

This study explored three approaches for the utilization of transpiration cooling in thermal protection systems. One model uses an impermeable wall with boiling water heat transfer at the backface (Model I). A second model uses a permeable wall with a boiling water backface and additional heat transfer to the water vapor as it flows in channels toward the exposed surface (Model II). The third model also uses a permeable wall, but maintains a boiling condition at the exposed surface of the material

(Model III). The governing equations for the models were developed in non-dimensional form and a comprehensive parametric investigation of the effects of the independent variables on the important dependent variables was performed. In addition, detailed analyses were performed for selected materials to evaluate the practical limitations of the results of the parametric study.

Author

*Thermal Protection; Transpiration; Cooling; Heat Transfer*

**2004000925** NASA Glenn Research Center, Cleveland, OH, USA

**Preliminary Comparison of Experimental and Analytical Efficiency Results of High-Speed Helical Gear Trains**

Handschuh, Robert F.; Kilmain, Charles J.; September 2003; 12 pp.; In English; 2003 International Design Engineering Technical Conferences, 2-6 Sep. 2003, Chicago, IL, USA

Contract(s)/Grant(s): WBS 22-708-28-02; DA Proj. 1L1-62211-A-47-A

Report No.(s): NASA/TM-2003-212371; ARL-TR-3019; DETC2003/PTG-48116; E-13947; Copyright; Avail: CASI; A03, Hardcopy

An experimental and analytical comparison of the efficiency of high-speed helical gear trains is presented. Analyses of the gearing losses were conducted. Test data from a helical gear train at varying speeds and loads (to 3730 kW (5,000 hp) and 15,000 rpm) was collected. A comparison of the results indicated that the operational conditions of the gearing system affects the loss contributions of the various mechanisms and therefore the overall efficiency of the gear system.

Author

*Tilt Rotor Aircraft; Test Facilities; Gears; Power Efficiency; High Speed*

**20040001726** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Effect of Crystal Orientation on Fatigue Failure of Single Crystal Nickel Base Turbine Blade Superalloys**

Arakere, N. K.; Swanson, G.; Journal of Engineering for Gas Turbines and Power; 2002; Volume 124, pp. 161-176; In English; International Gas Turbine and Aeroengine Congress and Exhibition, 8-11 May 2000, Munich, Germany

Report No.(s): Paper-00-GT-334; Copyright; Avail: Other Sources

High cycle fatigue (HCF) induced failures in aircraft gas turbine and rocket engine turbopump blades is a pervasive problem. Single crystal nickel turbine blades are being utilized in rocket engine turbopumps and jet engines throughout industry because of their superior creep, stress rupture, melt resistance, and thermomechanical fatigue capabilities over polycrystalline alloys. Currently the most widely used single crystal turbine blade superalloys are PWA 1480/1493, PWA 1484, RENE' N-5 and CMSX-4. These alloys play an important role in commercial, military and space propulsion systems. Single crystal materials have highly orthotropic properties making the position of the crystal lattice relative to the part geometry a significant factor in the overall analysis. The failure modes of single crystal turbine blades are complicated to predict due to the material orthotropy and variations in crystal orientations. Fatigue life estimation of single crystal turbine blades represents an important aspect of durability assessment. It is therefore of practical interest to develop effective fatigue failure criteria for single crystal nickel alloys and to investigate the effects of variation of primary and secondary crystal orientation on fatigue life. A fatigue failure criterion based on the maximum shear stress amplitude  $[\Delta(\tau)_{max}]$  on the 24 octahedral and 6 cube slip systems, is presented for single crystal nickel superalloys (FCC crystal). This criterion reduces the scatter in uniaxial LCF test data considerably for PWA 1493 at 1200 F in air. Additionally, single crystal turbine blades used in the alternate advanced high-pressure fuel turbopump (AHPFTP/AT) are modeled using a large-scale three-dimensional finite element model. This finite element model is capable of accounting for material orthotropy and variation in primary and secondary crystal orientation. Effects of variation in crystal orientation on blade stress response are studied based on 297 finite element model runs. Fatigue lives at critical points in the blade are computed using finite element stress results and the failure criterion developed. Stress analysis results in the blade attachment region are also presented. Results presented demonstrates that control of secondary and primary crystallographic orientation has the potential to significantly increase a component S resistance to fatigue crack growth with- out adding additional weight or cost. [DOI: 10.1115/1.1413767]

Derived from text

*Crystallography; Fatigue (Materials); Failure Modes; Single Crystals; Nickel Alloys; Turbine Blades*

**20040003768** NASA Glenn Research Center, Cleveland, OH, USA

**Evidence of Self-Organized Criticality in Dry Sliding Friction**

Zypman, Fredy R.; Ferrante, John; Jansen, Mark; Scanlon, Kathleen; Abel, Phillip; Journal of Physics: Condensed Matter; 2003; ISSN 0953-8984; Volume 15, pp. L191 - L196; In English

Contract(s)/Grant(s): WBS 22-297-60-06; Copyright; Avail: Other Sources

This letter presents experimental results on unlubricated friction, which suggests that stick-slip is described by self-organized criticality (SOC). The data, obtained with a pin-on-disc tribometer examines the variation of the friction force as a function of time-or sliding distance. This is the first time that standard tribological equipment has been used to examine the possibility of SOC. The materials were matching pins and discs of aluminium loaded with 250, 500 and 1000 g masses, and matching M50 steel couples loaded with a 1000 g mass. An analysis of the data shows that the probability distribution of slip sizes follows a power law. We perform a careful analysis of all the properties, beyond the two just mentioned, which are required to imply the presence of SOC. Our data strongly support the existence of SOC for stick-slip in dry sliding friction.

Author

*Sliding Friction; Tribometers*

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### 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*.

**20040000495** NASA Langley Research Center, Hampton, VA, USA

#### **METAShield: Hot Metallic Aeroshell Concept for RLV/SOV**

Scotti, Stephen J.; Poteet, Carl C.; Daryabeigi, Kamran; Nowak, Robert J.; Hsu, Su-Yuen; Schmidt, Irvin H.; Ku, Shih-Huei P.; July 2003; 33 pp.; In English

Contract(s)/Grant(s): 23-721-21-51-01

Report No.(s): NASA/TM-2003-212425; L-18310; No Copyright; Avail: CASI; **A03**, Hardcopy

An innovative fuselage design approach that combines many desirable operational features with a simple and efficient structural approach is being developed by NASA. The approach, named METAShield for METallic TransAtmospheric Shield, utilizes lightly loaded, hot aeroshell structures surrounding integral propellant tanks that carry the primary structural loads. The aeroshells are designed to withstand the local pressure loads, transmitting them to the tanks with minimal restraint of thermal growth. No additional thermal protection system protects the METAShield, and a fibrous or multilayer insulation blanket, located in the space between the aeroshell and the tanks, serves as both high temperature and cryogenic insulation for the tanks. The concept is described in detail, and the performance and operational features are highlighted. Initial design results and analyses of the structural, thermal, and thermal-structural performance are described. Computational results evaluating resistance to hypervelocity impact damage, as well as some supporting aerothermal wind tunnel results. are also presented. Future development needs are summarized.

Author

*Aeroshells; Thermal Protection; Fuselages; Impact Damage; Multilayer Insulation*

**20040000623** Saint-Gobain/Norton Industrial Ceramics Corp., Newbury, OH, USA

#### **Hexoloy(Registered Trademark) SiC Components**

Owens, Dean P.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 325-341; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; **A03**, Hardcopy

Silicon Carbide is a unique ceramic material which has come to dominate the world wide mechanical seal market. A brief description of material properties, additional applications and alternate materials will be discussed.

Author

*Ceramics; Silicon Carbides; Mechanical Properties; Microstructure*

**20040000632** Tribos Engineering, PC, Niskayuna, NY, USA

#### **Film Riding Brush Seal Preliminary Studies**

Shapiro, Wilbur; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 247-265; In English; See also 20040000616; Original contains color and black and white illustrations; No Copyright; Avail: CASI; **A03**, Hardcopy

Brush seals can improve engine efficiency by inhibiting secondary flow leakage, but rotor excursions produce wear that degrades performance. A brush seal combined with a film riding seal produces brush wear, accommodates rotor excursions without rubbing contact and restricts leakage to lower values than contemporary brush seals. The function of the brush is to

act as a secondary seal to limit the hydraulic closing load, and to provide radial resilience. A viewgraph presentation on Film Riding Brush Seal (FBRS) is shown.

Derived from text

*Brush Seals; Fabrication; Films; Mechanical Properties*

**20040001054** NASA Langley Research Center, Hampton, VA, USA

**Accurate Thermal Stresses for Beams: Normal Stress**

Johnson, Theodore F.; Pilkey, Walter D.; [2003]; 4 pp.; In English; SAMPE 2003, 11-15 May 2003, Long Beach, CA, USA  
Contract(s)/Grant(s): RTA 721-21-13-06; Copyright; Avail: CASI; [A01](#), Hardcopy

Formulations for a general theory of thermoelasticity to generate accurate thermal stresses for structural members of aeronautical vehicles were developed in 1954 by Boley. The formulation also provides three normal stresses and a shear stress along the entire length of the beam. The Poisson effect of the lateral and transverse normal stresses on a thermally loaded beam is taken into account in this theory by employing an Airy stress function. The Airy stress function enables the reduction of the three-dimensional thermal stress problem to a two-dimensional one. Numerical results from the general theory of thermoelasticity are compared to those obtained from strength of materials. It is concluded that the theory of thermoelasticity for prismatic beams proposed in this paper can be used instead of strength of materials when precise stress results are desired.

Author

*Mechanical Properties; Thermal Stresses; Thermoelasticity; Rectangular Beams; Numerical Analysis*

**20040001155** NASA Langley Research Center, Hampton, VA, USA

**Fatigue Crack Growth Rate and Stress-Intensity Factor Corrections for Out-of-Plane Crack Growth**

Forth, Scott C.; Herman, Dave J.; James, Mark A.; Fatigue and Fracture Mechanics; [2003]; Volume 34; 15 pp.; In English; Second International ASTM/ESIS Symposium on Fatigue and Fracture Mechanics, 19-21 Nov. 2003, Tampa, FL, USA; Copyright; Avail: CASI; [A03](#), Hardcopy

Fatigue crack growth rate testing is performed by automated data collection systems that assume straight crack growth in the plane of symmetry and use standard polynomial solutions to compute crack length and stress-intensity factors from compliance or potential drop measurements. Visual measurements used to correct the collected data typically include only the horizontal crack length, which for cracks that propagate out-of-plane, under-estimates the crack growth rates and over-estimates the stress-intensity factors. The authors have devised an approach for correcting both the crack growth rates and stress-intensity factors based on two-dimensional mixed mode-I/II finite element analysis (FEA). The approach is used to correct out-of-plane data for 7050-T7451 and 2025-T6 aluminum alloys. Results indicate the correction process works well for high DeltaK levels but fails to capture the mixed-mode effects at DeltaK levels approaching threshold ( $da/dN$  approximately  $10(\exp -10)$  meter/cycle).

Author

*Automatic Control; Crack Propagation; Fatigue (Materials); Stress Intensity Factors; Mechanical Properties*

**20040001363** NASA Langley Research Center, Hampton, VA, USA

**Failure Criteria for FRP Laminates in Plane Stress**

Davila, Carlos G.; Camanho, Pedro P.; November 2003; 28 pp.; In English

Contract(s)/Grant(s): WU 23-719-55

Report No.(s): NASA/TM-2003-212663; L-19012; No Copyright; Avail: CASI; [A03](#), Hardcopy

A new set of six failure criteria for fiber reinforced polymer laminates is described. Derived from Dvorak's fracture mechanics analyses of cracked plies and from Puck's action plane concept, the physically-based criteria, denoted LaRC03, predict matrix and fiber failure accurately without requiring curve-fitting parameters. For matrix failure under transverse compression, the fracture plane is calculated by maximizing the Mohr-Coulomb effective stresses. A criterion for fiber kinking is obtained by calculating the fiber misalignment under load, and applying the matrix failure criterion in the coordinate frame of the misalignment. Fracture mechanics models of matrix cracks are used to develop a criterion for matrix in tension and to calculate the associated in-situ strengths. The LaRC03 criteria are applied to a few examples to predict failure load envelopes and to predict the failure mode for each region of the envelope. The analysis results are compared to the predictions using other available failure criteria and with experimental results. Predictions obtained with LaRC03 correlate well with the experimental results.

Author

*Laminates; Fiber Composites; Cracks; Failure Analysis; Fracture Mechanics; Plane Stress*

**20040001397** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Strain-Gauge Measurement of Weight of Fluid in a Tank**

Figueroa, Jorge; SaintCyr, William; Rahman, Shamim; McVay, Gregory; VanDyke, David; Mitchell, William; Langford, Lester; April 15, 2003; 2 pp.; In English

Report No.(s): NASA/NP-2003-08-00035-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A method of determining the amount of fluid in a tank is based on measurement of strains induced in tank supports by the weight of the fluid. Unlike most prior methods, this method is nonintrusive: there is no need to insert instrumentation in the tank and, hence, no need to run wires, cables, or tubes through the tank wall. Also unlike most prior methods, this method is applicable even if the fluid in the tank is at supercritical pressure and temperature, because it does not depend on the presence of a liquid/gas interface (as in liquid-level-measuring methods). The strain gauges used in this method are of two types: foil and fiber-optic. Four foil gauges and one or more fiber-optic gauges are mounted on each of the tank-supporting legs. An additional fiber-optic gauge is mounted on an object, made of the same material as that of the tank-supporting legs, that is not subjected to any mechanical load. The reading obtained by the additional fiber-optic gauge is used to compensate for apparent strains caused by changes in temperature. The signals from the foil and fiber-optic gauges are conditioned, then digitized for input to a computer. As the tank is filled or emptied, the deformation in each leg increases or decreases, respectively. Measured deformations of all legs are added to obtain a composite deformation indicative of the change in weight of the tank plus fluid. An initial calibration is performed by recording data at two points (usually, empty and full) for which the mass or weight of fluid is known. It is assumed that the deformations are elastic, so that the line passing through the two points can be used as a calibration curve of mass (or weight) of fluid versus deformation. At the time of reporting the information for this article, a set of foil gauges had been tested on the supports of a 500-gallon (1,900-liter) tank. The gauges were found to be capable of measuring the deformations (up to 22 microstrain) that occurred during filling and emptying the tank. The fluid masses calculated from the gauge readings were found to be accurate within 4.5 percent. It has been estimated that once the fiber-optic gauges are put into operation, it should be possible to determine fluid masses with 3 percent or less. It may be possible to increase accuracy further by increasing the signal-to-noise ratio through the use of more deformable tank supporting legs.

Author

*Measuring Instruments; Strain Gages; Fluids; Tanks (Containers); Weight Measurement*

**20040003717** NASA Dryden Flight Research Center, Edwards, CA, USA

**Aging Theories for Establishing Safe Life Spans of Airborne Critical Structural Components**

Ko, William L.; December 2003; 41 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): 745-30-54-SE-35

Report No.(s): NASA/TP-2003-212034; H-2514; No Copyright; Avail: CASI; [A03](#), Hardcopy

New aging theories have been developed to establish the safe life span of airborne critical structural components such as B-52B aircraft pylon hooks for carrying air-launch drop-test vehicles. The new aging theories use the equivalent-constant-amplitude loading spectrum to represent the actual random loading spectrum with the same damaging effect. The crack growth due to random loading cycling of the first flight is calculated using the half-cycle theory, and then extrapolated to all the crack growths of the subsequent flights. The predictions of the new aging theories (finite difference aging theory and closed-form aging theory) are compared with the classical flight-test life theory and the previously developed Ko first- and Ko second-order aging theories. The new aging theories predict the number of safe flights as considerably lower than that predicted by the classical aging theory, and slightly lower than those predicted by the Ko first- and Ko second-order aging theories due to the inclusion of all the higher order terms.

Author

*Airborne Equipment; Service Life; Structural Design; Flight Safety; Flight Tests; Mechanical Properties*

**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*.

**20040000113** Raytheon Information Technology and Scientific Services, Wallops Island, VA, USA

**TOPEX Software Document Series, Volume 5, Rev. 1**

Lee, Jeffrey; Lockwood, Dennis; Hancock, David W., III; August 2003; 195 pp.; In English

Report No.(s): NASA/TM-2003-212236/VOL5/REV1; Rept-2003-02974-0/VOL5/REV1; NAS 1.15:212236/VOL5/REV1; No Copyright; Avail: CASI; A09, Hardcopy

This document is a compendium of the WFF TOPEX Software Development Team's knowledge regarding Geophysical Data Record (GDR) Processing. It includes many elements of a requirements document, a software specification document, a software design document, and a user's manual. In the more technical sections, this document assumes the reader is familiar with TOPEX and instrument files.

Author

*Data Processing; Geophysics; Software Engineering; Topex*

**20040000186** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Framboidal Structures in Earth Rocks and in Astromaterials**

Astafieva, M. M.; Rozanov, Alexei Y.; Hoover, Richard B.; [2003]; 1 pp.; In English; International Society for Optical Science and Technology 48th Annual Meeting, 3-8 Aug. 2003, San Diego, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Framboidal structures are common both in Earth rocks and in meteorites - carbonaceous chondrites. The main methods of formation of these structures are discussed. The role of biologic factors in formation of framboids is evaluated. Comparison of crystal forms comprising framboids formed in laboratory conditions and in nature is provided. On the basis of investigations of framboidal structures the proposition that pyritoidal form of crystals is typical for the formation of biogenic framboidal structures.

Author

*Petrology; Meteoritic Composition; Earth (Planet); Geochemistry; Petrogenesis; Carbonaceous Chondrites*

**20040000491** Raytheon Information Technology and Scientific Services, Wallops Island, VA, USA

**WFF TOPEX Software Documentation: Overview May 1999**

Brooks, Ronald L.; Lee, Jeffrey; May 2003; 38 pp.; In English

Report No.(s): NASA/TM-2003-212236/VOL2; Rept-2003-01566-0/VOL2; No Copyright; Avail: CASI; A03, Hardcopy

This document provides an overview of software development activities and the resulting products and procedures developed by the TOPEX Software Development Team (SWDT) at Wallops Flight Facility, in support of the WFF TOPEX Engineering Assessment and Verification efforts.

Author

*Software Engineering; Topex; General Overviews; Radio Altimeters; Poseidon Satellite*

**20040000494** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**TOPEX Software Document Series, Volume 4, TOPEX SDR Processing**

Lee, Jeffrey E.; Lockwood, Dennis W.; July 2003; 115 pp.; In English

Report No.(s): NASA/TM-2003-212236/VOL4; Rept-2003-02473-0/VOL4; No Copyright; Avail: CASI; A06, Hardcopy

This document is a compendium of the WFF TOPEX Software Development Team's knowledge regarding Sensor Data Record (SDR) Processing. It includes many elements of a requirements document, a software specification document, a software design document, and a user's manual. In the more technical sections, this document assumes the reader is familiar with TOPEX and instrument files.

Author

*Software Engineering; Topex; Sensors; Data Processing*

**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*.

**20040000007** Scripps Institution of Oceanography, La Jolla, CA, USA

**Accuracy and Resolution of Shuttle Radar Topography Mission Data**

Smith, Bridget; Sandwell, David; Geophysical Research Letters; 2003; ISSN 0094-8276; Volume 30, No. 9, pp. 20-1 - 20-4; In English

Contract(s)/Grant(s): NAG5-9623; NSF EAR-01-05896; NAGS-9623

Report No.(s): Paper-2002GL016643; Copyright; Avail: Other Sources

We assess the accuracy and resolution of topography data provided by the Shuttle Radar Topography Mission (SRTM) through spectral comparisons with the National Elevation Dataset (NED) and a high-resolution laser data set of the 1999 Hector Mine earthquake rupture. We find that SRTM and the NED are coherent for wavelengths greater than 200 m, however the spatial resolution of the NED data is superior to the SRTM data for wavelengths shorter than 350 m, likely due to the application of a boxcar filter applied during final SRTM processing stages. From these results, a low-pass filter/decimation algorithm can be designed in order to expedite large-area SRTM applications.

Author

*Shuttle Imaging Radar; Topography; Spatial Resolution; Accuracy*

**20040000130** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**The 10-Year Remote Sensing Industry Forecast**

Rabin, Robin; January 18, 2002; 31 pp.; In English; Presentation at Management Association for Private Photogrammetric Surveyors Winter Meeting 2002, 19-23 Jan. 2002, Cabo San Lucas, Mexico

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-01-00002-SSC; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents viewgraphs on ten years of remote sensing data collection and processing.

CASI

*Data Processing; Industries; Remote Sensing; Earth Resources*

**20040000482** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Comparing IKONOS and Landsat 7 Images**

Blonski, Slawomir; March 25, 2002; 25 pp.; In English; High Spatial Resolution Commercial Imagery Workshop, 25 Mar. 2002, Reston, VA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00022-SSC; No Copyright; Avail: CASI; A03, Hardcopy

This work is a continuation of the simulations presented at the previous workshop. Information is presented on the following: 20 IKONOS images compared with 10 Landsat 7 ETM+VNIR images acquired on the same days. Comparisons are based on simulations of the Landsat 7 images from the IKONOS data. IKONOS and Landsat 7 images used in simulations are on a similar processing level with radiometric correction, georeferenced with cubic-convolution resampling, and UTM projection with WGS-84 datum.

Derived from text

*Landsat 7; Image Analysis*

**20040000497** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Controls on Variations of Surface Energy, Water, and Carbon Budgets within Large-Scale Amazon Basin**

Smith, Eric A.; Cooper, Harry J.; Grose, Andrew; Gu, Jiu-Jing; Norman, John; daRocha, Humberto R.; Dias, Pedro Silva; [2002]; 1 pp.; In English; AGU Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; Copyright; Avail: Other Sources; Abstract Only

A key research focus of the LBA Research Program is understanding the space-time variations in interlinked surface energy, water, and carbon budgets, the controls on these variations, and the implications of these controls on the carbon sequestering capacity of the large scale forest-pasture system that dominates the Amazonia landscape. Quantification of these variations and controls are investigated by a combination of in situ measurements, remotely sensed measurements from space, and a realistically forced hydrometeorological model coupled to a carbon assimilation model, capable of simulating details within the surface energy and water budgets along with the principle processes of photosynthesis and respiration. Herein we describe the results of an investigation concerning the space-time controls of carbon sources and sinks distributed over the large scale Amazon basin. The results are derived from a carbon-water-energy budget retrieval system for the large scale Amazon basin, which uses a coupled carbon assimilation-hydrometeorological model as an integrating system, forced by both in situ meteorological measurements and remotely sensed radiation and precipitation fluxes obtained from a combination of GOES, SSM/I, TOMS, and TR4M satellite measurements. Results include validation of (a) retrieved surface radiation and precipitation fluxes based on 30-min averaged surface measurements taken at Ji-Parani in Rondonia and Manaus in Amazonas, and (b) modeled sensible, latent, and CO<sub>2</sub> fluxes based on tower measurements taken at Reserva Jaru, Manaus and Fazenda Nossa Senhora. The space-time controls on carbon sequestration are partitioned into sets of factors classified by: (1) above canopy meteorology, (2) incoming surface radiation, (3) precipitation interception, and (4) indigenous stomatal processes

varied over the different land covers of pristine rainforest, partially, and fully logged rainforests, and pasture lands. These are the principle meteorological, thermodynamical, hydrological, and biophysical control paths which perturb net carbon fluxes and sequestration, produce time-space switching of carbon sources and sinks, undergo modulation through atmospheric boundary layer feedbacks, and respond to any discontinuous intervention on the landscape itself such as produced by human intervention in converting rainforest to pasture or conducting selective/clearcut logging operations. The results demonstrate how relative carbon sequestration capacity of the Amazonian ecosystem responds to these controls, and how interpretation of space-time heterogeneities in carbon sequestration depends on a fairly exact quantification of the interacting non-linear properties of photosynthesis in response to incoming solar flux, air-canopy temperatures, and leaf water interception -- and soil respiration in response to upper layer soil temperature and water content. The results also show how the interpretation of the control processes is highly sensitive to the scales at which the surface fluxes are analyzed.

Author

*Amazon Region (South America); Structural Basins; Remote Sensing; Surface Energy; Carbon; Water; Ecosystems*

**20040000524** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Low Altitude AVIRIS Data for Mapping Landform Types on West Ship Island, Mississippi**

Spruce, Joseph; Otvos, Ervin; Giardino, Marco; March 21, 002; 18 pp.; In English; AVIRIS Earth Science and Applications Workshop, 5-8 Mar. 2002, Pasadena, CA, USA; Original contains poor quality, truncated or crooked pages

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00013-SSC; SE-2003-07-00027-SSC; Copyright; Avail: CASI; [A03](#), Hardcopy

This paper presents a viewgraph presentation on low altitude AVIRIS data for mapping landform types on West Ship Island, Mississippi. The topics of discussion include: 1) Project background; 2) Mapping methods; 3) Examples of results; 4) Apparent trends; and 5) Final remarks.

CASI

*Landforms; Low Altitude; Mapping; Mississippi; Data Acquisition; Infrared Spectrometers; Aerial Photography*

**20040000534** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**ASD FieldSpec Calibration Setup and Techniques**

Olive, Dan; October 23, 2001; 14 pp.; In English; Presentation at National Council of Standards Laboratories Regional Chapter Meeting, 8 Nov. 2001, Bay Saint Louis, MS, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2001-10-00063-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper describes the Analytical Spectral Devices (ASD) Fieldspec Calibration Setup and Techniques. The topics include: 1) ASD Fieldspec FR Spectroradiometer; 2) Components of Calibration; 3) Equipment list; 4) Spectral Setup; 5) Spectral Calibration; 6) Radiometric and Linearity Setup; 7) Radiometric setup; 8) Datadets Required; 9) Data files; and 10) Field of View Measurement. This paper is in viewgraph form.

CASI

*Calibrating; Spectroradiometers; Remote Sensing; Portable Equipment*

**20040000575** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**The National Aeronautics and Space Administration's Earth Science Applications Program: Exploring Partnerships to Enhance Decision Making in Public Health Practice**

Vann, Timi S.; Venezia, Robert A.; November 20, 2002; 10 pp.; In English

Report No.(s): SE-2002-11-00077-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

The National Aeronautics and Space Administration (NASA), Earth Science Enterprise is engaged in applications of NASA Earth science and remote sensing technologies for public health. Efforts are focused on establishing partnerships with those agencies and organizations that have responsibility for protecting the Nation's Health. The program's goal is the integration of NASA's advanced data and technology for enhanced decision support in the areas of disease surveillance and environmental health. A focused applications program, based on understanding partner issues and requirements, has the potential to significantly contribute to more informed decision making in public health practice. This paper intends to provide background information on NASA's investment in public health and is a call for partnership with the larger practice community.

Author

*Decision Making; Earth Sciences; NASA Programs; Public Health; Remote Sensing*

**2004000615** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**The Landsat Data Purchase and ESAD**

Policelli, Fritz; Fletcher, Rose; October 12, 2001; 29 pp.; In English; NASA Land Cover use Change Science Team Temperate and Boreal Workshop, 29-31 Oct. 2003, College Park, MD, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2001-10-00060; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Earth Science Applications Directorate (ESAD) purchases satellite imagery for The Scientific Data Purchase (SDP) Project. SDP allows a variety of customers in turn to purchase Landsat, IKONOS, and other data. The SDP customer base includes private companies, universities, and government agencies. SDP customers are required to register and receive clearance.

CASI

*Satellite Imagery; Landsat Satellites; Space Commercialization; Government Procurement*

**2004000681** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Archaeological Remote Sensing: Searching for Fort Clatsop from Space**

Karsmizki, Kenneth W.; Spruce, Joe; Giardino, Marco; July 30, 2002; 2 pp.; In English; Society for Historical Archaeology Annual Conference, 14-19 Jan. 2003, Providence, RI, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-07-00054-SSC; No Copyright; Avail: Other Sources; Abstract Only

The Columbia Gorge Discovery Center and NASA's Stennis Space Center have teamed up to use high-resolution aerial and satellite-based remote sensing in the search for Lewis and Clark expedition campsites. A Space Act Agreement between NASA and the Discovery Center has evolved into a study that employs remote sensing, plus modern and historical map data for relocating several Lewis and Clark encampments. Satellite data being studied include 30-meter Landsat Thematic Mapper and 1-meter Space Imaging IKONOS data. This paper includes an overview of the working relationship between NASA and the Discovery Center. It also reports on geospatial analyses of the Fort Clatsop site to demonstrate the ways geospatial technologies interface with the written and cartographic records of the expedition and how they are applied to the search for Lewis and Clark campsites.

Author

*Remote Sensing; Archaeology; Satellite Imagery*

**2004000726** Remote Sensing Systems, Inc., Santa Rosa, CA, USA

**Sensor Calibration and Ocean Products for TRMM Microwave Radiometer**

Wentz, Frank J.; Lawrence, Richard J., Technical Monitor; October 28, 2003; 47 pp.; In English

Contract(s)/Grant(s): NAS5-00217

Report No.(s): RSS-TR-102803; No Copyright; Avail: CASI; [A03](#), Hardcopy

During the three years of finding, we have carefully corrected for two sensor/platform problems, developed a physically based retrieval algorithm to calculate SST, wind speed, water vapor, cloud liquid water and rain rates, validated these variables, and demonstrated that satellite microwave radiometers can provide very accurate SST retrievals through clouds. Prior to this, there was doubt by some scientists that the technique of microwave SST retrieval from satellites is a viable option. We think we have put these concerns to rest, and look forward to making microwave SSTs a standard component of the Earth science data sets. Our TMI SSTs were featured on several network news broadcasts and were reported in Science magazine. Additionally, we have developed a SST algorithm for VIRS to facilitate IR/MW inter-comparisons and completed research into diurnal cycles and air-sea interactions.

Author

*Microwave Radiometers; Trmm Satellite; Calibrating*

**2004000847** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Leaf Optical Properties in Higher Plants: Linking Spectral Characteristics to Stress and Chlorophyll Concentration**

Carter, Gregory A.; Knapp, Alan K.; American Journal of Botany; April 14, 2000; 30 pp.; In English

Report No.(s): SE-2000-04-00002-SSC; Copyright; Avail: CASI; [A03](#), Hardcopy

A number of studies have linked responses in leaf spectral reflectance, transmittance or absorptance to physiological stress. A variety of stressors including dehydration, flooding, freezing, ozone, herbicides, competition, disease, insects and deficiencies in ectomycorrhizal development and N fertilization have been imposed on species ranging from grasses to

conifers and deciduous trees. In this cases, the maximum difference in reflectance within the 400 - 850 nm wavelength range between control and stressed states occurred as a reflectance increase at wavelength near 700 nm. In studies that included transmittance and absorbance as well as reflectance, maximum differences occurred as increases and decreases, respectively, near 700 nm. This common optical response to stress could be simulated closely by varying the chlorophyll concentrations in senescent leaves of five species. The optical response to stress near 700 nm, as well as corresponding changes in reflectance that occur in the green-yellow spectrum, can be explained by the general tendency of stress to reduce leaf chlorophyll concentration.

Author

*Leaves; Optical Properties; Plants (Botany); Chlorophylls; Deciduous Trees; Transmittance*

**2004000875** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Utilization of an Airborne Plant Chlorophyll Imaging System for Detection of Septic System Malfunction**

Spiering, Bruce A.; Carter, Gregory A.; June 04, 2001; 11 pp.; In English; Fifth International Airborne Remote Sensing Conference and Exhibition, 17-20 Sep. 2001, San Francisco, CA, USA

Report No.(s): NASA/SE-2001-06-00028-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

Malfunctioning, or leaking, sewer systems increase the supply of water and nutrients to surface vegetation. Excess nutrients and harmful bacteria in the effluent pollute ground water and local water bodies and are dangerous to humans and the aquatic ecosystems. An airborne multispectral plant chlorophyll imaging system (PCIS) was used to identify growth patterns in the vegetation covering onsite and public sewer systems. The objective was to evaluate overall performance of the PCIS as well as to determine the best operational configuration for this application. The imaging system was flown in a light aircraft over selected locations Mobile County, Alabama. Calibration panels were used to help characterize instrument performance. Results demonstrated that the PCIS performed well and was capable of detecting septic leakage patterns from altitudes as high as 915 m. From 915 m, 6 of 18 sites were suspected to have sewage leakage. Subsequent ground inspections confirmed leakage on 3 of the 6 sites. From 610 m, 3 of 8 known leakage sites were detected. Tree cover and shadows near residential structures prevented detection of several known malfunctioning systems. Also some leakages known to occur in clear areas were not detected. False detections occurred in areas characterized by surface water drainage problems or recent excavation.

Author

*Chlorophylls; Imaging Techniques; Sewers; Remote Sensing; Plants (Botany); Airborne Equipment; Malfunctions; Detection*

**2004000878** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA, NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Ikonos Imagery Product Nonuniformity Assessment**

Ryan, Robert; Zanoni, Vicki; Pagnutti, Mary; Holekamp, Kara; Smith, Charles; March 25, 2002; 2 pp.; In English; High Spatial Resolution Commercial Imagery Workshop-Ikonos, 25 Mar. 2002, Reston, VA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00028-SSC; Copyright; Avail: CASI; [A01](#), Hardcopy

During the early stages of the NASA Scientific Data Purchase (SDP) program, three approximately equal vertical stripes were observable in the IKONOS imagery of highly spatially uniform sites. Although these effects appeared to be less than a few percent of the mean signal, several investigators requested new imagery. Over time, Space Imaging updated its processing to minimize these artifacts. This however, produced differences in Space Imaging products derived from archive imagery processed at different times. Imagery processed before 2/22/01 is processed with one set of coefficients, while imagery processed after that date requires another set. Space Imaging produces its products from raw imagery, so changes in the ground processing over time can change the delivered digital number (DN) values, even for identical orders of a previously acquired scene. NASA Stennis initiated studies to investigate the magnitude and changes in these artifacts over the lifetime of the system and before and after processing updates.

Author

*Satellite Imagery; Image Processing*

**20040001074** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Requirements Analysis is Key to Realizing Increased Value from Remote Sensing**

Ryan, Robert; Alexander, Timothy M.; October 12, 2001; 4 pp.; In English

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2001-10-00061-SSC; Copyright; Avail: CASI; [A01](#), Hardcopy

This note explores requirements analysis - one of the critical and very often overlooked activities that enable satellites to measure what is important and to translate observations into effective and affordable information. Recent experience at the Stennis Space Center is used to illuminate some approaches for improving requirements practice.

Author

*Remote Sensing; User Requirements; Satellite Observation; Management Analysis*

**20040001187** NASA Stennis Space Center, Bay Saint Louis, MS, USA, Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Remote Sensing Requirements Development: A Simulation-Based Approach**

Zanoni, Vicki; Davis, Bruce; Ryan, Robert; Gasser, Gerald; Blonski, Slawomir; October 14, 2002; 6 pp.; In English; 15th William T. Pecora Memorial Remote Sensing Symposium, 8-15 Nov. 2002, Denver, CO, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-10-00071-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

Earth science research and application requirements for multispectral data have often been driven by currently available remote sensing technology. Few parametric studies exist that specify data required for certain applications. Consequently, data requirements are often defined based on the best data available or on what has worked successfully in the past. Since properties such as spatial resolution, swath width, spectral bands, signal-to-noise ratio (SNR), data quantization and band-to-band registration drive sensor platform and spacecraft system architecture and cost, analysis of these criteria is important to optimize system design objectively. Remote sensing data requirements are also linked to calibration and characterization methods. Parameters such as spatial resolution, radiometric accuracy and geospatial accuracy affect the complexity and cost of calibration methods. However, few studies have quantified the true accuracies required for specific problems. As calibration methods and standards are proposed, it is important that they be tied to well-known data requirements. The Application Research Toolbox (ART) developed at the John C. Stennis Space Center provides a simulation-based method for multispectral data requirements development. The ART produces simulated datasets from hyperspectral data through band synthesis. Parameters such as spectral band shape and width, SNR, data quantization, spatial resolution and band-to-band registration can be varied to create many different simulated data products. Simulated data utility can then be assessed for different applications so that requirements can be better understood.

Author

*Remote Sensing; User Requirements; Simulation; Multispectral Band Scanners*

**20040001428** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Irrigation Monitoring Project Results**

Terrie, Gregory; Berglund, Judith; Ryan, Robert; Harrington, Gary; Stewart, Randy; Spiering, Bruce; November 29, 2003; 66 pp.; In English; AG20/20 Annual Meeting, 3-5 Dec.2002, Bay Saint Louis, MS, USA; Original contains black and white illustrations

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-11-00079-SSC; No Copyright; Avail: CASI; [A04](#), Hardcopy

The objective of this project is to investigate remote sensing requirements for irrigation scheduling to define future systems. Temperature-based crop stress indicators have been developed that could be used for irrigation management. This viewgraph presentation describes an experiment to use airborne and satellite thermal imagery to evaluate the water requirements of irrigated crops.

CASI

*Thermal Mapping; Farm Crops; Irrigation; Water; Remote Sensing*

**20040001430** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Coastal Research Imaging Spectrometer**

July 30, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2003-01-0003-SSC; Copyright; Avail: CASI; [A01](#), Hardcopy

The Coastal Research Imaging Spectrometer (CRIS) is an airborne remote-sensing system designed specifically for research on the physical, chemical, and biological characteristics of coastal waters. The CRIS includes a visible-light hyperspectral imaging subsystem for measuring the color of water, which contains information on the biota, sediment, and nutrient contents of the water. The CRIS also includes an infrared imaging subsystem, which provides information on the temperature of the water. The combination of measurements enables investigation of biological effects of both natural and

artificial flows of water from land into the ocean, including diffuse and point-source flows that may contain biological and/or chemical pollutants. Temperature is an important element of such measurements because temperature contrasts can often be used to distinguish among flows from different sources: for example, a sewage outflow could manifest itself in spectral images as a local high-temperature anomaly. Both the visible and infrared subsystems scan in 'pushbroom' mode: that is, an aircraft carrying the system moves along a ground track, the system is aimed downward, and image data are acquired in across-track linear arrays of pixels. Both subsystems operate at a frame rate of 30 Hz. The infrared and visible-light optics are adjusted so that both subsystems are aimed at the same moving swath, which has across-track angular width of 15°. Data from the infrared and visible imaging subsystems are stored in the same file along with aircraft-position data acquired by a Global Positioning System receiver. The combination of the three sets of data is used to construct infrared and hyperspectral maps of scanned areas shown.

Derived from text

*Coastal Water; Imaging Spectrometers; Remote Sensing; Airborne Equipment; Research and Development*

**20040001453** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Validation of ADAR System 5500 Digital Imagery: Delivery Task Order #1, Task Request #857 - Brookings, SD**

Blonski, Slawomir; January 29, 2003; 19 pp.; In English

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2003-01-00007-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

This work was performed under NASA's Verification and Validation Program as an independent check of data supplied by Positive Systems, Inc. through the Earth Science Enterprise's Scientific Data Purchase (SDP) Program. This document serves as the basis for reporting results associated with validation of multispectral imagery according to the specifications of contract NAS 13-98049. The validation was performed under the Positive Systems Imaging System Validation Work Instruction CRSP-WI-28: Spectral registration, spatial resolution, endlaps, sidelaps, and image quality were evaluated. The validation was preceded by Shipment Verification, as described in the Work Instruction CRSP-WI-22: Every image was passed through an automatic ingest verification and thumbnail review process to identify omissions, problems with media integrity, and gross errors in data quality. Validation of metadata files is not within the scope of this report, but it was performed separately.

Author

*Image Analysis; Satellite Imagery; Image Processing; Multispectral Photography*

**20040001502** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**ASPRS Digital Imagery Guideline Image Gallery Discussion**

Ryan, Robert; April 24, 2002; 37 pp.; In English; 2002 ASPRS-ACSM Annual Conference, 22-26 Apr. 2002, Washington, DC, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): NASA/SE-2002-04-00037-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

The objectives of the image gallery are to 1) give users and providers a simple means of identifying appropriate imagery for a given application/feature extraction; and 2) define imagery sufficiently to be described in engineering and acquisition terms. This viewgraph presentation includes a discussion of edge response and aliasing for image processing, and a series of images illustrating the effects of signal to noise ratio (SNR) on images. Another series of images illustrates how images are affected by varying the ground sample distances (GSD).

CASI

*Pattern Recognition; Image Classification; Digital Techniques; Satellite Imagery*

**20040001740** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA, NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Low Altitude AVIRIS Data for Mapping Land Form Types on West Ship Island, Mississippi**

Spruce, Joseph P.; Otvos, Ervin G.; Giardino, Marco J.; September 14, 2002; 11 pp.; In English; 2003 AVIRIS Earth Science and Applications Workshop, 5-8 Mar. 2002, Pasadena, CA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-09-00065-SSC; Copyright; Avail: CASI; [A03](#), Hardcopy

Barrier islands help protect the southern and southeastern U.S. shoreline from hurricanes and severe storms. They are important for coastal resource management and geologic research, especially in studies that involve changes in island areas

and surface environments, and they display a dynamically changing and diverse mix of landform and vegetative cover habitats. Many Gulf Coast barrier islands have undergone dramatic decreases in areal extent, often due to hurricane and severe storm damage. For example, Louisiana's barrier islands have lost 55 percent of their surface area over the past 100 years. Aerial photography and Landsat data have been used to monitor changes in barrier island areal extent, although neither data source is optimal for making maps of detailed landform types at site-specific scales. High spatial resolution hyperspectral imagery, such as that obtained from the high spatial resolution Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) sensor, may enable improved mapping of landform types, which would benefit studies of the dynamics of barrier island environments. During the summers of 2000 and 2001, a study was conducted to assess low-altitude AVIRIS data for mapping the landform types of West Ship Island, a barrier island in Harrison County, Mississippi. This study area was selected because of the availability of low-altitude AVIRIS data acquired on July 22, 1999, and because of the area's accessibility to the investigating team. West Ship Island is one of the six barrier islands that belong to the Gulf Shores National Seashore, which is managed by the National Park Service. This island contains an impressive range of landform categories. Surface types include beach, dune, and sand flat environments. West Ship Island also harbors Fort Massachusetts, a historic fort used during the Civil War. Because it is located near Stennis Space Center, the island is frequently imaged by NASA's airborne and spaceborne sensors.

Author

*Mississippi; Coasts; Landforms; Multispectral Band Scanners; Airborne Equipment; Imaging Spectrometers; Barriers (Landforms)*

**20040001755** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA, NASA Stennis Space Center, Bay Saint Louis, MS, USA

#### **Measurement Sets and Sites Commonly used for Characterizations**

Pagnutti, Mary; Holekamp, Kara; Ryan, Robert; Blonski, Slawomir; Sellers, Richard; Davis, Bruce; Zaroni, Vicki; October 08, 2002; 7 pp.; In English; International Society for Photogrammetry and Remote Sensing Conference, 8-15 Nov. 2002, Denver, CO, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): NASA/SE-2002-10-00070-SSC; Copyright; Avail: CASI; [A02](#), Hardcopy

Scientists with NASA's Earth Science Applications Directorate are creating a well-characterized Verification & Validation (V&V) site at the Stennis Space Center (SSC). This site enables the in-flight characterization of remote sensing systems and the data that they require. The data are predominantly acquired by commercial, high-spatial resolution satellite systems, such as IKONOS and QuickBird 2, and airborne systems. The smaller scale of these newer high-resolution remote sensing systems allows scientists to characterize the geometric, spatial, and radiometric data properties using a single V&V site. The targets and techniques used to characterize data from these newer systems can differ significantly from the earlier, coarser spatial resolution systems. Scientists are also using the SSC V&V site to characterize thermal infrared systems and active Light Detection and Ranging (LIDAR) systems. SSC employs geodetic targets, edge targets, radiometric tarps, and thermal calibration ponds to characterize remote sensing data products. This paper presents a proposed set of required measurements for visible-through-longwave infrared remote sensing systems, and a description of the Stennis characterization. Other topics discussed include: 1) use of ancillary atmospheric and solar measurements taken at SSC that support various characterizations, 2) other sites used for radiometric, geometric, and spatial characterization in the continental USA, and 3) the need for a standardized technique to be adopted by the Committee on Earth Observation Satellites (CEOS) and other organizations.

Author

*Characterization; Earth Sciences; Remote Sensing; Geodesy; Optical Radar; Artificial Satellites; Radiation Measuring Instruments*

**20040001756** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

#### **NASA IKONOS Radiometric Characterization**

Pagnutti, Mary; Ryan, Robert; Holekamp, Kara; Zaroni, Vicki; March 24, 2002; 32 pp.; In English; High Spatial Resolution Commercial Imagery Workshop-IKONOS, 22 Mar. 2003, Reston, VA, USA; Original contains poor quality, truncated or crooked pages

Contract(s)/Grant(s): NAS13-650

Report No.(s): NASA/SE-2002-03-00021-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

The objective of this project is to perform radiometric vicarious calibrations of IKONOS satellite imagery and compare with Space Imaging calibration coefficients. This viewgraph presentation describes characterization undertaken at Lunar Lake Playa, Nevada; and Stennis Space Center, Mississippi.

CASI

*Satellite Imagery; Characterization; Calibrating; Radiometers*

**20040001760** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**NASA Scientific Data Purchase Project: From Collection to User**

Nicholson, Lamar; Policelli, Fritz; Fletcher, Rose; January 22, 2002; 5 pp.; In English; NASA Science Data Processing Workshop 2002, 26-28 Feb. 2002, Greenbelt, MD, USA

Contract(s)/Grant(s): NAS13-650; Copyright; Avail: CASI; [A01](#), Hardcopy

NASA's Scientific Data Purchase (SDP) project is currently a \$70 million operation managed by the Earth Science Applications Directorate at Stennis Space Center. The SDP project was developed in 1997 to purchase scientific data from commercial sources for distribution to NASA Earth science researchers. Our current data holdings include 8TB of remote sensing imagery consisting of 18 products from 4 companies. Our anticipated data volume is 60 TB by 2004, and we will be receiving new data products from several additional companies. Our current system capacity is 24 TB, expandable to 89 TB. Operations include tasking of new data collections, archive ordering, shipment verification, data validation, distribution, metrics, finances, customer feedback, and technical support. The program has been included in the Stennis Space Center Commercial Remote Sensing ISO 9001 registration since its inception. Our operational system includes automatic quality control checks on data received (with MatLab analysis); internally developed, custom Web-based interfaces that tie into commercial-off-the-shelf software; and an integrated relational database that links and tracks all data through operations. We've distributed nearly 1500 datasets, and almost 18,000 data files have been downloaded from our public web site; on a 10-point scale, our customer satisfaction index is 8.32 at a 23% response level. More information about the SDP is available on our Web site.

Author

*Space Commercialization; Remote Sensing; Earth Sciences; Imagery*

**20040003747** Global Positioning Solutions, Inc., USA

**Remote Sensing and Information Technology for Large Farms**

Williams, John E.; Ramsay, Jimmie A.; July 25, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2002-12-00043-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A method of applying of remote sensing (RS) and information management technology to help large farms produce at maximum efficiency is undergoing development. The novelty of the method does not lie in the concept of 'precision agriculture,' which involves variation of seeding, of application of chemicals, and of irrigation according to the spatially and temporally local variations in the growth stages and health of crops and in the chemical and physical conditions of soils. The novelty also does not lie in the use of RS data registered with other data in a geographic information system (GIS) to guide the use of precise agricultural techniques. Instead, the novelty lies in a systematic approach to overcoming obstacles that, heretofore, have impeded the timely distribution of reliable, relevant, and sufficient GIS data to support day-to-day, acre-to-acre decisions concerning the application of precise agricultural techniques to increase production and decrease cost. The development and promotion of the method are inspired in part by a vision of equipping farm machinery to accept GIS (including RS) data and using the data for automated or semiautomated implementation of precise agricultural techniques. Primary examples of relevant GIS data include information on plant stress, soil moisture, and effects of applied chemicals, all derived by automated computational analysis of measurements taken by one or more airborne spectroradiometers. Proper management and timeliness of the large amount of GIS information are of paramount concern in agriculture. Information on stresses and changes in crops is especially perishable and important to farmers. The need for timeliness and management of information is satisfied by use of computing hardware and software capable of (1) rapid georectification and other processing of RS data, (2) packaging the output data in the form of GIS plots, and (3) making the data available to farmers and other subscribers by Internet password access. It is a goal of this development program to make RS data available no later than the data after an aerial survey. In addition, data from prior surveys are kept in the data base. Farmers can, for example, use current and prior data to analyze changes.

Author

*Farm Crops; Information Management; Remote Sensing; Agriculture*

**20040003825** NASA Wallops Flight Center, Wallops Island, VA, USA

**TOPEX NASA Altimeter Operations Handbook**

Hancock, David W., III; Hayne, George S.; Purdy, Craig L.; Bull, James B.; Brooks, Ronald L.; September 2003; 155 pp.; In English

Report No.(s): NASA/TM-2003-212236/VOL6; Rept-2003-02975-0/VOL6; No Copyright; Avail: CASI; [A08](#), Hardcopy

This operations handbook identifies the commands for the NASA radar altimeter for the TOPEX/Poseidon spacecraft, defines the functions of these commands, and provides supplemental reference material for use by the altimeter operations

personnel. The main emphasis of this document is placed on command types, command definitions, command sequences, and operational constraints. Additional document sections describe uploadable altimeter operating parameters, the telemetry stream data contents (for both the science and the engineering data), the Missions Operations System displays, and the spacecraft and altimeter health monitors.

Author

*Handbooks; Topex; Poseidon Satellite; Radio Altimeters; Spacecraft Instruments*

**20040003964** Massachusetts Inst. of Tech., Lexington, MA

**Earth Observing-1 Advanced Land Imager: Imaging Performance On-Orbit**

Hearn, D. R.; 115 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F19628-00-C-0002

Report No.(s): AD-A410322; PR-EO-1-12; ESC-TR-2002-078; No Copyright; Avail: CASI; **A06**, Hardcopy

This report analyzes the on-orbit imaging performance of the Advanced Land Imager (ALI) on the Earth Observing-1 satellite. The pre-flight calibrations are first summarized. The methods used to reconstruct and geometrically correct the image data from this push-broom sensor are described. The method used here does not refer to the position and attitude telemetry from the spacecraft. Rather, it is assumed that the image of the scene moves across the focal plane with a constant velocity, which can be ascertained from the image data itself. Next, an assortment of the images so reconstructed is presented. Color images sharpened with the 10-m panchromatic band data are shown, and the algorithm for producing them from the 30-m multispectral data is described. The approach taken for assessing spatial resolution is to compare the sharpness of features in the on-orbit image data with profiles predicted on the basis of the pre-flight calibrations. A large assortment of bridge profiles is analyzed, and very good fits to the predicted shapes are obtained. Lunar calibration scans are analyzed to examine the sharpness of the edge-spread function at the limb of the moon. The darkness of the space beyond the limb is better for this purpose than anything that could be simulated on the ground. From these scans, we find clear evidence of scattering in the optical system, as well as some weak ghost images. Scans of planets and stars are also analyzed. Stars are useful point sources of light at all wavelengths, and delineate the point-spread functions of the system. From a quarter-speed scan over the Pleiades, we find that the ALI can detect 6th magnitude stars. The quality of the reconstructed images verifies the capability of the ALI to produce Landsat-type multi spectral data. The signal-to-noise and panchromatic spatial resolution are considerably superior to those of the existing Landsat sensors. The spatial resolution is confirmed to be as good as it was designed to be.

DTIC

*Detectors; Photography; Telemetry; Satellites; Imaging Techniques; Landsat Satellites*

## 45

### ENVIRONMENT POLLUTION

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

**20040000090** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The 2002 Antarctic Ozone Hole**

Newman, P. A.; Nash, E. R.; Douglass, A. R.; Kawa, S. R.; January 2003; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Since 1979, the ozone hole has grown from near zero size to over 24 Million km<sup>2</sup>. This area is most strongly controlled by levels of inorganic chlorine and bromine concentrations. In addition, dynamical variations modulate the size of the ozone hole by either cooling or warming the polar vortex collar region. We will review the size observations, the size trends, and the interannual variability of the size. Using a simple trajectory model, we will demonstrate the sensitivity of the ozone hole to dynamical forcing, and we will use these observations to discuss the size of the ozone hole during the 2002 Austral spring. We will further show how the Cly decreases in the stratosphere will cause the ozone hole to decrease by 1-1.5% per year. We will also show results from a 3-D chemical transport model (CTM) that has been continuously run since 1999. These CTM results directly show how strong dynamics acts to reduce the size of the ozone hole.

Author

*Ozone Depletion; Variability*

**2004000679** NASA Ames Research Center, Moffett Field, CA, USA

**Estimates of the Spectral Aerosol Single Scattering Albedo and Aerosol Radiative Effects during SAFARI 2000**

Bergstrom, Robert W.; Schmid, Beat; Pilewskie, Peter; Russell, Philip B.; Journal of Geophysical Research; November 1, 2003; ISSN 0148-0227; Volume 108, No. D13, pp. 10-1 - 10-11; In English

Contract(s)/Grant(s): NCC2-1164; Copyright; Avail: Other Sources

Using measurements of the spectral solar radiative flux and optical depth for 2 days (24 August and 6 September 2000) during the SAFARI 2000 intensive field experiment and a detailed radiative transfer model, we estimate the spectral single scattering albedo of the aerosol layer. The single scattering albedo is similar on the 2 days even though the optical depth for the aerosol layer was quite different. The aerosol single scattering albedo was between 0.85 and 0.90 at 350 nm, decreasing to 0.6 in the near infrared. The magnitude and decrease with wavelength of the single scattering albedo are consistent with the absorption properties of small black carbon particles. We estimate the uncertainty in the single scattering albedo due to the uncertainty in the measured fractional absorption and optical depths. The uncertainty in the single scattering albedo is significantly less on the high-optical-depth day (6 September) than on the low-optical-depth day (24 August). On the high-optical-depth day, the uncertainty in the single scattering albedo is 0.02 in the midvisible whereas on the low-optical-depth day the uncertainty is 0.08 in the midvisible. On both days, the uncertainty becomes larger in the near infrared. We compute the radiative effect of the aerosol by comparing calculations with and without the aerosol. The effect at the top of the atmosphere (TOA) is to cool the atmosphere by 13 W m<sup>-2</sup> on 24 August and 17 W m<sup>-2</sup> on 6 September. The effect on the downward flux at the surface is a reduction of 57 W m<sup>-2</sup> on 24 August and 200 W m<sup>-2</sup> on 6 September. The aerosol effect on the downward flux at the surface is in good agreement with the results reported from the Indian Ocean Experiment (WDOEX).

Author

*Aerosols; Albedo; Radiative Transfer*

**2004000743** National Center for Atmospheric Research, Boulder, CO, USA

**Macroscopic Relationships Among Latent Heating, Precipitation, Organized Convection, and the Environment**

Moncrieff, Mitchell; December 1, 2003; 5 pp.; In English

Contract(s)/Grant(s): NAG5-12010; No Copyright; Avail: CASI; [A01](#), Hardcopy

The two studies summarized below represent the results of a one-year extension to the original award grant. These studies involve cloud-resolving simulation, theory and parameterization of multi-scale convective systems in the Tropics. It is a contribution to the basic scientific objectives of TRMM and the prospective NASA Global Precipitation Mission.

Derived from text

*Latent Heat; Precipitation (Meteorology); Convection; Environmental Chemistry*

**2004000787** Miami Univ., FL, USA

**TOMS Validation Based on Profiles of Aerosol Properties in the Lower Troposphere as Obtained with Light Aircraft Systems**

Prospero, Joseph M.; Maring, Hal; Savoie, Dennis; March 30, 2003; 24 pp.; In English

Contract(s)/Grant(s): NAG5-7110; N00014-98-1-0902; N00014-01-WX-20194

Report No.(s): NRA-97-MTPE-07; Copyright; Avail: CASI; [A03](#), Hardcopy

The goal of the University of Miami Aerosol Group (UMAG) in this project was to make measurements of vertical profiles of aerosol properties and aerosol optical depth using a light aircraft. The UMAG developed a light aircraft aerosol package (LAAP) that was used in light aircraft (Cessna 172) during the Puerto Rico Dust Experiment (PRIDE). This field campaign took place on Puerto Rico during July 2000. Design details and results from the use of the LAAP were presented at TOMS Science team meetings on April 1998, April 1999, and May 2000. Results from the LAAP collected during the PRIDE Experiment were presented at the Fall Meeting of the American Geophysical Union, December 2000. Some of the results from the LAAP collected during the PRIDE Experiment have been accepted for publication in the Journal of Geophysical Research in a 'topical section' made up of papers from the PRIDE Program.

Author

*Aerosols; Measurement; Vertical Distribution; Optical Thickness; Total Ozone Mapping Spectrometer*

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*.

**20040000194** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The MODIS Aerosol Algorithm: From First Light to Maturity**

Remer, L. A.; Levy, R. C.; Kaufman, Y. J.; Holben, B. N.; [2002]; 1 pp.; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; Copyright; Avail: Other Sources; Abstract Only

The MODerate resolution Imaging Spectroradiometer (MODIS) currently aboard both the Terra and Aqua satellites produces a suite of products designed to characterize global aerosol distribution, optical thickness and particle size. Terra with MODIS aboard was launched at the end of 1999 and began transmitting data at the end of February 2000. Algorithms were in place, designed to use the observed radiances to derive many important aerosol products. Early comparisons of the retrieved aerosol parameters with ground-based validation data, showed remarkable agreement between the two types of data, but also showed us situations in which the algorithms could be improved. Almost immediately, the algorithms were modified to reflect a better understanding of the instrument's capabilities and the nature of aerosols and clouds. We describe the MODIS aerosol algorithms, highlighting the changes that were implemented post-launch. We describe the wealth of aerosol products derived from MODIS data and available to any user. Lastly, we compare over a year of MODIS data to co-located ground-based data as validation, and analyze the validation as to geographic location and temporal changes. This presentation is meant as an overview of the mature MODIS aerosol algorithm.

Author

*Aerosols; Algorithms; MODIS (Radiometry); Geophysics*

**20040000285** Mission Research Corp., Nashua, NH

**Validation Report for the Celestial Background Scene Descriptor (CBSD) zodiacal Emission Model CBZODY6**

Noah, Paul V.; Noah, Meg A.; Feb. 2001; 83 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F19628-93-C-0028; Proj-S321

Report No.(s): AD-A418442; AFRL-VS-TR-2001-1578; No Copyright; Avail: CASI; [A05](#), Hardcopy

This report provides detailed information on the evolving improvements and verification of the AFRL/HRS Celestial Background Scene Descriptor (CBSD) zodiacal Emission code (CBZODV). The CBZODY model predicts the flux from the solar system dust cloud for a given line-of-sight or field-of-view that would be detected by optical and infrared sensor systems. CBZODY is currently in use by the MDA as a component of the SSGM simulation package and as part of the AFRL PLEXUS R3V2 atmospheric effects modeling suite.

DTIC

*Atmospheric Effects; Field of View; Infrared Detectors*

**20040000364** Bolt, Beranek, and Newman, Inc., Arlington, VA, USA

**Integration of InfraMAP with Near-Real-Time Atmospheric Characterizations and Applications to Infrasound Modeling**

Gibson, Robert G.; Norris, David E.; Nov. 13, 2003; 9 pp.; In English

Contract(s)/Grant(s): DTRA01-01-C-0084; Proj-DTRA

Report No.(s): AD-A418449; AFRL-VS-TR-2003-1609; No Copyright; Avail: CASI; [A02](#), Hardcopy

Predicting the long-range propagation of infrasound relies on characterization of the propagation medium, namely, the global atmosphere from the ground to altitudes above 100 km. The ability to realistically model infrasound propagation depends on the fidelity of the atmospheric characterization. The analysis tool kit InfraMAP (Infrasound Modeling of Atmospheric Propagation) offers a range of options for specifying the propagation environment. The baseline capability utilizes global climatological models of temperature, wind, and air composition. Of particular interest herein is the recently developed capability to incorporate near-real-time atmospheric updates, such as the output from numerical weather prediction models, to supplement climatological characterization of the environment. New InfraMAP modules support integration of propagation models (ray-tracing, parabolic equation) with two versions of near-real-time atmospheric characterizations. First, output from the Navy's synoptic model NOGAPS (Navy Operational Global Atmospheric Prediction System) can be imported into InfraMAP and merged with the baseline climatological models, HWM-93 and NRL-MSISE-00. Second, output from the NRL-G2S specification can be imported and used to characterize the entire propagation environment. The primary objective of this research effort is development of an enhanced InfraMAP software tool kit that enables higher-fidelity infrasound

propagation modeling by incorporating near-real-time atmospheric characterizations. A validation effort is also being undertaken to improve confidence in the modeling techniques and provide calibration in support of operational needs. Anticipated uses of the software include the following: in-depth analysis of events and scenarios of particular monitoring interest; sensitivity analyses; and detailed infrasound localization and detection studies. (5 figures, 9 refs.)

DTIC

*Predictions; Atmospheric Models; Climatology; Infrasonic Frequencies*

**2004000690** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The O+ Density Trough at 5000 km Altitude in the Polar Cap**

Zeng, W.; Horowitz, J. L.; Cravens, P. D.; Rich, F. J.; Moore, T. E.; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

At altitudes near 5000 km over the Southern polar cap region of the terrestrial magnetosphere, the Thermal Ion Dynamics Experiment (TIDE) onboard the Polar satellite has observed O+ ion density trough regions, in which the O+ densities were at least one order of magnitude lower than the surrounding O+ densities. In the O+ density trough regions, the estimated O+ densities were generally lower than 0.01 per cc. The boundaries between normal density level regions and the trough density regions were usually abrupt transitions. From December 1, 1997 to November 30, 1998, polar cap O+ troughs in Polar/TIDE observations occurred at a frequency of about 48%. Statistical examination of the Polar perigee observations from December 1, 1997 to November 30, 1998 shows that the Polar perigee passes evenly covered the southern polar cap region, while the O+ density trough was always located on the nightside portion of the polar cap magnetosphere, and that invariant latitude spans of such troughs could be as large as 230 in extent. The trough occurrence displayed strong seasonal dependence; in the winter season (e.g. for July in the southern hemisphere) the O+ ion density trough occurrence frequency ranged up to 92%, while in the summer season (e.g. for January in the southern hemisphere) it decreased to as infrequent as 15%. The O+ ion density trough occurrence appeared relatively independent of the geomagnetic Kp index, and IMF Bz, By conditions. However, as suggested by the seasonal dependence, the O+ ion density trough occurrence was strongly related to the solar zenith angle (SZA). In the SZA range 500 to 1250, the trough occurrence increased monotonically with SZA. Also, case-by-case examinations of near-simultaneous O+ densities and vertical velocities observed by the DMSP satellite group orbiting at 840 km altitude indicate that the O+ density troughs observed at 5000 km altitude exhibit moderate correlation or anti-correlation with topside ionosphere density or velocity features at 840 km altitude for approximately half of the near-conjunction cases examined.

Author

*Polar Caps; Oxygen; Ion Density (Concentration)*

**2004000701** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**Measurement of H<sub>2</sub>O and other Trace Gases in the Stratosphere Using a High Resolution Far-Infrared Spectrometer**

Traub, Wesley A.; Chance, Kelly V.; Jucks, Kenneth W.; Johnson, David G.; November 2003; 5 pp.; In English

Contract(s)/Grant(s): NAG5-9361; No Copyright; Avail: CASI; A01, Hardcopy

This report covers the time period 1 January 2002 to 31 October 2003. During this period we had two balloon flights, continued analyzing data from past and recent flights, exploring issues such as radical partitioning, stratospheric transport, and molecular spectroscopy and further developed our beamsplitter technology.

Derived from text

*Balloon Flight; Molecular Spectroscopy; Atmospheric Composition; Computer Programs*

**20040003721** National Space Science and Technology Center, Huntsville, AL, USA

**Transport of Photoelectrons in the Nightside Magnetosphere**

Khazanov, G. V.; Liemohn, M. W.; Journal of Geophysical Research; 2002; ISSN 0148-0227; Volume 107, No. A5, pp. 10-1 - 10-12; In English

Contract(s)/Grant(s): NAG5-4771; NAG5-6976; NAG5-5030; NCC8-181; NSF ATM-97-11381; NSF ATM-97-10326; Copyright; Avail: CASI; A03, Hardcopy

Kinetic modeling results are analyzed to examine the transport of photoelectrons through the nightside inner magnetosphere. Two sources are considered, those on the dayside from direct solar illumination and those across the nightside from light scattered by the upper atmosphere and geocorona. A natural filter exists on the nightside for the dayside photoelectrons. Coulomb collisions erode the distribution at low energies and low L shells, and magnetospheric convection compresses the electrons as they drift toward dawn. It is shown that for low-activity levels a band of photoelectrons forms

between  $L = 4$  and  $6$  that extends throughout the nightside local times and into the morning sector. For the scattered light photoelectrons the trapped zone throughout the nightside is populated with electrons of  $E$  less than  $30$  eV. At high  $L$  shells near dawn, convective compression on the nightside yields an accelerated population with electrons at energies up to twice the ionospheric energy maximum (that is, roughly  $1200$  eV for dayside photoelectrons and  $60$  eV for scattered light electrons). Modeled energy and pitch angle distributions are presented to show the features of these populations.

Author

*Photoelectrons; Magnetospheres; Transport Theory; Mathematical Models; Kinetic Energy; Night*

## 47

### METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

**20040000179** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **The Reanalysis for Stratospheric Trace-gas Studies**

Pawson, Steven; Li, Shuhua; [2002]; 1 pp.; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, USA; No Copyright; Avail: Other Sources; Abstract Only

In order to re-examine trace gas transport in the middle atmosphere for the period May 1991 until April 1995, a 'reanalysis' is being performed using an up-to-date version of the DAO's 'GEOS' assimilation system. The Reanalysis for Stratospheric Trace-gas Studies (ReSTS) is intended to provide state-of-the-art estimates of the atmosphere during a period when the Upper Atmospheric Research Satellite provided a high density of trace-gas observations, and when the aerosol loading from the eruption of Mount Pinatubo contaminated the lower stratosphere, at the same time performing a natural tracer transport experiment. This study will present the first results from ReSTS, focussing on the improvements over the meteorological analyses produced by the then-operational GEOS-1 data assimilation system; emphasis will be placed on the improved representations of physical processes between GEOS-1 and the current GEOS-4 systems, highlighting the transport properties of the datasets. Alongside the production of a comprehensive atmospheric dataset, important components of ReSTS include performing sensitivity studies to the formulation of the assimilation system (including the representation of physical processes in the GCM, such as feedbacks between ozone/aerosols and meteorology) and to the inclusion of additional data types (including limb-sounding temperature data alongside the TOVS observations). Impacts of some of these factors on the analyzed meteorology and transport will be discussed. Of particular interest are attempts to determine the relative importance of various steps in the assimilation process to the quality of the final analyses.

Author

*Stratosphere; Trace Elements; Meteorology; Earth Sciences*

**20040000183** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **A National Program for Analysis of the Climate System**

Schubert, Siegfried; Arkin, Phil; Kalnay, Eugenia; Laver, James; Trenberth, Kevin; [2002]; 1 pp.; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Perhaps the single greatest roadblock to fundamental advances in our understanding of climate variability and climate change is the lack of robust and unbiased long-term global observations of the climate system. Such observations are critical for the identification and diagnosis of climate variations, and provide the constraints necessary for developing and validating climate models. The first generation of reanalysis efforts, by using fixed analysis systems, eliminated the artificial climate signals that occurred in analyses generated at the operational numerical weather prediction centers. These datasets are now widely used by the scientific community in a variety of applications including atmosphere-ocean interactions, seasonal prediction, climate monitoring, the hydrological cycle, and a host of regional and other diagnostic studies. These reanalyses, however, had problems that made them sub-optimal or even unusable for some applications. Perhaps the most serious problem for climate applications was that, while the assimilation system remained fixed, changes in the observing systems did produce spurious changes in the perceived climate. The first generation reanalysis products also exposed problems with physical consistency of the products and the accurate representation of physical processes in the climate system. Examples are bias in the estimates of ocean surface fluxes, and inadequate representation of polar hydrology. In this talk, I will describe some initial plans for a national program on reanalysis. The program is envisioned to be part of an on-going activity to maintain, improve,

and reprocess our record of climate observations. I will discuss various issues affecting the quality of reanalyses, with a special focus on those relevant to the ocean.

Author

*Climatology; Climate Models; Meteorology; Numerical Weather Forecasting*

**2004000208** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Use of MODIS/AIRS Direct Broadcast Data for Short Term Weather Forecasting**

Jedlovec, Gary; [2003]; 1 pp.; In English; EOS Direct Broadcast Users Conference, 17-20 Nov. 2003, Kohala Coast, HI, USA; No Copyright; Avail: Other Sources; Abstract Only

Operational weather forecasting relies heavily on real time data and modeling products for forecast preparation and dissemination of significant weather information to the public. The key to this success is access to real time data and integration of the data and products into weather decision support systems. NASA's Short-term Prediction Research and Transition (SPORT) Program has demonstrated this capability with MODIS and AIRS data through several local NWS Forecast Offices. This presentation will describe the use of real time EOS Direct Broadcast (DB) data in local weather forecast operations, highlight the utility of real time data from the EOS DB systems, and provide insight into how EOS DB data can have the most impact on the weather forecast community.

Author

*MODIS (Radiometry); Weather Forecasting; Meteorological Services; Earth Observing System (Eos); Broadcasting*

**2004000334** NASA Goddard Space Flight Center, Greenbelt, MD, USA, Maryland Univ., College Park, MD, USA

**Regional Climate Simulation and Data Assimilation with Variable-Resolution GCMs**

Fox-Rabinovitz, Michael S.; [2002]; 2 pp.; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; No Copyright; Avail: CASI; [A01](#), Hardcopy

Variable resolution GCMs using a global stretched grid (SG) with enhanced regional resolution over one or multiple areas of interest represents a viable new approach to regional climate change and data assimilation studies and applications. The multiple areas of interest, at least one within each global quadrant, include the major global mountains and major global monsoonal circulations over North America, South America, India-China, and Australia. They also can include the polar domains, and the European and African regions. The SG-approach provides an efficient regional downscaling to mesoscales, and it is an ideal tool for representing consistent interactions of global- and regional- scales while preserving the high quality of global circulation. Basically, the SG-GCM simulations are no different from those of the traditional uniform-grid GCM simulations besides using a variable-resolution grid. Several existing SG-GCMs developed by major centers and groups are briefly described. The major discussion is based on the GEOS (Goddard Earth Observing System) SG-GCM regional climate simulations.

Author

*Climate Models; Precipitation (Meteorology)*

**2004000343** Air Force Combat Climatology Center, Scott AFB, IL, USA

**Western Pacific Basin: A Climatological Study**

Higdon, Melody; Louer, John, III; Lilianstrom, Robert; Killman, Virgil; Carey, Don; Aug. 29, 2003; 258 pp.; In English; Original contains color illustrations

Report No.(s): AD-A418468; AFCCC/TN-03/001; No Copyright; Avail: CASI; [A12](#), Hardcopy

This technical note is a climatological study of the Western Pacific Basin. After describing the geography and major meteorological features of the entire region, the study discusses in detail the climatic controls of each of the Western Pacific Basin's 'five zones of climatic commonality.' Each 'season' is defined and discussed in considerable detail with emphasis on general weather, hazards, clouds, visibility, winds, precipitation, and temperature.

DTIC

*Climatology; Regions; Weather*

**2004000344** Naval Surface Warfare Center, Dahlgren, VA

**Measurement and Prediction of Particulate Concentration Within External and Internal Flows**

Russell, Lisle H.; Bushong, Philip M.; Richardson, Robert E.; Oct. 1997; 98 pp.; In English; Original contains color illustrations

Report No.(s): AD-A418455; NSWCDD/JTR-97/08; No Copyright; Avail: CASI; [A05](#), Hardcopy

The focus of this report is the formation, growth, and transport of airborne particulate clouds within the boundary layer atmosphere as well as the interaction of such clouds with the terrain surface and objects (e.g., ships and buildings) on the earth's surface. The methodology outlined in the report can be used to answer the simple question, 'What happens to particulate clouds once they are formed?' The specific particulate subjected to detailed analysis was a millimeter-wave (mmw) obscurant. A novel concentration measurement device (a type of interferometer) applicable to this class of obscurants was used to collect data during a dissemination field test. The experimental data compared favorably to external flow predictions resulting from the Transport, Diffusion, and Radiance (TDR) computer code, interim version 3.2. TDR is based on Gaussian statistics with high fidelity physical assumptions governing the behavior of puffs and plumes. Predictions were also made of internal room contamination caused by the ingestion of a particulate cloud by a notional, ventilated building. This analysis employed the Ship Chemical Warfare Vulnerability Ventilation Model (VENM). Time-dependent concentration, exposure, and deposition histories were calculated and graphically rendered for the mmw obscurant cloud. Parameters that significantly impact the TDR predictions for these quantities were varied as part of a sensitivity analysis. Limitations in particulate concentration measurement accuracy are discussed in an overall sense and are related to predictions resulting from both Gaussian and computational fluid dynamics (CFD) models. Suggestions are provided as to when Gaussian and when CFD modeling approaches are warranted.

DTIC

*Clouds (Meteorology); Boundary Layers*

**20040000493** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Synergic use of TOMS and Aeronet Observations for Characterization of Aerosol Absorption**

Torres, O.; Bhartia, P. K.; Dubovik, O.; Holben, B.; Siniuk, A.; [2003]; 1 pp.; In English; EGS-AGU-EUG Joint Assembly 2003, 7-11 Apr. 2003, Nice, France; No Copyright; Avail: Other Sources; Abstract Only

The role of aerosol absorption on the radiative transfer balance of the earth-atmosphere system is one of the largest sources of uncertainty in the analysis of global climate change. Global measurements of aerosol single scattering albedo are, therefore, necessary to properly assess the radiative forcing effect of aerosols. Remote sensing of aerosol absorption is currently carried out using both ground (Aerosol Robotic Network) and space (Total Ozone Mapping Spectrometer) based observations. The satellite technique uses measurements of backscattered near ultraviolet radiation. Carbonaceous aerosols, resulting from the combustion of biomass, are one of the most predominant absorbing aerosol types in the atmosphere. In this presentation, TOMS and AERONET retrievals of single scattering albedo of carbonaceous aerosols, are compared for different environmental conditions: agriculture related biomass burning in South America and Africa and peat fires in Eastern Europe. The AERONET and TOMS derived aerosol absorption information are in good quantitative agreement. The most absorbing smoke is detected over the African Savanna. Aerosol absorption over the Brazilian rain forest is less absorbing. Absorption by aerosol particles resulting from peat fires in Eastern Europe is weaker than the absorption measured in Africa and South America. This analysis shows that the near UV satellite method of aerosol absorption characterization has the sensitivity to distinguish different levels of aerosol absorption. The analysis of the combined AERONET-TOMS observations shows a high degree of synergy between satellite and ground based observations.

Author

*Aerosols; Remote Sensing; Total Ozone Mapping Spectrometer; Satellite Observation; Absorption*

**20040000680** New Mexico Univ., Albuquerque, NM, USA

**The Structural Changes of Tropical Cyclones Upon Interaction with Vertical Wind Shear**

Ritchie, Elizabeth A.; [2003]; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG5-12364; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Fourth Convection and Moisture Experiment (CAMEX-4) provided a unique opportunity to observe the distributions and document the roles of important atmospheric factors that impact the development of the core asymmetries and core structural changes of tropical cyclones embedded in vertical wind shear. The state-of-the-art instruments flown on the NASA DC-8 and ER-2, in addition to those on the NOAA aircraft, provided a unique set of observations that documented the core structure throughout the depth of the tropical cyclone. These data have been used to conduct a combined observational and modeling study using a state-of-the-art, high-resolution mesoscale model to examine the role of the environmental vertical wind shear in producing tropical cyclone core asymmetries, and the effects on the structure and intensity of tropical cyclones. The scientific objectives of this study were to obtain in situ measurements that would allow documentation of the physical mechanisms that influence the development of the asymmetric convection and its effect on the core structure of the tropical cyclone.

Author

*Cyclones; Wind Shear*

**20040000736** NASA Ames Research Center, Moffett Field, CA, USA

**Principal Component Analysis of Arctic Solar Irradiance Spectra**

Rabbette, Maura; Pilewskie, P.; [2003]; 13 pp.; In English

Contract(s)/Grant(s): NCC2-1164; Copyright; Avail: Other Sources

During the First International Satellite Cloud Climatology Regional Experiment Phase III (FIRE III) Arctic Cloud Experiment (ACE) and coincident Surface Heat Budget of the Arctic Ocean (SHEBA) campaign, detailed moderate-resolution solar spectral measurements were made to study the radiative energy budget of the coupled Arctic Ocean - atmosphere system. The National Aeronautics and Space Administration (NASA) Ames Solar Spectral Flux Radiometers (SSFR) were used to measure moderate-resolution solar spectral irradiance in the spectral range 380-2200 nm on board the NASA ER-2 (flying at 21 km) and on the surface at the SHEBA ice camp. Principal Component Analysis (PCA) of SSFR spectra was used to quantify the variability in the data, to determine its causes, to assess our ability to separate cloud and surface effects, and to compare PCA in the Arctic with similar analysis of spectra obtained at a midlatitude continental site. For both the upwelling and downwelling spectra, nearly all of the variance was contained in the first six principal components (PC). The variability in the Arctic downwelling solar irradiance spectra was explained by a few fundamental components including cloud absorption, surface reflectance, molecular scattering, water vapor, and ozone. PCA of the SSFR upwelling spectra separated the influence of the ice surface from that of clouds.

Author

*Principal Components Analysis; Solar Radiation; Solar Spectra; Arctic Regions; Climatology; Remote Sensing; Radiometers*

**20040000776** ENSCO, Inc., Cocoa Beach, FL, USA

**MiniSODAR(TradeMark) Evaluation**

Short, David A.; Wheeler, Mark M.; October 2003; 35 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NAS10-01052

Report No.(s): NASA/CR-2003-211192; Rept-03-003; No Copyright; Avail: CASI; A03, Hardcopy

This report describes results of the AMU's Instrumentation and Measurement task for evaluation of the Doppler miniSODAR(TradeMark) System (DmSS). The DmSS is an acoustic wind profiler providing high resolution data to a height of approx. 410 ft. The Boeing Company installed a DmSS near Space Launch Complex 37 in mid-2002 as a substitute for a tall wind tower and plans to use DmSS data for the analysis and forecasting of winds during ground and launch operations. Peak wind speed data are of particular importance to Launch Weather Officers of the 45th Weather Squadron for evaluating user Launch Commit Criteria. The AMU performed a comparative analysis of wind data between the DmSS and nearby wind towers from August 2002 to July 2003. The DmSS vertical profile of average wind speed showed good agreement with the wind towers. However, the DmSS peak wind speeds were higher, on average, than the wind tower peak wind speeds by about 25%. A statistical model of an idealized Doppler profiler was developed and it predicted that average wind speeds would be well determined but peak wind speeds would be over-estimated due to an under-specification of vertical velocity variations in the atmosphere over the Profiler.

Author

*Wind Measurement; Spacecraft Launching; Ground Operational Support System; Wind Velocity*

**20040000848** Massachusetts Inst. of Tech., Cambridge, MA, USA

**Physical Processes Influencing Atmospheric Trace Constituents Measured from Aircraft in Trace-P**

Newell, Reginald E.; Plumb, R. Alan; October 31, 2003; 5 pp.; In English

Contract(s)/Grant(s): NCC1-415; No Copyright; Avail: CASI; A01, Hardcopy

This paper presents a final report on physical processes influencing atmospheric trace constituents measured for aircraft in trace-P. This report covers the period of July 21, 2000 through October 31, 2003.

CASI

*Atmospheric Composition; Tropical Regions; Meteorology; Trace Contaminants; Transition Region and Coronal Explorer; Physical Properties*

**20040000990** NASA Ames Research Center, Moffett Field, CA, USA

**Solar Spectral Radiative Forcing during the Southern African Regional Science Initiative**

Pilewskie, P.; Pommier, J.; Bergstrom, R.; Gore, W.; Howard, S.; Rabbette, M.; Schmid, B.; Hobbs, P. V.; Tsay, S. C.; Journal of Geophysical Research; 2003; ISSN 0148-0227; Volume 108, No. D13, pp. 22-1 - 22-7; In English

Contract(s)/Grant(s): NCC2-1164; Copyright; Avail: Other Sources

During the dry season component of the Southern African Regional Science Initiative (SAFARI) in late winter 2000, the net solar spectral irradiance was measured at flight levels throughout biomass burning haze layers. From these measurements, the flux divergence, fractional absorption, instantaneous heating rate, and absorption efficiency were derived. Two cases are examined: on 24 August 2000 off the coast of Mozambique in the vicinity of Inhaca Island and on 6 September 2000 in a very thick continental haze layer over Mongu, Zambia. The measured absolute absorption was substantially higher for the case over Mongu where the measured midvisible optical depth exceeded unity. Instantaneous heating from aerosol absorption was 4 K do over Mongu, Zambia and 1.5 K do near Inhaca Island, Mozambique. However, the spectral absorption efficiency was nearly identical for both cases. Although the observations over Inhaca Island preceded the river of smoke from the southern African continent by nearly 2 weeks, the evidence here suggests a continental influence in the lower tropospheric aerosol far from source regions of burning. particles (0345, 4801); 0342 Atmospheric Composition and Structure: Middle atmosphere-energy

Author

*Aerosols; Solar Radiation*

**20040001060** Bucknell Univ., Lewisburg, PA, USA

**Investigation of Aerodynamic and Radiometric Land Surface Temperatures**

Crago, Richard D.; Friedl, Mark; Kustas, William; Wang, Ye-Qiao; November 08, 2003; 11 pp.; In English

Contract(s)/Grant(s): NAG5-8679; No Copyright; Avail: CASI; A03, Hardcopy

The overall goal of the project was to reconcile the difference between  $T_{s,r}$  and  $T_{aero}$ , while maintaining consistency within models and with theory and data. The project involved collaboration between researchers at Bucknell University, Boston University, University of mode Island, and the USDNARS Hydrology Laboratory. This report focuses on the work done at Bucknell, which used an analytical continuous-source flux model developed by Crago (1998), based on work by Brutsaert and Sugita (1996) to generate fluxes at all levels of the canopy. Named ALARM [Analytical Land-Atmosphere-Radiometer Model] by Suleiman and Crago (2002), the model assumes the foliage has an exponential vertical temperature profile. The same profile is felt by the within-canopy turbulence and 'seen' by a radiometer viewing the surface from any zenith view angle. ALARM converts radiometric surface temperatures taken from any view angle into a clearly-defined version of  $T_{aero}$  called the equivalent isothermal surface temperature  $T_{s,j}$ , and then calculates the sensible heat flux  $H$  using Monin-Obukhov similarity theory. This allows remotely sensed  $T_{s,r}$  measurements to be used to produce high quality sensible and latent heat flux estimates, or to validate or update the surface temperature produced by SVATs in climate or mesoscale models.

Author

*Surface Temperature; Temperature Profiles; Aerodynamics; Radiometers; Atmospheric Models; Earth Surface*

**20040001075** NASA Langley Research Center, Hampton, VA, USA

**Near-Real-Time Satellite Cloud Products for Icing Detection and Aviation Weather over the USA**

Minnis, Patrick; Smith, William L., Jr.; Nguyen, Louis; Murray, J. J.; Heck, Patrick W.; Khaiyer, Mandana M.; [2003]; 7 pp.; In English; FAA In-Flight Icing/Ground De-Icing International Conference, 16-20 Jun. 2003, Chicago, IL, USA

Contract(s)/Grant(s): DE-AI02-97ER-62341

Report No.(s): Paper 2003-01-2097; No Copyright; Avail: CASI; A02, Hardcopy

A set of physically based retrieval algorithms has been developed to derive from multispectral satellite imagery a variety of cloud properties that can be used to diagnose icing conditions when upper-level clouds are absent. The algorithms are being applied in near-real time to the Geostationary Operational Environmental Satellite (GOES) data over Florida, the Southern Great Plains, and the midwestern USA. The products are available in image and digital formats on the world-wide web. The analysis system is being upgraded to analyze GOES data over the CONUS. Validation, 24-hour processing, and operational issues are discussed.

Author

*Cloud Physics; Ice Formation; Real Time Operation; Weather; Detection; Aeronautics*

48  
**OCEANOGRAPHY**

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

**20040001347** Lockheed Martin Corp., Bay Saint Louis, MS, USA

**Floating Probe Assembly for Measuring Temperature of Water**

Stewart, Randy; Ruffin, Clyde; March 22, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2002-06-00026-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A floating apparatus denoted a temperature probe aquatic suspension system (TPASS) has been developed for measuring the temperature of an ocean, lake, or other natural body of water at predetermined depths. Prior instruments built for the same purpose were found to give inaccurate readings because the apparatuses themselves significantly affected the temperatures of the water in their vicinities. The design of the TPASS is intended to satisfy a requirement to minimize the perturbation of the temperatures to be measured. The TPASS includes a square-cross-section aluminum rod 28 in. (=71 cm) long with floats attached at both ends. Each float includes five polystyrene foam disks about 3/4 in.(=1.9 cm) thick and 2.5 in. (=6.4 cm) in diameter. The disks are stacked to form cylinders, bolted to the rod, and covered with hollow plastic sleeves. A metal sleeve is clamped to the middle of the aluminum rod, from whence it hangs down into the water. Temperature probes (which can be thermocouples, thermistors, or resistance temperature devices) are placed within the sleeve at the desired measurement depths. Wires from the temperature probes are routed to the input terminals of a data logger.

Author

*Temperature Probes; Water Depth; Ocean Temperature; Floating*

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*.

**20030068897** NASA Langley Research Center, Hampton, VA, USA

**Physiological Feedback Method and System**

Pope, Alan T., Inventor; Severance, Kurt E., Inventor; November 12, 2002; 14 pp.; In English

Patent Info.: Filed 28 Jan. 2000; US-Patent-6,478,735; US-Patent-Appl-SN-494160; US-Patent-Appl-SN-118772; US-Patent-Appl-SN-170784; NASA-Case-LAR-15396-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

A method and system provide physiological feedback for a patient and/or physician. At least one physiological effect experienced by a body part of a patient is measured noninvasively. A three-dimensional graphics model serving as an analogous representation of the body part is altered in accordance with the measurements. A binocular image signal representative of the three-dimensional graphics model so-altered is displayed for the patient and/or physician in a virtual reality environment.

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

*Feedback; Virtual Reality; Physiological Effects*

**20040000096** Scripps Research Inst., La Jolla, CA

**The Role of Dereglated Cyclin E Proteolysis in Breast Cancer Development**

Drogen, Frank van; Reed, Steven; Strohmaier, Heimo M.; May 2003; 21 pp.; In English

Contract(s)/Grant(s): DAMD17-00-1-0428

Report No.(s): AD-A418341; No Copyright; Avail: CASI; [A03](#), Hardcopy

In breast cancer, the regulatory mechanisms that operate to control proper progression of the cell through each cell cycle are perturbed, leading to uncontrolled cell division. A key regulator of cell cycle passage is the G1 cyclin, cyclin E, which regulates the transition from G1 phase into S phase where replication of the DNA occurs. Cyclin E is synthesized and associates periodically with its catalytic subunit, the cyclin-dependent kinase CDK2, followed by its rapid destruction in early S phase. Abnormal accumulation of cyclin E is frequently observed in breast cancer. The levels of cyclin S correlate with the advanced stage and grade of the tumor and with a poor prognosis for breast cancer patients. Previous work has suggested that defects in the proteolytic destruction of cyclin E may account for its accumulation in these tumors. In the first year of this

study, we have shown that the turnover of cyclin S is controlled by the ubiquitin- dependent SCF pathway. We have also isolated a novel human F- box protein, designated hCdc4, that specifically directs ubiquitination of cyclin E in a phosphorylation-dependent manner. In the second year of this proposal, we have extended the characterization of this newly identified pathway and we have addressed the question whether mutations to components of the pathway might account for accumulation of cyclin E in tumor cells.

DTIC

*Cells (Biology); Cancer*

**2004000099** Toledo Univ., OH

**Measurement of the Electron Density Distribution of Estrogens - A First Step to Advanced Drug Design**

Parrish, Damon A.; Pinkerton, A. A.; Jul. 2003; 54 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-00-1-0468

Report No.(s): AD-A418344; No Copyright; Avail: CASI; [A04](#), Hardcopy

It has been shown that the development of certain types of cancer can be hormone dependent. Estrogens, such as estradiol, have the ability to bind as ligands to the estrogen receptor in the first of many steps which could result in the activation or repression of genes critical in the mechanism of tumor growth. The principle objective of this proposal is to relate known biological reactions to physical properties such as point charges of atoms and the electrostatic potential. We are obtaining information about these electronic properties of estrogen derivatives from experimental determination of their electron density using high quality single crystal X-ray crystallography. During the past year, the focus was in completing Task 3, analysis of charge density data sets, for three systems (17-beta estradiol.1/2MeOH, 17-alpha estradiol. 1/ 2H2O, and 17-alpha-estradiol .urea). Data integration techniques have been refined to improve overall data quality and consistency. Topological analysis has been completed, while analysis of the electrostatic potential is nearly complete. Initial comparisons have yielded some expected and unexpected results. These will be discussed in the body of the report. Continued effort must be made to obtain more quality data of different systems to increase the amount of data we have to reference to.

DTIC

*Estrogens; Cancer*

**2004000103** Sloan-Kettering Inst. for Cancer Research, New York, NY

**Radiolabeled Herceptin to Increase Treatment Efficacy in Breast Cancer Patients With Low Tumor HER-2/neu Expression**

Sgouros, George; Jul. 2003; 42 pp.; In English

Contract(s)/Grant(s): DAMD17-00-1-0429

Report No.(s): AD-A418347; No Copyright; Avail: CASI; [A03](#), Hardcopy

The primary objective of the proposal is to evaluate the efficacy and feasibility of using radiolabeled Herceptin antibody to target rapidly accessible breast carcinoma cells or micrometastases. By using Herceptin to specifically deliver radiation we anticipate that the efficacy of Herceptin will be extended to include breast cancer cells that are not high HER-2/neu antigen expressors. This hypothesis will be tested using the spheroid model to simulate rapidly accessible micrometastases. An alpha-particle emitting radionuclide will be used to enhance tumor cell kill. Completion of tasks 1-3 and progress towards task 5 was reported in the previous annual report. The animal model previously used towards task 5 was a HER-2/neu expressing ovarian carcinoma. The PI has identified an appropriate disseminated breast carcinoma animal model and will be using this to satisfy the remaining tasks of the proposal. Because the PI relocated in 2003, progress in the past year has been delayed. The PI is in the process of setting up a sub- contract at Hopkins to complete the tasks of the proposal. The sub-contract mechanism is being used because after discussions with the contracting officer this was deemed the most expeditious approach to providing funds for the PI to complete the work at Hopkins.

DTIC

*Cancer; Spheroids*

**2004000119** Fox Chase Cancer Center, Philadelphia, PA, USA

**Validate Mitotic Checkpoint and Kinetochore Motor Proteins in Breast Cancer Cells as Targets for the Development of Novel Anti-Mitotic Drugs**

Yen, Timothy J.; Jul. 2003; 14 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-01-1-0239

Report No.(s): AD-A418346; No Copyright; Avail: CASI; [A03](#), Hardcopy

Drugs that inhibit microtubule functions are one of many anti-neoplastic drugs that are used to combat breast and other cancers. Taxol and vincristine are microtubule poisons that block that proper function of microtubules that are essential for a broad spectrum of motile biological processes that include cell division, vesicle transport, cell shape, and flagella functions. For rapidly proliferating cancer cells, anti-microtubule drugs offers a highly effective means to block cell division and thus stop tumor growth. Nevertheless, these drugs block other microtubule dependent processes that adversely affect the functions of many non- dividing cells. Furthermore, there is the complication that the cancer cells can develop multi-drug resistance that makes them refractile to conventional antineoplastic agents. The identification of novel drugs with increased selectivity towards mitotic processes and act synergistically with existing anti-microtubule drugs should enhance and refine the modalities used to treat breast cancer patients. Our interest in the molecular and biochemical mechanisms that are central to mitosis in human cells has led to the identification of novel proteins and pathways that are suited for designing highly specific anti-mitotic drugs. The objective of this proposal is to disrupt such pathways in established breast cancer cell lines to validate them as suitable targets for developing new anti-mitotic drugs.

DTIC

*Cancer; Cytology; Activity (Biology)*

**20040000123** State Univ. of New York, Stony Brook, NY, USA

**Identification of the Role of MnSOD in EGFR- Positive Breast Cancer Development**

Archer, Herbert; Bar-Sagi, Dafna; May 2003; 7 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0519

Report No.(s): AD-A418348; No Copyright; Avail: CASI; [A02](#), Hardcopy

In accordance with Task 1 of the Statement of Work, the HB4a cell line was characterized with respect to its requirements for normal cellular growth, and the conditions needed to support growth in soft agar. After determining the optimal conditions for supporting growth in soft agar, further effort was placed on optimizing the use of the human erbB2 expression vector. Because a large part of the experimental design included the use of single cell microinjection assays, there was a need to tag the erbB2 construct for ease of identification. Since erbB2 is a membrane protein, I was unwilling to attach a tag directly to the protein. Instead, an Ires-GFP element was placed downstream of erbB2 in the pcDNA background. Transient transfection and microinjection studies confirmed the expression from the Ires-GFP element in HB4a cells. Microinjection experiments were performed using both MnSOD and erbB2-Ires-GFP in HB4a cells to identify the role of MnSOD in mediating the proliferative response to erbB2. The results initially showed a MnSOD mediated inhibition of erbB2 induced cell cycle progression. However, a recent analysis of the dual expression of MnSOD and ERBB2 indicated a significant level of promoter competition between the 2 constructs. Current efforts are focused on subcloning the MnSOD cDNA into an expression vector that has been shown to work well with the pcDNA promoter. Once this issue is resolved, I will repeat the analysis of cell cycle progression and continue with Tasks I and 2 as planned.

DTIC

*Cancer; Experiment Design*

**20040000127** Fox Chase Cancer Center, Philadelphia, PA, USA

**Hierarchical Nonlinear Mixed Effects Modeling: Defining Post-Radiation Therapy Relapse in Prostate Cancer Patients**

Hanlon, Alexandra L.; Jul. 2003; 8 pp.; In English

Contract(s)/Grant(s): DAMD17-01-1-0056

Report No.(s): AD-A418391; No Copyright; Avail: CASI; [A02](#), Hardcopy

During this grant period, a linear-quadratic random effects model of the profile of PSA levels in men following radiation therapy for prostate cancer was developed. It can be used to predict, for a new patient, the expected trajectory of future PSA levels, and the probability of biochemical failure. The model, which includes terms for initial PSA, post- treatment PSA nadir, time of nadir, and future PSA level, also allows us to update these predictions as new PSA measurements on the patient are collected. We show that our method has some advantages over the widely used definition of biochemical failure as three consecutive rises in post-nadir PSA level.

DTIC

*Prostate Gland; Cancer*

**20040000150** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Thiamin Pyrophosphate-Motif**

Dominiak, P.; Ciszak, E.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Using databases the authors have identified a common thiamin pyrophosphate (TPP)-motif in the family of functionally diverse TPP-dependent enzymes. This common motif consists of multimeric organization of subunits and two catalytic centers. Each catalytic center (PP:PYR) is formed at the interface of the PP-domain binding the magnesium ion, pyrophosphate and amhopyrimidine ring of TPP, and the PYR-domain binding the aminopyrimidine ring of that cofactor. A pair of these catalytic centers constitutes the catalytic core (PP:PYR)(sub 2) within these enzymes. Analysis of the structural elements of this catalytic core reveals novel definition of the common amino acid sequences, which are GXPhiX(sub 4)(G)PhiXXGQ and GDGX(sub 25-30)NN in the PP-domain, and the EX(sub 4)(G)PhiXXGPhi in the PYR-domain, where Phi corresponds to a hydrophobic amino acid. This TPP-motif provides a novel tool for annotation of TPP-dependent enzymes useful in advancing functional proteomics.

Author

*Proteome; Enzymes; Sequencing; Phosphates*

**20040000170** Alabama Univ., Birmingham, AL

**Understanding the Mechanism of Action of Breast Metastasis Suppressor BRMS1**

Samant, Rajeev S.; Jul. 2003; 40 pp.; In English

Contract(s)/Grant(s): DAMD17-01-1-0362

Report No.(s): AD-A418406; No Copyright; Avail: CASI; [A03](#), Hardcopy

The focus of this study is to understand the biology behind the metastasis suppression via BRMS1, a recently identified metastasis suppressor gene. BRMS1 is a protein with a glutamic acid rich N-terminus, coiled-coil domain, an imperfect leucine zipper and nuclear localization signals. It is expressed almost ubiquitously in human tissues and is highly conserved across species. Sub-cellular fractionation and fluorescence immuno-cytochemistry has indicated that it localizes to nucleus. BRMS1 is shown to restore homotypic gap-junctional communication. Our hypothesis is that it may be involved in transcription regulatory complex. To identify proteins that interacting with BRMS1 a yeast two- hybrid screen was performed using full length BPNS1 as a bait and human mammary gland library as a prey. We confirmed RBPI (Rh binding protein), FLJ000S2 (EST), MRJ (Hsp40 related chaperon) and Nmi (N-myc interactor) as potential interactors at cellular level by co-immunoprecipitation studies. We have further demonstrated that BRMS1 is a component of mSin3-HDAC complex. Based on these observations it is tempting to speculate that BRMS1 regulates gene expression by histone deacetylation. Currently we are studying the role of this complex in regulation of metastasis of breast cancer.

DTIC

*Genes; Mammary Glands; Metastasis; Cancer*

**20040000192** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Alpha-amylase from the Hyperthermophilic Archaeon Thermococcus thio-reducens**

Bernhardsdotter, E. C. M. J.; Pusey, M. L.; Ng, M. L.; Garriott, O. K.; [2003]; 1 pp.; In English; American Society for Gravitational and Space Biology Conference, 12-16 Nov. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NCC8-200; Copyright; Avail: Other Sources; Abstract Only

Extremophiles are microorganisms that thrive in, from an anthropocentric view, extreme environments such as hot springs. The ability of survival at extreme conditions has rendered enzymes from extremophiles to be of interest in industrial applications. One approach to producing these extremozymes entails the expression of the enzyme-encoding gene in a mesophilic host such as E.coli. This method has been employed in the effort to produce an alpha-amylase from a hyperthermophile (an organism that displays optimal growth above 80 C) isolated from a hydrothermal vent at the Rainbow vent site in the Atlantic Ocean. alpha-amylases catalyze the hydrolysis of starch to produce smaller sugars and constitute a class of industrial enzymes having approximately 25% of the enzyme market. One application for thermostable alpha-amylases is the starch liquefaction process in which starch is converted into fructose and glucose syrups. The a-amylase encoding gene from the hyperthermophile Thermococcus thio-reducens was cloned and sequenced, revealing high similarity with other archaeal hyperthermophilic a-amylases. The gene encoding the mature protein was expressed in E.coli. Initial characterization of this enzyme has revealed an optimal amylolytic activity between 85-90 C and around pH 5.3-6.0.

Author

*Thermophiles; Microorganisms; Enzymes*

**20040000210** Brigham and Women's Hospital, Boston, MA

**Regulation of FAK Signaling in Mammary Epithelial Cells by Cbl Proto-Oncogene Product**

Donoghue, Stephen; Band, Hamid; Ghosh, Amly; Jan. 2003; 98 pp.; In English

Contract(s)/Grant(s): DAMD17-99-1-9085

Report No.(s): AD-A418422; No Copyright; Avail: CASI; [A05](#), Hardcopy

Proliferation and differentiation of normal breast epithelial cells are regulated by activation of the cellular tyrosine kinase machinery upon coordinated cellular stimulation through growth factor receptor tyrosine kinases and extra-cellular matrix receptor-induced activation of focal adhesion kinase FAK. This proposal is designed to investigate a novel hypothesis that Cbl provides, which has become established as a negative regulator of growth factor receptors, attenuates FAK-dependent growth signals in mammary epithelial cells. Given the recent findings that Cbl functions as ubiquitin ligase towards tyrosine kinases, we have been examining the possibility that Cbl regulates FAK signaling by targeting it for degradation directly and/or by targeting Src- family kinases that function as upstream activators of FAK. The work reported here describes FAK mutants that appear to be unable to interact with Cbl tyrosine kinase-binding domain and their ability to alter actin cytoskeleton. Together with the demonstration of Src-family degradation and negative regulation by Cbl, the present studies establish FAK as a target of Cbl. Further studies based on these novel findings are likely to provide important insights into the regulation of proliferation signals in breast cancer cells.

DTIC

*Epithelium; Mammary Glands; Cancer; Enzyme Activity*

**20040000233** Cornell Univ., New York, NY, USA

**Molecular Markers of Retinoid Action in Human Prostate**

Li, Rong; Gudas, Lorraine J.; Jun. 2003; 18 pp.; In English

Contract(s)/Grant(s): DAMD17-01-1-0048

Report No.(s): AD-A418424; No Copyright; Avail: CASI; [A03](#), Hardcopy

Retinoic acid (RA) has been used successfully in cancer prevention and therapy. RA exerts its biological effects through retinoic acid receptors (RARs, alpha, beta, gamma) It has been reported that RARbeta plays an important role in mediating growth inhibitory actions of RA. The expression of RAR beta is lost in prostate cancer cell lines, PC-3, and DU-145, while transfection of RAR beta into PC-3 cells results in an increased sensitivity to growth inhibitory effects of RAR beta against. Despite the correlation between the level of RAR beta and the RA-associated growth inhibition, it remains unknown how RAR beta mediates the growth inhibitory effects of RA. This study used murine F9 wild type (Wt) and RAR beta knockout (F9 RAR beta-1-) cells as an experimental model to investigate the molecular mechanisms by which RAR beta mediates the growth inhibitory actions of RA. Our study demonstrated that p27, a cell cycle progression regulatory protein, is increased by RA in F9 Wt cells as compared to the F9 RAR beta-1- cells. In addition, RA stabilizes the protein stability of p27. Considering the striking findings that transfection of RAR% into the PC-3 cells results in an increased sensitivity to growth inhibition caused by RAR beta against, our study may lead to more efficient chemotherapy with retinoids.

DTIC

*Chemotherapy; Prostate Gland; Cancer*

**20040000299** Army Research Inst. of Environmental Medicine, Natick, MA

**The U.S. Army's Health Risk Appraisal (HRA) Survey, Part I, History, Reliability, and Validity**

Senier, Laura; Bell, Nicole S.; Strowman, Shelley R.; Schempp, Catherine; Amoroso, Paul J.; Aug. 2003; 110 pp.; In English  
Report No.(s): AD-A418456; USARIEM-TN-03-6; No Copyright; Avail: CASI; [A06](#), Hardcopy

The U.S. Army offered a health risk appraisal from 1988 to 1998 as part of a comprehensive health promotion program. Although health risk appraisals are typically designed and used solely for educational and diagnostic purposes, and not to gather information for research purposes, the Army's Health Risk Appraisal (HRA) has yielded an enormous database of self-reported information about health habits that is potentially useful for both surveillance and research efforts. This report documents the history of the Army's HRA and establishes its utility as a tool for epidemiologic research.

DTIC

*Epidemiology; Health; Risk*

**20040000555** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Radiation Dose-effects on Cell Cycle, Apoptosis, and Marker Expression of Ataxia Telangiectasia-Heterozygous Human Breast Epithelial Cells**

Cruz, A.; Bors, K.; Jansen, H.; Richmond, R.; [2003]; 1 pp.; In English; 5th Annual Biological Sciences Retreat, 11 Oct. 2003, Guntersville, AL, USA; No Copyright; Avail: Other Sources; Abstract Only

Ataxia-telangiectasia (A-T) is a radiation-sensitive genetic condition. AT-heterozygous human mammary epithelial cells (HMEC) were irradiated using a Cs137 source in order to compare cell cycle, apoptosis, and marker expression responses across 3 radiation doses. No differences in cell cycle and apoptosis were found with any of the radiation doses used (30, 60,

and 90 rads) compared with the unirradiated control (0 rad). At the same doses, however, differences were found in marker expression, such as keratin 18 (kl8), keratin 14 (k14), insulin-like growth factor I receptor (IGF-IR), and connexin 43 (cx43). This may indicate that radiation sensitivity in the heterozygous state may be initiated through signal transduction responses.

Author

*Apoptosis; Radiation Effects; Mammary Glands; Ataxia; Dosage; Genetics*

**20040000576** California Univ., Berkeley, CA, USA

**A Hedgehog Homolog Regulates Gut Formation in Leech (*Helobdella*)**

Kang, Dongmin; Huang, Françoise; Li, Dongling; Shankland, Marty; Gaffield, William; Weisblat, David A.; *Development* 130; 2003, pp. 1645-1657; In English

Contract(s)/Grant(s): NSF IBN 97-23114; NIH-RO1-GM-60240; NAG2-1349; NAG2-1359; Copyright; Avail: Other Sources

Signaling by the hedgehog (hh)-class gene pathway is essential for embryogenesis in organisms ranging from *Drosophila* to human. We have isolated a hh homolog (Hrohh) from a lophotrochozoan species, the glossiphoniid leech, *Helobdella robusta*, and examined its expression by reverse transcription polymerase chain reaction (RT-PCR) and whole-mount in situ hybridization. The peak of Hrohh expression occurs during organogenesis (stages 10-11). No patterned expression was detected within the segmented portion of the germinal plate during the early stages of segmentation. In stage 10-11 embryos, Hro-hh is expressed in body wall, foregut, anterior and posterior midgut, reproductive organs and in a subset of ganglionic neurons. Evidence that Hro-hh regulates gut formation was obtained using the steroidal alkaloid cyclopamine, which specifically blocks HH signaling. Cyclopamine induced malformation of both foregut and anterior midgut in *Helobdella* embryos, and no morphologically recognizable gonads were seen. In contrast, no gross abnormalities were observed in the posterior midgut. Segmental ectoderm developed normally, as did body wall musculature and some other mesodermal derivatives, but the mesenchymal cells that normally come to fill most of the coelomic cavities failed to develop. Taken with data from *Drosophila* and vertebrates, our data suggest that the role of hh-class genes in gut formation and/or neural differentiation is ancestral to the bilaterians, whereas their role in segmentation evolved secondarily within the Ecdysozoa.

Author

*Invertebrates; Organs; Digestive System; Genes; Embryology*

**20040000577** California Univ., Berkeley, CA, USA

**An Overview of Glossiphoniid Leech Development**

Weisblat, David A.; Huang, Françoise Z.; *Canadian Journal of Zoology*; [2001]; Volume 79, pp. 218-232; In English

Contract(s)/Grant(s): NAG2-1359; NSF IBN-91-05713; NIH-ROI-GM/HD-60240; HFSPO-RG-162/98; Copyright; Avail: Other Sources

Dramatic advances in understanding the development of selected 'model' organisms, coupled with the realization that genes which regulate development are often conserved between diverse taxa, have renewed interest in comparative development and evolution. Recent molecular phylogenies seem to be converging on a new consensus 'tree,' according to which higher bilaterians fall into three major groups, Deuterostoma, Ecdysozoa, and Lophotrochozoa. Commonly studied model systems for development fall almost exclusively within the first two of these groups. Glossiphoniid leeches (phylum Annelida) offer certain advantages for descriptive and experimental embryology per se, and can also serve to represent the lophotrochozoan clade. We present an overview of the development of glossiphoniid leeches, highlighting some current research questions and the potential for comparative cellular and molecular studies.

Author

*Worms; Ontogeny; Embryology*

**20040000683** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**The Use of Chlorophyll Fluorescence Lifetime to Assess Phytoplankton Physiology within a River-Dominated Environment**

Hall, Callie M.; Miller, Richard L.; Redalje, Donald G.; Fernandez, Salvador M.; January 5, 2002; 8 pp.; In English; Seventh International Conference of Remote Sensing for Marine and Coastal Environment, 20--22 May 2002, Miami, FL, USA

Report No.(s): SE-2002-03-00018-SSC; No Copyright; Avail: CASI; A02, Hardcopy

Chlorophyll a fluorescence lifetime was measured for phytoplankton populations inhabiting the three physical zones surrounding the Mississippi River's terminus in the Gulf of Mexico. Observations of river discharge volume, nitrate + nitrite, silicate, phosphate, PAR (Photosynthetically Active Radiation) diffuse attenuation within the water column, salinity, temperature, SPM, and chl a concentration were used to characterize the distribution of chl fluorescence lifetime within a given

region within restricted periods of time. 33 stations extending from the Mississippi River plume to the shelf break of the Louisiana coast were surveyed for analysis of chlorophyll fluorescence lifetime during two cruises conducted March 31 - April 6, 2000, and October 24 - November 1, 2000. At each station, two to three depths were chosen for fluorescence lifetime measurement to represent the vertical characteristics of the water column. Where possible, samples were taken from just below the surface and from just above and below the pycnocline. All samples collected were within the 1% light level of the water column (the euphotic zone). Upon collection, samples were transferred to amber Nalgene bottles and left in the dark for at least 15 minutes to reduce the effects of non-photochemical quenching and to insure that photosynthetic reaction centers were open. Before measurements within the phase fluorometer were begun, the instrument was allowed to warm up for no less than one hour.

Derived from text

*Chlorophylls; Fluorescence; Mississippi River (Us); Gulf of Mexico; Nearshore Water; Phytoplankton; Photosynthesis*

**20040000699** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Biomaterials and Magnetic fields for Cancer Therapy**

Ramachandran, Narayanan; Mazuruk, Konstanty; [2003]; 2 pp.; In English; Conference on Space Technologies, 4-6 Nov. 2003, Colorado Springs, CO, USA

Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: CASI; [A01](#), Hardcopy

The field of biomaterials has emerged as an important topic in the purview of NASA's new vision of research activities in the Microgravity Research Division. Although this area has an extensive track record in the medical field as borne out by the routine use of polymeric sutures, implant devices, and prosthetics, novel applications such as tissue engineering, artificial heart valves and controlled drug delivery are beginning to be developed. Besides the medical field, biomaterials and bio-inspired technologies are finding use in a host of emerging interdisciplinary fields such as self-healing and self-assembling structures, biosensors, fuel systems etc. The field of magnetic fluid technology has several potential applications in medicine. One of the emerging fields is the area of controlled drug delivery, which has seen its evolution from the basic oral delivery system to pulmonary to transdermal to direct inoculations. In cancer treatment by chemotherapy for example, targeted and controlled drug delivery has received vast scrutiny and substantial research and development effort, due to the high potency of the drugs involved and the resulting requirement to keep the exposure of the drugs to surrounding healthy tissue to a minimum. The use of magnetic particles in conjunction with a static magnetic field allows smart targeting and retention of the particles at a desired site within the body with the material transport provided by blood perfusion. Once so located, the therapeutic aspect (radiation, chemotherapy, hyperthermia, etc.) of the treatment, now highly localized, can be implemented.

Author

*Bioinstrumentation; Magnetostatic Fields; Tissue Engineering; Prosthetic Devices; Microgravity; Artificial Heart Valves*

**20040000843** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Desulfonatronum Thiodismutans sp. nov., a Novel Alkaliphilic, Sulfate-reducing Bacterium Capable of Lithoautotrophic Growth**

Pikuta, Elena V.; Hoover, Richard B.; Bej, Asim K.; Marsic, Damien; Whitman, William B.; Cleland, David; Krader, Paul; International Journal of Systematic and Evolutionary Microbiology; 2003; Volume 53, pp. 1327-1332; In English; Copyright; Avail: CASI; [A01](#), Hardcopy

A novel alkaliphilic, sulfate-reducing bacterium, strain MLF1(sup T), was isolated from sediments of soda Mono Lake, California. Gram-negative vibrio-shaped cells were observed, which were 0.6-0.7 x 1.2-2.7 microns in size, motile by a single polar flagellum and occurred singly, in pairs or as short spirilla. Growth was observed at 15-48 C (optimum, 37 C), > 1-7 % NaCl, w/v (optimum, 3%) and pH 8.0-10.0 (optimum, 9.5). The novel isolate is strictly alkaliphilic, requires a high concentration of carbonate in the growth medium and is obligately anaerobic and catalase-negative. As electron donors, strain MLF1(sup T) uses hydrogen, formate and ethanol. Sulfate, sulfite and thiosulfate (but not sulfur or nitrate) can be used as electron acceptors. The novel isolate is a lithoheterotroph and a facultative lithoautotroph that is able to grow on hydrogen without an organic source of carbon. Strain MLF1(sup T) is resistant to kanamycin and gentamicin, but sensitive to chloramphenicol and tetracycline. The DNA G+C content is 63.0 mol% (HPLC). DNA-DNA hybridization with the most closely related species, *Desulfonatronum lacustre* Z-7951(sup T), exhibited 51 % homology. Also, the genome size (1.6 x 10<sup>9</sup> Da) and T(sub m) value of the genomic DNA (71 +/- 2 C) for strain MLF1(sup T) were significantly different from the genome size (2.1 x 10<sup>9</sup> Da) and T(sub m) value (63 +/- 2 C) for *Desulfonatronum lacustre* Z-7951(sup T). On the basis of physiological and molecular properties, the isolate was considered to be a novel species of the genus

Desulfonatronum, for which the name Desulfonatronum thiodismutans sp. nov. is proposed (the type strain is MLF1(sup T) = ATCC BAA-395(sup T) = DSM 14708(sup T)).

Author

*Bacteria; Alkalinity; Sulfates; Reduction (Chemistry); Anaerobes; Lakes*

**20040000964** Akron Univ., Akron, OH, USA

**Detection of Directions of Gravity by Organisms and Contributions to SmagIce**

Dill, Loren H.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003]; 2 pp.; In English; See also 20040000959; No Copyright; Avail: CASI; [A01](#), Hardcopy

Research covers the following: In the Microgravity Environment and Telescience Branch, a study was extended that focused upon a flagellated alga or other swimming microbe and the effect of gravity upon its swimming direction. It has long been known that many organisms tend to swim up or down on Earth. How organisms detect the direction of gravity is a question not fully resolved. The response of such organisms to reduced gravity or the absence of gravity is also of interest, particularly because the expected modified behavior may affect the health of astronauts.

Author

*Microorganisms; Gravitational Effects*

**20040001019** Pennsylvania State Univ., University Park, PA, USA

**Molecular Control of Cell Growth During Gravity Responses of Maize Seedlings**

Cosgrove, Daniel J.; [2003]; 5 pp.; In English

Contract(s)/Grant(s): NAG2-1342; No Copyright; Avail: CASI; [A01](#), Hardcopy

Gravity influences plants in many ways via its physical effects on the convective flows of gases and liquids, the buoyancy and sedimentation of cellular organelles, and the distribution of mechanical stresses in weight-bearing structures. These physical effects lead to a variety of reactions and adaptive developmental responses in plants. Perhaps the best-studied plant gravity response is gravitropism - the 'homing in' of growing organs towards a particular angle with respect to gravity. Most plants respond to gravity by gravitropic bending of roots downwards and stems upwards. Such gravitropic bending arises from differential cell growth on the two sides of the bending organ. For this project we hypothesized that such growth differences arise from differences in expansin activity, which come about because of organ-level asymmetries of H<sup>+</sup> efflux and expansin export to the wall.

Author

*Gravitational Effects; Gene Expression; Vegetation Growth*

**20040001161** Alabama Univ., Birmingham, AL

**Treatment of Breast Cancer with Antibodies Against DR4 and DR5 Receptors in Combination with Chemotherapy**

Buchsbaum, Donald J.; Jun. 2003; 16 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-02-1-0264

Report No.(s): AD-A418338; No Copyright; Avail: CASI; [A03](#), Hardcopy

The overall goal of this proposal is to determine the therapeutic potential of apoptosis-inducing anti-human DR5 and DR4 antibodies, alone or together, in combination with chemotherapeutic drugs with activity against breast cancer, for the treatment of metastatic breast cancer. Aim 1 was to determine the expression profile in human breast cancer cell lines of DR5 and DR4 before and after treatment with anti-DR5 and -DR4 MAb alone, together, and in combination with chemotherapy drugs. Aim 3 was to determine the cytotoxicity of anti-DR5 and -DR4 antibodies against human breast cancer cells alone, together, and in combination with adriamycin or paclitaxel. Aim 4 was to determine the therapeutic efficacy and toxicity of anti-DR5 and -DR4 antibodies against human breast cancer xenografts alone, together, and combined with adriamycin or paclitaxel. All breast cancer cell lines expressed DR5 with TRA-8 reactivity varying from strongly to weakly positive. Four cell lines were sensitive to TRA-8 cytotoxicity with IC(50) of 17 to 299 ng/ml while other cell lines had weak cytotoxicity or were resistant. In vivo studies demonstrated significant inhibition of growth of 2LMP xenografts by TRA-8 treatment alone. TRA-8 alone or in combination with adriamycin, paclitaxel, or radiation produced a significant increase in tumor doubling time compared to any modality alone. Complete tumor regressions occurred in 1/42 untreated animals, 1/54 animals receiving chemotherapy and/or radiation and 28/68 animals receiving TRA-8 alone or TRA-8 combination regimens.

DTIC

*Antibodies; Chemotherapy; Cancer*

**20040003963** Woods Hole Oceanographic Inst., MA

**Decoupling of Iron and Phosphate in the Global Ocean**

Parekh, Payal; Jun. 2003; 143 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): NCC5-625

Report No.(s): AD-A417400; MITWHOI-2003-11; No Copyright; Avail: CASI; [A07](#), Hardcopy

Iron is an essential micronutrient for marine phytoplankton, limiting their growth in high nutrient, low chlorophyll regions of the ocean. I use a hierarchy of ocean circulation and biogeochemistry models to understand controls on global iron distribution. I formulate a mechanistic model of iron cycling which includes scavenging onto sinking particles and complexation with an organic ligand. The iron cycle is coupled to a phosphorus cycling model. Iron's aeolian source is prescribed. In the context of a highly idealized multi-box model scheme, the model can be brought into consistency with the relatively sparse ocean observations of iron in the oceans. This biogeochemical scheme is also implemented in a coarse resolution ocean general circulation model. This model also successfully reproduces the broad regional patterns of iron and phosphorus. In particular, the high macronutrient concentrations of the Southern Ocean result from iron limitation in the model. Due to the potential ability of iron to change the efficiency of the carbon pump in the remote Southern Ocean, I study Southern Ocean surface phosphate response to increased aeolian dust flux. My box model and GCM results suggest that a global ten fold increase in dust flux can support a phosphate drawdown of 0.25-0.5 micromolar.

DTIC

*Ocean Currents; Iron; Phosphates; Biogeochemistry*

**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*.

**20040000338** NASA Johnson Space Center, Houston, TX, USA

**Method for Selective Thermal Ablation**

Arndt, G. Dickey, Inventor; Carl, James, Inventor; Ngo, Phong, Inventor; Raffoul, George W., Inventor; July 15, 2003; 14 pp.;

In English; Avail: CASI; [A03](#), Hardcopy

A method, simulation, and apparatus are provided that are highly suitable for treatment of benign prostatic hyperplasia (BPH). A catheter is disclosed that includes a small diameter disk loaded monopole antenna surrounded by fusion material having a high heat of fusion and a melting point preferably at or near body temperature. Microwaves from the antenna heat prostatic tissue to promote necrosing of the prostatic tissue that relieves the pressure of the prostatic tissue against the urethra as the body reabsorbs the necrosed or dead tissue. The fusion material keeps the urethra cool by means of the heat of fusion of the fusion material. This prevents damage to the urethra while the prostatic tissue is necrosed. A computer simulation is provided that can be used to predict the resulting temperature profile produced in the prostatic tissue. By changing the various control features of the catheter and method of applying microwave energy a temperature profile can be predicted and produced that is similar to the temperature profile desired for the particular patient.

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

*Medical Equipment; Ablation; Monopole Antennas; Microwaves; Prostate Gland*

**54**

**MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

Includes human factors engineering, bionics, man-machine systems, life support, space suits and protective clothing. For related information see also *16 Space Transportation and Safety* and *52 Aerospace Medicine*.

**20040000536** Allied Aerospace Industries, Inc., Huntsville, AL, USA

**Odyssey in Space Human Factors: The Challenges of Going Where No One has Gone Before**

Blume, Jenifer Linda; [2003]; 14 pp.; In English; Georgia Tech Engineering Psychology Colloquium, 4 Nov. 2003, Atlanta, GA, USA

Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: CASI; [A03](#), Hardcopy

Some human factors challenges for space missions include: 1) Reduced Gravity; 2) Remote Operation; 3) Information; 4) Multi-Purpose Design. This viewgraph presentation addresses each of these topics. It describes how the design and layout

of equipment on spacecraft can accommodate human activity in a microgravity environment. It describes the remote operation of robotic arms and robots. Displays, procedures, information sharing, and automation are means of conveying information. Multi-purpose design facilitates accommodating and supporting tasks onboard a single vehicle.

CASI

*Human Factors Engineering; Space Missions; Spacecrews; Spacecraft Design*

**2004000687** NASA Marshall Space Flight Center, Huntsville, AL, USA

**A Tabletop Tool for Modeling Life Support Systems**

Ramachandran, N.; Majumdar, A.; McDaniels, D.; Stewart, E.; [2003]; 1 pp.; In English; Conference on Space Technologies, 4-6 Nov. 2003, Colorado Springs, CO, USA

Contract(s)/Grant(s): NAS8-02096; Copyright; Avail: Other Sources; Abstract Only

This paper describes the development plan for a comprehensive research and diagnostic tool for aspects of advanced life support systems in space-based laboratories. Specifically it aims to build a high fidelity tabletop model that can be used for the purpose of risk mitigation, failure mode analysis, contamination tracking, and testing reliability. We envision a comprehensive approach involving experimental work coupled with numerical simulation to develop this diagnostic tool. It envisions a 10% scale transparent model of a space platform such as the International Space Station that operates with water or a specific matched index of refraction liquid as the working fluid. This allows the scaling of a 10 ft x 10 ft x 10 ft room with air flow to 1 ft x 1 ft x 1 ft tabletop model with water/liquid flow. Dynamic similitude for this length scale dictates model velocities to be 67% of full-scale and thereby the time scale of the model to represent 15% of the full-scale system; meaning identical processes in the model are completed in 15% of the full-scale time. The use of an index matching fluid (fluid that matches the refractive index of cast acrylic, the model material) allows making the entire model (with complex internal geometry) transparent and hence conducive to non-intrusive optical diagnostics. So using such a system one can test environment control parameters such as core flows (axial flows), cross flows (from registers and diffusers), potential problem areas such as flow short circuits, inadequate oxygen content, build up of other gases beyond desirable levels, test mixing processes within the system at local nodes or compartments and assess the overall system performance. The system allows quantitative measurements of contaminants introduced in the system and allows testing and optimizing the tracking process and removal of contaminants. The envisaged system will be modular and hence flexible for quick configuration change and subsequent testing. The data and inferences from the tests will allow for improvements in the development and design of next generation life support systems and configurations.

Author

*Life Support Systems; Space Platforms; Failure Modes; Risk; Scale Models; Reliability; Contamination*

**20040003924** Physics and Electronics Lab. TNO, The Hague, Netherlands

**SMP Experiment in the Marnewaard to Determine the Thermal Characteristics of Combat Suits**

Jacobs, P. A. M.; April 2003; 32 pp.; In English

Contract(s)/Grant(s): A02/KL/643; TNO Proj. 31446; TNO Proj. 32678

Report No.(s): FEL-02-A305; TD-2003-0025; Copyright; Avail: Other Sources

The main thrust of the activities of the group is on thermal aspects of combat suits. After a baseline field trial in Canada in 2001, the main field trial of the group was hosted by the Royal Dutch Army at the Marnewaard military exercise area near Groningen on 2 to 5 September 2002. NL, GE and CA provided measurement equipment and FR, CA, GE and NL provided experimental thermal suits. Next to thermal signatures, radar signatures were collected by TNO- FEL, while GE tested some new urban suits in Marnehuizen. Multispectral signatures of soldiers were collected in a variety of situations. The weather conditions during the trial were favourable and data collection was successful. Soldiers from an artillery battery in t Harde were kindly provided by the Royal Dutch Army to serve as test persons. This report provides an overview of the NL contribution and presents a quick look at selected thermal images recorded during the trial and some initial quantitative analysis of the data. The main part of the analyses will be done by members of the group and documented in the final report of the group.

Derived from text

*Protective Clothing; Thermodynamic Properties*

55  
**EXO BIOLOGY**

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

**20040000278** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Atlas of Bacteriomorphs in Carbonaceous Chondrites**

Hoover, Richard B.; Rozanov, Alexei Yu.; [2003]; 1 pp.; In English; 48th Annual Meeting on SPIE-The International Society for Optical Science and Technology, 3-8 Aug. 2003, San Diego, CA, USA; Copyright; Avail: Other Sources; Abstract Only

During the past few years, there has appeared much new and interesting data concerning the distribution of bacteriomorphic structures in both meteorites (carbonaceous chondrites) and in earth rocks of different ages (Archean to Recent). The bacterial forms studied are of very diverse morphologies and they are represented by cocci, filaments, rod-shaped forms, etc. The biomorphic forms that are encountered in earth rocks are practically indistinguishable from the biomorphic forms that are found in meteorites. Therefore, it has become necessary to compare and correlate bacteriomorphic structures from earth rocks and from meteorites. In order to better understand this problem, we have initiated efforts to compile an Atlas of bacteriomorphic images.

Author

*Carbonaceous Chondrites; Bacteria; Photomicrographs; Morphology*

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*.

**20040000390** NASA Langley Research Center, Hampton, VA, USA

**Continuous-Time Bilinear System Identification**

Juang, Jer-Nan; September 2003; 24 pp.; In English

Contract(s)/Grant(s): 258-30-10-02

Report No.(s): NASA/TM-2003-212646; L-19004; No Copyright; Avail: CASI; A03, Hardcopy

The objective of this paper is to describe a new method for identification of a continuous-time multi-input and multi-output bilinear system. The approach is to make judicious use of the linear-model properties of the bilinear system when subjected to a constant input. Two steps are required in the identification process. The first step is to use a set of pulse responses resulting from a constant input of one sample period to identify the state matrix, the output matrix, and the direct transmission matrix. The second step is to use another set of pulse responses with the same constant input over multiple sample periods to identify the input matrix and the coefficient matrices associated with the coupling terms between the state and the inputs. Numerical examples are given to illustrate the concept and the computational algorithm for the identification method.

Author

*System Identification; Matrices (Mathematics)*

**20040000583** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Just being on the Internet is Old News**

Koczor, Ronald J.; [2003]; 1 pp.; In English; Fall Meeting of the ADP Council of the Southeastern States, 22-24 Oct. 2004, Biloxi, MS, USA; No Copyright; Avail: Other Sources; Abstract Only

E-Gov is an idea that is very popular these days. Many government agencies are adopting electronic information technology to improve both their internal and external capabilities to communicate with stakeholders and customers. This is an area where the Internet offers huge improvements in responsiveness. Unfortunately, Internet outreach traditionally has not been a budget area that received strong support in most agencies. Today, almost every government agency has some Internet presence: some extensive; others minimal. However, if you really want to reach your stakeholders and customers, just putting information out is not enough to assure it is useful. The most effective outreach sites are those that have moved beyond first generation static designs and concepts to newer communications approaches that stress two-way communication and collection and analysis of customer-oriented performance metrics. This talk discusses a few basic concepts in customer/stakeholder interaction as practiced by the very successful NASA family of websites, Science@NASA. Started 7 years ago

as a single website, focusing on the science output of the Space Science Lab at NASA's Marshall Space Flight Center, Science@NASA in 2002 consisted of 6 websites with 450,000 subscribers and garnered over 700 million hits (approx. 64 million visits) in 2002 plus 3 international awards in the past 3 years. Focused content, tying presentation techniques to advanced communications concepts, managing and soliciting subscribers lists, automatic collection of performance metrics, soliciting and responding to customer feedback, and subscriber surveys are among the topics to be discussed. The successful NASA Kids Club and the interactivity offered to children will also be covered. The attempt to make the customer/stakeholder DO SOMETHING is critical to our success.

Author

*Information Systems; User Requirements; Websites; Internets; Surveys*

**2004000873** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**On the Hilbert-Huang Transform Data Processing System Development**

Kizhner, Semion; Flatley, Thomas P.; Huang, Norden E.; Cornwell, Evette; Smith, Darell; [2003]; 19 pp.; In English; 6th MAPLD International Conference on Military and Aerospace Programmable Logic Devices, 9-11 Sep. 2003, Washington, DC, USA; Copyright; Avail: CASI; [A03](#), Hardcopy

One of the main heritage tools used in scientific and engineering data spectrum analysis is the Fourier Integral Transform and its high performance digital equivalent - the Fast Fourier Transform (FFT). The Fourier view of nonlinear mechanics that had existed for a long time, and the associated FFT (fairly recent development), carry strong a-priori assumptions about the source data, such as linearity and of being stationary. Natural phenomena measurements are essentially nonlinear and nonstationary. A very recent development at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC), known as the Hilbert-Huang Transform (HHT) proposes a novel approach to the solution for the nonlinear class of spectrum analysis problems. Using the Empirical Mode Decomposition (EMD) followed by the Hilbert Transform of the empirical decomposition data (HT), the HHT allows spectrum analysis of nonlinear and nonstationary data by using an engineering a-posteriori data processing, based on the EMD algorithm. This results in a non-constrained decomposition of a source real value data vector into a finite set of Intrinsic Mode Functions (IMF) that can be further analyzed for spectrum interpretation by the classical Hilbert Transform. This paper describes phase one of the development of a new engineering tool, the HHT Data Processing System (HHTDPS). The HHTDPS allows applying the 'T to a data vector in a fashion similar to the heritage FFT. It is a generic, low cost, high performance personal computer (PC) based system that implements the HHT computational algorithms in a user friendly, file driven environment. This paper also presents a quantitative analysis for a complex waveform data sample, a summary of technology commercialization efforts and the lessons learned from this new technology development.

Author

*Data Processing; Fast Fourier Transformations; Hilbert Transformation; Nonlinearity; Systems Engineering*

**20040001192** NASA Langley Research Center, Hampton, VA, USA

**Choice of Variables and Preconditioning for Time Dependent Problems**

Turkel, Eli; Vatsa, Verr N.; [2003]; 10 pp.; In English; 16th AIAA CFD Conference, 23-26 Jun. 2003, Orlando, FL, USA Report No.(s): AIAA Paper 2003-3692; No Copyright; Avail: CASI; [A02](#), Hardcopy

We consider the use of low speed preconditioning for time dependent problems. These are solved using a dual time step approach. We consider the effect of this dual time step on the parameter of the low speed preconditioning. In addition, we compare the use of two sets of variables, conservation and primitive variables, to solve the system. We show the effect of these choices on both the convergence to a steady state and the accuracy of the numerical solutions for low Mach number steady state and time dependent flows.

Author

*Time Dependence; Preconditioning; Numerical Analysis; Real Variables; Formulations*

## 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*.

**20040001071** Clemson Univ., SC, USA

**High Performance Input/Output for Parallel Computer Systems**

Ligon, W. B.; July 1, 1996; 9 pp.; In English

Contract(s)/Grant(s): NAS5-32337; USRA-5555-20; No Copyright; Avail: CASI; [A02](#), Hardcopy

The goal of our project is to study the I/O characteristics of parallel applications used in Earth Science data processing systems such as Regional Data Centers (RDCs) or EOSDIS. Our approach is to study the runtime behavior of typical programs and the effect of key parameters of the I/O subsystem both under simulation and with direct experimentation on parallel systems. Our three year activity has focused on two items: developing a test bed that facilitates experimentation with parallel I/O, and studying representative programs from the Earth science data processing application domain. The Parallel Virtual File System (PVFS) has been developed for use on a number of platforms including the Tiger Parallel Architecture Workbench (TPAW) simulator, The Intel Paragon, a cluster of DEC Alpha workstations, and the Beowulf system (at CESDIS). PVFS provides considerable flexibility in configuring I/O in a UNIX- like environment. Access to key performance parameters facilitates experimentation. We have studied several key applications from levels 1,2 and 3 of the typical RDC processing scenario including instrument calibration and navigation, image classification, and numerical modeling codes. We have also considered large-scale scientific database codes used to organize image data.

Derived from text

*Parallel Computers; Parallel Processing (Computers); Input/Output Routines; Simulators; Architecture (Computers); Mathematical Models*

**20040001072** Syracuse Univ., NY, USA

**High Performance Input/Output Systems for High Performance Computing and Four-Dimensional Data Assimilation**

Fox, Geoffrey C.; Ou, Chao-Wei; [1997]; 9 pp.; In English

Contract(s)/Grant(s): NAS5-32337; USRA-5555-26; No Copyright; Avail: CASI; [A02](#), Hardcopy

The approach of this task was to apply leading parallel computing research to a number of existing techniques for assimilation, and extract parameters indicating where and how input/output limits computational performance. The following was used for detailed knowledge of the application problems: 1. Developing a parallel input/output system specifically for this application 2. Extracting the important input/output characteristics of data assimilation problems; and 3. Building these characteristics s parameters into our runtime library (Fortran D/High Performance Fortran) for parallel input/output support.

Author

*Parallel Processing (Computers); Assimilation; Extraction; Input/Output Routines*

**20040002078** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Dedication**

Holm, Jeanne M.; ASK Magazine; December 2003, No. 15, pp. 19-23; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

The NASA Web portal was exactly what we felt that NASA management wanted: a new face for the Agency., engaging, interactive, and upbeat; a real change from the staid, informational Web site that NASA had already.

CASI

*NASA Space Programs; Websites*

**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.

**20040000029** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**The Use of Socetset Software for Visualization Applications**

Fuhrmann, Melvin; March 19, 2002; 29 pp.; In English

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00023-SSC; No Copyright; Avail: Other Sources

A brief report is presented pertaining to applications visulaization. The programs initiatives include:research and development of RS/GIS applications, providing expertise through NASA to commercial companies, universities, and government agencies, and educational outreach. Software/Hardware include SocetSet-Sun/SGI platforms, World Construction Set, Lightwave, Multigen/Vega, and TerraVista/V Tree.Various images are included.

CASI

*Applications Programs (Computers); Images*

**20040000114** Carnegie-Mellon Univ., Pittsburgh, PA

**Identifying Commercial Off-the-Shelf (COTS) Product Risks: The COTS Usage Risk Evaluation**

Carney, David J.; Morris, Edwin J.; Place, Patrick R. H.; Sep. 2003; 34 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418382; CMU/SEI-2003-TR-023; ESC-TR-2003-023; No Copyright; Avail: CASI; [A03](#), Hardcopy

The expansion in use of commercial off-the-shelf (COTS) products has been accompanied by an increase in program failures. Many of these failures have been due to a lack of familiarity with the changed approach that COTS products demand. This report describes the development of an approach to reduce the number of program failures attributable to COTS software: the COTS Usage Risk Evaluation (CURE). The origin of CURE and an overview of the method, along with detail on the materials and mechanisms used in CURE, are provided. The CURE process is outlined and the results of the evaluations that have been conducted are summarized. Finally, possible future directions for CURE are explored.

DTIC

*Commercial Off-the-Shelf Products; Failure*

**20040000117** Carnegie-Mellon Univ., Pittsburgh, PA

**A Model Problem Approach to Measurement-to-Track Association**

Lewis, Grace A.; Meyers, B. C.; Sep. 2003; 88 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418389; CMU/SEI-2003-TR-020; ESC-TR-2003-020; No Copyright; Avail: CASI; [A05](#), Hardcopy

This is the first in a series of reports that illustrate the use of model problems in the design of a system. The problem considered is measurement-to-track association. A 'track' represents the state data about an object in the environment, and has a set of associated attributes. 'Measurement-to-track association' is the process of determining the relation between a measurement and an existing track. In this process, tracks that meet particular attribute criteria can be selected via filters. This report examines the development and application of filters that can be used as selector mechanisms. The report also presents an initial design of the model problem, by using concepts and constructs from Unified Modeling Language (UML), Executable UML (xUML), and Object-Oriented Analysis (OOA). Also covered are possible extensions to this work, related to performance considerations, additional filter types, and the distribution of filter information.

DTIC

*Systems Engineering; Selectors*

**20040000132** Carnegie-Mellon Univ., Pittsburgh, PA

**Measures for Software Product Lines**

Zubrow, Dave; Chastek, Gary; Oct. 2003; 36 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418393; CMU/SEI-2003-TN-031; No Copyright; Avail: CASI; [A03](#), Hardcopy

This technical note characterizes the status of measurement associated with the operation of a software product line, suggests a small set of measures to support its management, and provides guidance for those establishing measurement activities within a software product line. It is intended to help managers of software product lines develop a set of base measures for tracking those categories of needs most relevant to their organization's products, projects, and processes. The measures suggested here range from relatively mature to those whose general utility have yet to be validated. Therefore, an organization using this paper needs to assess its ability to generate the measures and the value they are likely to return to the organization. In most cases, an organization may wish to start with a subset of the measures described.

DTIC

*Software Engineering; Production Engineering*

**20040000137** Carnegie-Mellon Univ., Pittsburgh, PA

**The Software Engineering Institute's Second Workshop on Predictable Assembly: Landscape of Compositional Predictability**

Stafford, Judith A.; Hissam, Scott; Jun. 2003; 32 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418396; CMU/SEI-2003-TN-029; No Copyright; Avail: CASI; [A03](#), Hardcopy

To further its work in predictable assembly focusing on compositional reasoning techniques, the Software Engineering Institute (SEI(SM)) held its second Predictable Assembly from Certifiable Components (PACC) Workshop on January 10-11,

2003. Six leading researchers in component- based software engineering were invited to discuss topics related to compositional reasoning with members of the SEI technical staff. During the workshop, participants articulated the current state of research, identified gaps in the available technology, and set the direction for future efforts.

DTIC

*Computer Programs; Predictions*

**20040000143** Carnegie-Mellon Univ., Pittsburgh, PA

**Deriving Enterprise-Based Measures Using the Balanced Scorecard and Goal-Driven Measurement Techniques**

Goethert, Wolfhart; Fisher, Matt; Oct. 2003; 61 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418401; CMU/SEI-2003-TN-024; No Copyright; Avail: CASI; [A04](#), Hardcopy

This technical note describes the synergistic application of the balanced scorecard and goal- driven measurement methodologies to develop measures and associated indicators for measuring an organization's health and performance. Through this iterative approach, an organization's strategic goals and subgoals are mapped to the balanced scorecard and refined. The goal -question-(indicator) -measurement methodology is then applied to identify indicators and measures for each scorecard dimension. A hypothetical example of how to apply the methodology at a 'typical' organization performing software development and maintenance activities is provided. The example yields typical indicators to illustrate the methodology.

DTIC

*Software Engineering; Measurement*

**20040000174** Carnegie-Mellon Univ., Pittsburgh, PA

**The Evolution of Product Line Assets**

McGregor, John D.; Jun. 2003; 62 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418409; CMU/SEI-2003-TR-005; ESC-TR-2003-005; No Copyright; Avail: CASI; [A04](#), Hardcopy

Change is a natural, although not always welcome, part of product line development. The changes may be initiated to correct, improve, or extend assets or products. Since no asset is independent of all other assets, changes to one asset often require corresponding changes in other assets. And changes to assets propagate to affect all the products using those assets. Many of the practices of a successful product line initiate, manage, or consume these changes. Both conceptual techniques and software tools are available to assist in the management of these changes. The focus of this technical report is how evolutionary changes affect the various types of assets in a software product line. Change can be anticipated and managed, or it can be unanticipated and potentially disruptive. This technical report defines a few basic evolution concepts and then discusses those product line practices that initiate, anticipate, control, and direct the evolution. Conceptual and automated techniques that support these practices are also presented.

DTIC

*Software Engineering; Production Engineering; Product Development*

**20040000178** Carnegie-Mellon Univ., Pittsburgh, PA

**Requirements Engineering for Survivable Systems. Networked Systems Survivability**

Mead, Nancy R.; Sep. 2003; 44 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418410; CMU/SEI-2003-TN-013; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report describes the current state of requirements engineering for survivable systems, that is, systems that are able to complete their mission in a timely manner, even if significant portions are compromised by attack or accident. Requirements engineering is defined and requirements engineering activities are described. Survivability requirements are then explained, and requirements engineering methods that may be suitable for survivable systems are introduced. The report concludes with a summary and a plan for future research opportunities in survivable systems requirements engineering.

DTIC

*Software Engineering; Requirements*

**20040000182** Carnegie-Mellon Univ., Pittsburgh, PA

**Interpreting Capability Maturity Model(Trademark) Integration (CMMI(Trademark)) for Service Organizations - A Systems Engineering and Integration Services Example**

Herndon, Mary A.; Moore, Robert; Phillips, Mike; Walker, Julie; West, Laura; Nov. 2003; 50 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418412; CMU/SEI-2003-TN-005; No Copyright; Avail: CASI; [A03](#), Hardcopy

Capability Maturity Model Integration (CMMI) provides a framework for improving the processes organizations use to develop, deliver, and maintain products and services. This technical note presents one organization's interpretation of CMMI best practices for organizations that primarily provide services. Service organizations can use this example interpretation of CMMI practices to inform management and staff about how CMMI practices apply to their work. The interpretation will also help appraisal team members ensure that implemented practices provide the business value necessary to satisfy the goals for quality process improvement that are stated in the CMMI models.

DTIC

*Systems Engineering; Procedures*

**20040000187** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Business Systems Integration**

Bramley, Craig; Ciaruffoli, Veronica; Matteson, Mike; March 13, 2001; 2 pp.; In English; IT Group Exchange, 29-31 Mar. 2001, Philadelphia, PA, USA

Contract(s)/Grant(s): NAS13-99030

Report No.(s): SE-2001-03-00016-SSC; No Copyright; Avail: Other Sources; Abstract Only

An Oracle based system, which provides reporting and data warehouse functions is briefly described. The system is modifiable.

Author

*Management; Computer Programs*

**20040000196** Carnegie-Mellon Univ., Pittsburgh, PA

**Real-Time Application Development With OSEK: A Review of the OSEK standards**

Feiler, Peter H.; Nov. 2003; 49 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418413; CMU/SEI-2003-TN-004; No Copyright; Avail: CASI; [A03](#), Hardcopy

OSEK is an abbreviation for a German term that translates to 'open systems and the corresponding interfaces for automotive electronics.' OSEK OS is the operating system specification and OSEK COM is the communication specification. Both are application program interface (API) standards for automotive real-time application development. They are complemented by OSEK Implementation Language (OIL), a modeling language for describing the configuration of an OSEK application and operating system. This paper covers the SEI evaluation of these standards from the perspective of real-time application development. The SEI identified shortcomings in the description and semantics of certain services offered by the OSEK API. These shortcomings introduce unnecessary complexity to application developers and limit application portability. The SEI also identified the potential of OIL as an architectural modeling language to support design-time analyses, such as schedulability analysis. OIL's potential as a basis for generating both real-time OS data tables and an application runtime executive was examined. Utilizing OIL in this way simplifies application component development. Correct use of OSEK API functionality is then relegated to a generation tool that operates on OIL. Such improvements would facilitate practitioners' adoption of OSEK by reducing its perceived complexity.

DTIC

*Design Analysis; Real Time Operation*

**20040000197** Carnegie-Mellon Univ., Pittsburgh, PA

**Using the Architecture Tradeoff Analysis MethodSM (ATAMSM) to Evaluate the Software Architecture for a Product Line of Avionics Systems: A Case Study**

Barbacci, Mario; Clements, Paul; Lattanze, Anthony; Northrop, Linda; Wood, William; Jul. 2003; 32 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418415; CMU/SEI-2003-TN-012; No Copyright; Avail: CASI; [A03](#), Hardcopy

The quality of a software-intensive system depends heavily on the system's software architecture. When used

appropriately, software architecture evaluations can have a favorable effect on a delivered or modified government system. This technical note describes the application of the Architecture Tradeoff Analysis Method(SM) (ATAM(SM)) to an Army avionics system acquisition. A government-contractor team is developing the Common Avionics Architecture System (CAAS) for a family of U.S. Army Special Operations helicopters. This technical note presents the contextual background about the software architecture, the organization, and the system being evaluated. It also provides a general overview of the ATAM process, describes the application of the ATAM to the CAAS, and presents important results and benefits.

DTIC

*Software Engineering; Architecture (Computers); Computer Systems Programs; Avionics*

**2004000200** Carnegie-Mellon Univ., Pittsburgh, PA

**What About Ada? The State of the Technology in 2003**

Smith, Jim; Jul. 2003; 28 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418418; CMU/SEI-2003-TN-021; No Copyright; Avail: CASI; [A03](#), Hardcopy

The projected life-cycle cost of a system is a central concern for any program manager (PM) in the Department of Defense (DoD). Choices made early in system development, such as choosing appropriate programming languages, can have profound effects on life-cycle cost. This report documents a recent investigation which characterized the technical and programmatic risks in reusing significant quantities of legacy Ada code in a new system. The investigation attempted to answer three questions: First, what is the business case for Ada? Second, how is Ada viewed by the defense industry? Third, how is Ada supported by academe? The results of this investigation point to a bleak future for Ada: no longer in the mainstream of computer science education, software engineering practice, or commercial support, Ada is little more than a niche language used primarily within the DoD community and in limited civilian market segments, especially where there is defense market crossover or similar requirements as in commercial aviation, process control, and medical instrumentation. The data collected in this report should help PMs evaluate the risks-both during initial development and throughout the entire life cycle-of using Ada for software-intensive systems.

DTIC

*Ada (Programming Language); Aerospace Medicine; Bioinstrumentation; Systems Engineering*

**2004000211** Carnegie-Mellon Univ., Pittsburgh, PA

**Documenting Software Architectures in an Agile World**

Clements, Paul; Ivers, James; Little, Reed; Nord, Robert; Stafford, Judith; Jul. 2003; 24 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418423; CMU/SEI-2003-TN-023; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report compares the Software Engineering Institute's Views and Beyond approach for documenting software architectures with the documentation philosophy embodied in agile software-development methods. This report proposes an approach for capturing architecture information in a way that is consistent with agile methods.

DTIC

*Software Engineering; Architecture (Computers)*

**2004000218** Carnegie-Mellon Univ., Pittsburgh, PA

**Quality Attribute Workshops (QAWs) Third Edition**

Barbacci, Mario R.; Ellison, Robert; Lattanze, Anthony J.; Stafford, Judith A.; Weinstock, Charles B.; Aug. 2003; 36 pp.; In English

Report No.(s): AD-A418428; CMU/SEI-2002-TR-016; ESC-TR-2002-016; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Quality Attribute Workshop (QAW) is a facilitated method that engages system stake- holders early in the life cycle to discover the driving quality attributes of a software-intensive system. The QAW was developed to complement the Architecture Tradeoff Analysis Method(SM) (ATAM(SM)) and provides a way to identify important quality attributes and clarify system requirements before the software architecture has been created. This is the third edition of a technical report describing the QAW. We have narrowed the scope of a QAW to the creation of prioritized and refined scenarios. This report describes the newly revised QAW and describes potential uses of the refined scenarios generated during it.

DTIC

*Architecture (Computers); Quality Control; Life (Durability)*

**20040000219** Carnegie-Mellon Univ., Pittsburgh, PA

**The Team Software Process<sup>SM</sup> (TSPSM) in Practice: A Summary of Recent Results**

Davis, Noopur; Mullaney, Julia; Sep. 2003; 104 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418430; CMU/SEI-2003-TR-014; ESC-TR-2003-014; No Copyright; Avail: CASI; [A06](#), Hardcopy

Most software organizations are facing critical business needs for better cost and schedule management, effective quality management, and cycle-time reduction. The Team Software Process addresses these critical business needs. This report provides results and implementation data from projects and individuals that have adopted the TSP. The results show that TSP teams are delivering essentially defect-free software on schedule, while improving productivity. These data can be used for benchmarking and planning, motivation, lessons learned, and other guidance to those currently using the TSP or considering its use. The report also illustrates adoption experiences of practitioners in the field, including TSP team members, their managers, and their coaches and instructors.

DTIC

*Software Engineering; Productivity*

**20040000290** Mitre Corp., McLean, VA

**Examining Precision Munitions Alternatives: Modeling the Average Isn't Good Enough**

Davidson, Peter A.; Jun. 11, 2003; 15 pp.; In English

Contract(s)/Grant(s): DAAB07-02-N200

Report No.(s): AD-A418447; Rept-03-0535; No Copyright; Avail: CASI; [A03](#), Hardcopy

As the military employs more precision munitions to maximize effects and minimize collateral damage, the commander should understand each munition's strengths and weaknesses. These munitions are usually expensive and in short supply in relation to their less intelligent compatriots. Due to these constraints, engagement planning is limited to specific situations such as urban terrain and targets moving at the time of engagement. To compare different types of guidance for precision munition performance in these scenarios, combat modeling usually employs averages for the engagement. The average location of the round in the 'basket,' average range from target when the seeker 'wakes up,' and seeker field of view are usually combined into another average such as probability of hit. While these averages provide useful insights, critical limitations are obscured. This paper will use analysis done for the Precision Guided Mortar Munition (PGMM) to examine these types of modeling limitations. (12 figures, 8 refs.)

DTIC

*Computer Programs; Cities; Combat; Field of View*

**20040000292** Carnegie-Mellon Univ., Pittsburgh, PA

**Snapshot of CCL: A Language for Predictable Assembly**

Wallnau, Kurt C.; Ivers, James; Jun. 2003; 40 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418453; CMU/SEI-2003-TN-025; No Copyright; Avail: CASI; [A03](#), Hardcopy

Construction and composition language (CCL) plays several roles in our approach to achieving automated predictable assembly. CCL is used to produce specifications that contain structural, behavioral, and analysis-specific information about component technologies, as well as components and assemblies in such technologies. These specifications are translated to one or more reasoning frameworks that analyze and predict the runtime properties of assemblies. CCL processors can also be used to automate many of the constructive activities of component-based development through various forms of program generation. Using a common specification for prediction and construction improves confidence that analysis models match implementations. This report presents a snapshot of CCL by examining a small example CCL specification.

DTIC

*Computer Programs; Structural Analysis*

**20040000302** Carnegie-Mellon Univ., Pittsburgh, PA

**CMMI (Trademark) Interpretive Guidance Project: Preliminary Report**

Chrissis, Mary B.; Wemyss, Gian; Goldenson, Dennis; Konrad, Mike; Smith, Kenneth; Oct. 2003; 298 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418458; CMU/SEI-2003-SR-007; No Copyright; Avail: CASI; [A13](#), Hardcopy

The CMMI (Capability Maturity Model Integration) Interpretive Guidance project was formed to help commercial

software, information technology (IT), and information systems (IS) organizations adopt CMMI. Project members collected data to learn more about how CMMI is being accepted by these organizations. This report describes the data-collection activities and includes summaries of the data collected through August 2003. The project received both positive and negative comments that lead to some interesting and surprising observations. Overall, the positive comments greatly outnumbered the negative. Input provided by commercial software, IT, and IS organizations was similar to input from organizations from other disciplines. Organizations reported that CMMI is adequate for guiding their process improvement activities and that CMMI training courses and appraisal methods are suitable for their needs, although there are specific opportunities for improvement. Having two representations caused concern and confusion for some but was a benefit for others, so the project will investigate these comments further to see what can be done to address these concerns. The cost of CMMI is an issue that affected adoption decisions for some but not for others. Finally, return-on- investment information is usually helpful to organizations when making the business case to adopt CMMI.

DTIC

*Software Engineering; Data Acquisition; Education*

**20040000308** Carnegie-Mellon Univ., Pittsburgh, PA

**Predicting When Product Line Investment Pays**

Cohen, Sholom; Jul. 2003; 34 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418466; CMU/SEI-2000-TR-017; No Copyright; Avail: CASI; [A03](#), Hardcopy

A product line approach may appear very attractive, with obvious benefits in speedier time to market and higher quality, however many organizations demand financial justification before proceeding. Without knowing costs, the decision makers won't budget funds or personnel to carry out the up-front asset construction tasks. In addition, not all organizations are ready to commit up front to a full asset set, one that covers most if not all product line features. Many managers favor an incremental approach to product line adoption, one that first tackles areas of highest and most readily available commonality, earning payback early in the adoption cycle. This report defines key factors to consider in taking an incremental approach to fielding a product line. An organization building a business case can apply these factors to show that product line investment can result in product development savings. The example presented here shows a net savings of almost \$180 million in projects that would have cost about \$600 million under traditional development approaches. The \$180 million in savings takes into account an investment of \$54 million in product line start-up costs. The example also illustrates ways to present the data needed to make a compelling business case.

DTIC

*Software Engineering; Production Engineering; Product Development; Predictions*

**20040000721** Ohio Univ., Athens, OH, USA

**Alternate Communications Spectrum Study (ACSS) for Aviation Data Links (ADL)**

Matolak, David W.; October 2003; 46 pp.; In English

Contract(s)/Grant(s): NAG3-2815

Report No.(s): OU/AEC-03-17TM-NAG3-2815; No Copyright; Avail: CASI; [A03](#), Hardcopy

The aim of the work was to identify the key factors involved in the use of alternate spectrum in various bands for a future integrated CNS data link. The study focused on systems and spectral bands that can deliver VDL-or-higher data rates in a two-way communication setting (including air-ground, ground-air, and air-air modes of operation), with multiple platforms (aircraft) operating in the same local environment. We begin with a review of the initial task list, and the final task list. The final task list contained a focus upon spectral availability and related systems that could be affected by the deployment of a new aviation data link (ADL) system. Most of this addresses the lower few layers of the communications protocol stack. A brief review of current related efforts in the aeronautical community is then provided, in which we describe several systems and programs of interest. Participation in some of these efforts is recommended. We also delineate several of the advantages and disadvantages of these system/efforts, in view of anticipated requirements of a new ADL. Desired attributes of a new ADL system are then discussed, and a connection with existing systems is made. The need to consider a wider set of alternative systems and technologies is described, and the beneficial aspects of a particular transmission technique- spread spectrum-are discussed. We then discuss in more detail several potential spectral regions, in terms of propagation conditions, available technology, spectrum availability, and waveform selection. Some comments on the need for standardization are also provided. We note that none of the existing systems described will likely meet the full range of desired features of a new ADL, but that several systems and spectral regions offer promise in terms of one or more characteristics. A system design and analysis approach is then provided. In this, we again focus on the lower few layers of the protocol stack, and aim to capture the main

features and parameters that must be selected in the design. Two appendices show example versions and initial results of the first few technical steps in the design approach. Some conclusions are then drawn, and in the final section, recommendations are provided, the most important of which are repeated here: 1. Continue the effort begun here. As detailed in this report, we have only uncovered much of the work that needs to be done in order to provide the foundation for a flexible, high-performance, robust ADL. 2. Seize the opportunity to begin testing in the MLS band. The wide bandwidths and low level of usage of this band make it an ideal one for proof-of-concept type testing. Other (non- aeronautical) organizations are likely to make claims on the band if it is not being used. The primary conclusion is that there is a real and pressing need for a new aviation data link. vi

Derived from text

*Protocol (Computers); Microwave Landing Systems; Spread Spectrum Transmission; Waveforms; Design Analysis; Feasibility Analysis*

**20040000842** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**A Framework for Intelligent Rocket Test Facilities with Smart Sensors**

Figueroa, Fernando; Solano, Wanda; Morris, Jon; Mandayam, Shreekanth; Polikar, Robi; [2003]; 7 pp.; In English; Sensors for Industry Conference, 27-29 Jan. 2003, New Orleans, LA, USA

Report No.(s): SE-2003-07-00048-SSC; Copyright; Avail: CASI; [A02](#), Hardcopy

A long-term center goal at the John C. Stennis Space Center (SSC) is the formulation and implementation of a framework for an Intelligent Rocket Test Facility (IRTF), which incorporates distributed smart sensor elements. The IRTF is to provide reliable, high-confidence measurements. Specific objectives include: 1. Definition of a framework and architecture that supports implementation of highly autonomous methodologies founded on basic physical principles and embedded knowledge. 2. Modeling of autonomous sensors and processes as self-sufficient, evolutionary elements. 3. Development of appropriate communications protocols to enable the complex interactions that must take place to allow timely and high-quality flow of information among all the autonomous elements of the system. 4. Development of lab-scale prototypes of key system elements. Though our application is next-generation rocket test facilities, applications for the approach are much wider and include monitoring of shuttle launch operations, air and spacecraft operations and health monitoring, and other large-scale industrial system operations such as found in processing and manufacturing plants. Elements of prototype IRTF have been implemented in preparation for advanced development and validation using rocket test stand facilities at SSC. This work has identified issues that are important to further development of complex network and should be of interest to other working with sensor networks.

Author

*Manufacturing; Protocol (Computers); Rocket Test Facilities; Test Stands; Sensors*

**20040000864** Lockheed Martin Corp., Bay Saint Louis, MS, USA

**Document Concurrence System**

Muhsin, Mansour; Walters, Ian; June 02, 2003; 2 pp.; In English

Report No.(s): NASA/NP-2003-07-00027-SSC; No Copyright; Avail: Other Sources; Abstract Only

The Document Concurrence System is a combination of software modules for routing users' expressions of concurrence with documents. This system enables determination of the current status of concurrences and eliminates the need for the prior practice of manually delivering paper documents to all persons whose approvals were required. This system runs on a server, and participants gain access via personal computers equipped with Web-browser and electronic-mail software. A user can begin a concurrence routing process by logging onto an administration module, naming the approvers and stating the sequence for routing among them, and attaching documents. The server then sends a message to the first person on the list. Upon concurrence by the first person, the system sends a message to the second person, and so forth. A person on the list indicates approval, places the documents on hold, or indicates disapproval, via a Web-based module. When the last person on the list had concurred, a message is sent to the initiator, who can then finalize the process through the administration module. A background process running on the server identifies concurrence processes that are overdue and sends reminders to the appropriate persons.

Author

*Documents; Computer Systems Programs; Software Engineering; Electronic Modules*

**20040000867** Akron Univ., Akron, OH, USA

**FLAPS (Fatigue Life Analysis Programs): Computer Programs to Predict Cyclic Life Using the Total Strain Version of Strainrange Partitioning and Other Life Prediction Methods, Users' Manual and Example Problems, Version 1.0**

Halford, Gary R., Technical Monitor; Arya, Vinod K.; August 2003; 85 pp.; In English

Contract(s)/Grant(s): NCC3-768

Report No.(s): NASA/CR-2003-212530; E-14092; No Copyright; Avail: CASI; [A05](#), Hardcopy

This manual presents computer programs FLAPS for characterizing and predicting fatigue and creep-fatigue resistance of metallic materials in the high-temperature, long-life regime for isothermal and nonisothermal fatigue. The programs use the Total Strain version of Strainrange Partitioning (TS-SRP), and several other life prediction methods described in this manual. The user should be thoroughly familiar with the TS-SRP and these life prediction methods before attempting to use any of these programs. Improper understanding can lead to incorrect use of the method and erroneous life predictions. An extensive database has also been developed in a parallel effort. The database is probably the largest source of high-temperature, creep-fatigue test data available in the public domain and can be used with other life-prediction methods as well. This users' manual, software, and database are all in the public domain and can be obtained by contacting the author. The Compact Disk (CD) accompanying this manual contains an executable file for the FLAPS program, two datasets required for the example problems in the manual, and the creep-fatigue data in a format compatible with these programs.

Author

*Computer Programs; Fatigue Life; Fatigue (Materials); Creep Strength; Metals; Predictions*

**20040000963** Akron Univ., Akron, OH, USA

**Computer Simulation of a Digital Global Velocimeter**

Cheung, H. Mike; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 3-5; In English; See also 20040000959; Original contains black and white illustrations

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

The objective is to continue the development of a Monte-Carlo simulation of a Doppler Global Velocimetry (DGV) optical system starting with the Mie scattering from the particles in the fluid to the collection optics, through the beamsplitter, Iodine absorption cell and finally to the CCD sensor. The simulation program will read in a configuration file that completely describes the attributes of a DGV system (optical, physical layout, location of detectors, laser properties, CCD sensor noise characteristics...). The simulation program will output a set of images that simulate the data collected from a DGV system. NASA GRC has the DGV software developed at NASA Langley and this simulation program will prove invaluable for determining the accuracy of the DGV technique and provide insight into optimizing the data reduction techniques. The DGV simulation software will also prove valuable in a DDF funded project entitled Planar Particle Imaging Doppler Velocimetry (PPIDV), which was recently awarded in March 2002.

Author

*Particle Image Velocimetry; Digital Systems; Computerized Simulation*

**20040001073** George Washington Univ., Washington, DC, USA

**Research in Satellite-Fiber Network Interoperability**

Edelson, Burt; [1997]; 84 pp.; In English

Contract(s)/Grant(s): NAS5-32337; USRA-5555-066-50; No Copyright; Avail: CASI; [A05](#), Hardcopy

This four part report evaluated the performance of high data rate transmission links using the ACTS satellite, and to provide a preparatory test framework for two of the space science applications that have been approved for tests and demonstrations as part of the overall ACTS program. The test plan will provide guidance and information necessary to find the optimal values of the transmission parameters and then apply these parameters to specific applications. The first part will focus on the satellite-to-earth link. The second part is a set of tests to study the performance of ATM on the ACTS channel. The third and fourth parts of the test plan will cover the space science applications, Global Climate Modeling and Keck Telescope Acquisition Modeling and Control.

Author

*Data Transfer (Computers); Climate Models; Technology Utilization*

**20040001395** Lockheed Martin Corp., Bay Saint Louis, MS, USA

**Software for Improved Extraction of Data From Tape Storage**

Cheng, Chiu-Fu; May 10, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2002-12-00042-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A computer program has been written to replace the original software of Racal Storeplex Delta tape recorders, which are still used at Stennis Space Center but have been discontinued by the manufacturer. Whereas the original software could be activated by a command-line interface only, the present software offers the option of a command-line or graphical user interface. The present software also offers the option of batch-file operation (activation by a file that contains command lines for operations performed consecutively). The present software is also more reliable than was the original software: The original software was plagued by several deficiencies that made it difficult to execute, modify, and test. In addition, when using the original software to extract data that had been recorded within specified intervals of time, the resolution with which one could control starting and stopping times was no finer than about a second (or, in some cases, several seconds). In contrast, the present software is capable of controlling playback times to within 1/100 second of times specified by the user, assuming that the tape-recorder clock is accurate to within 1/100 second.

Author

*Computer Programs; Tape Recorders; Software Engineering*

**20040001596** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Software for Viewing Landsat Mosaic Images**

[2002]; 2 pp.; In English

Report No.(s): NASA/NP-2002-04-00015-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

A Windows-based computer program has been written to enable novice users (especially educators and students) to view images of large areas of the Earth (e.g., the continental USA) generated from image data acquired in the Landsat observations performed circa the year 1990. The large-area images are constructed as mosaics from the original Landsat images, which were acquired in several wavelength bands and each of which spans an area (in effect, one tile of a mosaic) of approx. 5 in latitude by approx. 6 deg in longitude. Whereas the original Landsat data are registered on a universal transverse Mercator (UTM) grid, the program converts the UTM coordinates of a mouse pointer in the image to latitude and longitude, which are continuously updated and displayed as the pointer is moved. The mosaic image currently on display can be exported as a Windows bit-map file. Other images (e.g., of state boundaries or interstate highways) can be overlaid on Landsat mosaics. The program interacts with the user via standard toolbar, keyboard, and mouse user interfaces. The program is supplied on a compact disk along with tutorial and educational information.

Author

*Computer Programs; Satellite Imagery; Landsat Satellites; Mosaics*

**20040001659** Lockheed Martin Corp., Bay Saint Louis, MS, USA

**NASA's Virtual Product Laboratory Overview**

Gasser, Gerald; McConnell, Ken; Cao, Chang-Yong; Prados, Don; Carter, Judy; Blonski, Slawomir; Ryan, Robert; Zaroni, Vicki; April 1999; 2 pp.; In English; International Symposium on Special Sensing Research, 31 Oct. - 4 Nov. 1999, Las Vegas, NV, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2003-05-00041-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

The Virtual Product Laboratory (VPL) developed at Stennis Space Center is a tool that enables design and verification of remote sensing systems within a software (virtual) environment. The VPL can serve NASA's industry, government, and university partners by providing a means to conduct system trade studies, visual modeling, and data product simulations entirely in a virtual environment. The VPL can serve as a complete end-to-end simulation tool capable of producing system-level compatibility assessments, performance characterizations, and simulated data products. In this paper, we present an overview of the VPL's current functions and planned capabilities. The VPL functional areas include Requirements, Design and Analysis, Simulation, Project Management, and Knowledge Base. A description of each function, along with the tools and techniques used to accomplish these functions, is provided.

Author

*Remote Sensing; Data Simulation; Computer Programs; End-to-End Data Systems*

**20040001722** Washington Univ., Saint Louis, MO, USA

**Applying Reflective Middleware Techniques to Optimize a QoS-enabled CORBA Component Model Implementation**

Wang, Nanbor; Kircher, Michael; Schmidt, Douglas C.; [2000]; 4 pp.; In English; 24th IEEE Computer Software and Applications Conference, October 2000

Contract(s)/Grant(s): NCC3-777; No Copyright; Avail: CASI; [A01](#), Hardcopy

Although existing CORBA specifications, such as Real-time CORBA and CORBA Messaging, address many end-to-end quality-of-service (QoS) properties, they do not define strategies for configuring these properties into applications flexibly, transparently, and adaptively. Therefore, application developers must make these configuration decisions manually and explicitly, which is tedious, error-prone, and often sub-optimal. Although the recently adopted CORBA Component Model (CCM) does define a standard configuration frame-work for packaging and deploying software components, conventional CCM implementations focus on functionality rather than adaptive quality-of service, which makes them unsuitable for next-generation applications with demanding QoS requirements. This paper presents three contributions to the study of middleware for QoS-enabled component-based applications. It outlines reflective middleware techniques designed to adaptively: (1) select optimal communication mechanisms, (2) manage QoS properties of CORBA components in their containers, and (3) (re)configure selected component executors dynamically. Based on our ongoing research on CORBA and the CCM, we believe the application of reflective techniques to component middleware will provide a dynamically adaptive and (re)configurable framework for COTS software that is well-suited for the QoS demands of next-generation applications.

Author

*Computer Programs; Quality Control; Services*

## 62

### COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

**2004000012** NASA Stennis Space Center, Bay Saint Louis, MS, USA

#### **Sensor Fusion for a Network of Processes/Systems with Highly Autonomous Sensors**

Figuroa, Fernando; Yuan, Xiao-Jing; November 28, 2000; 8 pp.; In English; 2001 IEEE International Workshop on Virtual and Intelligent Measurement Systems, 19-20 May 2001, Budapest, Hungary

Report No.(s): SE-2001-11-00023-SSC; No Copyright; Avail: CASI; [A02](#), Hardcopy

This paper describes a distributed sensor-data-fusion paradigm and theory based on a previously developed theory to model sensors as highly autonomous units. Generic procedures are defined to reason and make decisions at the qualitative level. This facilitates distribution of intelligence (code and hardware) to the sensor level and peer-to-peer communication among sensors, controllers, and other devices in the system.

Author

*Multisensor Fusion; Autonomy*

**20040000231** Florida Inst. of Tech., Melbourne, FL

#### **CIPIAF Fellows**

Whittaker, James A.; Jorgensen, Allan A.; Rekab, Kamel; Aug. 2003; 8 pp.; In English

Contract(s)/Grant(s): F49620-01-1-0294

Report No.(s): AD-A418395; AFRL-SR-AR-TR-03-0457; No Copyright; Avail: CASI; [A02](#), Hardcopy

Florida Tech hired two Fellows for two years under the CIPIAF program. They acted as co-Principal Investigators working with Dr. James Whittaker in the areas of (1) statistical methods for intrusion detection and (2) automatic methods for hostile data stream testing. Our findings were successful in both projects. Dr. Kamel Rekab was the Principal on the first project and his results showed that attack traffic possesses a strong statistical signature and logistic regression analysis can be used to distinguish between legitimate - and attack traffic. Dr. -Rekab has been retained as a full faculty in our department to continue this research. Dr. Alan Jorgensen was the Principal on the second project and used his technique to find a zero-day exploit in Macromedia Flash. He subsequently received funding from Macromedia and is currently working as a private consultant using his techniques on behalf of a number of software vendors.

DTIC

*Warning Systems; Detection*

**20040001358** NASA Stennis Space Center, Bay Saint Louis, MS, USA

#### **Software Estimates Costs of Testing Rocket Engines**

August 15, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2003-01-00005-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

Simulation-Based Cost Model (SiCM) is a computer program that simulates pertinent aspects of the testing of rocket

engines for the purpose of estimating the costs of such testing during time intervals specified by its users. A user enters input data for control of simulations; information on the nature of, and activity in, a given testing project; and information on resources. Simulation objects are created on the basis of this input. Costs of the engineering-design, construction, and testing phases of a given project are estimated from numbers and labor rates of engineers and technicians employed in each phase, the duration of each phase; costs of materials used in each phase; and, for the testing phase, the rate of maintenance of the testing facility. The three main outputs of SiCM are (1) a curve, updated at each iteration of the simulation, that shows overall expenditures vs. time during the interval specified by the user; (2) a histogram of the total costs from all iterations of the simulation; and (3) table displaying means and variances of cumulative costs for each phase from all iterations. Other outputs include spending curves for each phase.

Author

*Cost Analysis; Rocket Engines; Computer Programs; Computerized Simulation; Mathematical Models*

**20040001404** Lockheed Martin Corp., Bay Saint Louis, MS, USA

**Data Acquisition and Control Systems Laboratory**

Holland, Randy; Jensen, Scott; Burrell, Terrence; Spooner, Richard; May 09, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2002-07-00027; No Copyright; Avail: CASI; [A01](#), Hardcopy

The Data Acquisition and Control Systems (DACS) Laboratory is a facility at Stennis Space Center that provides an off test-stand capability to develop data-acquisition and control systems for rocket-engine test stands. It is also used to train new employees in state-of-the-art systems, and provides a controlled environment for troubleshooting existing systems, as well as the ability to evaluate the application of new technologies and process improvements. With the SSC propulsion testing schedules, without the DACS Laboratory, it would have been necessary to perform most of the development work on actual test systems, thereby subjecting both the rocket-engine testing and development programs to substantial interference in the form of delays, restrictions on modifications of equipment, and potentially compromising software configuration control. The DACS Laboratory contains a versatile assortment of computer hardware and software, digital and analog electronic control and data-acquisition equipment, and standard electronic bench test equipment and tools. Recently completed Control System development and software verification projects include support to the joint NASA/Air Force Integrated Powerhead Demonstration (IPD) LOX & LH2 PreBurner and Turbopump ground testing programs. In other recent activities, the DACS Laboratory equipment and expertise have supported the off-stand operation of high-pressure control valves to correct valve leak problems prior to installation on the test stand. Future plans include expanding the Laboratory's capabilities to provide cryogenic control valve characterization prior to installation, thereby reducing test stand activation time.

Derived from text

*Data Acquisition; Control Systems Design; Computer Systems Programs; Program Verification (Computers)*

**20040001720** George Washington Univ., Washington, DC, USA

**Evaluating Early High-Performance Computing Systems**

El-Ghazawi, Tarek; Ozkaya, Armagan; Meajil, Abdullah; January 26, 1994; 52 pp.; In English

Contract(s)/Grant(s): NAS5-30428; WU 506-59-11; No Copyright; Avail: CASI; [A04](#), Hardcopy

Evaluating high-performance computing systems (HPCS) based on MPP architectures is a key part of the HPCC initiative. In order to provide HPCS designers with the insight needed to improve the next generation, one must correlate the performance measurements with the dynamic characteristics of the workload itself. This work develops an abstract model suitable for experimentally characterizing workloads based on a set of attributes that illustrate how the workloads stress the various architectural features. Meanwhile, the experimental characterization is conducted in a manner that isolates the effects of the machine loading or architecture on which the measurements are obtained, focusing only on the application. Characterization attributes are designed to reflect the applications' scalability, spatial and temporal locality of references for both instructions and data, and amount of work. Workload produced by NASA ESS Grand Challenge applications was experimentally characterized in order to explore the unique characteristics of this application domain.

Author

*Supercomputers; Architecture (Computers); Computer Networks; Computer Systems Performance*

**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*.

**20030112118** NASA Ames Research Center, Moffett Field, CA, USA

**Method for Constructing Composite Response Surfaces by Combining Neural Networks with other Interpolation or Estimation Techniques**

Rai, Man Mohan, Inventor; Madavan, Nateri K., Inventor; August 12, 2003; 15 pp.; In English  
Patent Info.: Filed 13 Aug. 1999; US-Patent-6,606,612; US-Patent-Appl-SN-374491; US-Patent-Appl-SN-113318; US-Patent-Appl-SN-096660; NASA-Case-ARC-14281-1; No Copyright; Avail: CASI; **A03**, Hardcopy

A method and system for design optimization that incorporates the advantages of both traditional response surface methodology (RSM) and neural networks is disclosed. The present invention employs a unique strategy called parameter-based partitioning of the given design space. In the design procedure, a sequence of composite response surfaces based on both neural networks and polynomial fits is used to traverse the design space to identify an optimal solution. The composite response surface has both the power of neural networks and the economy of low-order polynomials (in terms of the number of simulations needed and the network training requirements). The present invention handles design problems with many more parameters than would be possible using neural networks alone and permits a designer to rapidly perform a variety of trade-off studies before arriving at the final design.

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

*Design Optimization; Neural Nets; Estimating*

**20040000025** AIR-O-SPACE International, USA

**Earth Science Enterprise Scientific Data Purchase Project: Verification and Validation**

Jenner, Jeff; Policelli, Fritz; Fletcher, Rosea; Holecamp, Kara; Owen, Carolyn; Nicholson, Lamar; Dartez, Deanna; February 14, 2000; 19 pp.; In English; Earth Watch/Intermap STAR-3i IFSSAR Data Workshop, 16-17 Feb. 2000, Bay Saint Louis, MS, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): EB-2000-02-0001-SSC; Copyright; Avail: CASI; **A03**, Hardcopy

This paper presents viewgraphs on the Earth Science Enterprise Scientific Data Purchase Project's verification, and validation process. The topics include: 1) What is Verification and Validation? 2) Why Verification and Validation? 3) Background; 4) ESE Data Purchas Validation Process; 5) Data Validation System and Ingest Queue; 6) Shipment Verification; 7) Tracking and Metrics; 8) Validation of Contract Specifications; 9) Earth Watch Data Validation; 10) Validation of Vertical Accuracy; and 11) Results of Vertical Accuracy Assessment.

CASI

*Earth Sciences; Program Verification (Computers); Data Acquisition; Systems Engineering*

**20040000317** Naval Academy, Annapolis, MD

**Continuous Localization and Navigation of Mobile Robots**

Graves, Kevin P.; May 7, 1997; 52 pp.; In English; Original contains color illustrations

Report No.(s): AD-A418467; No Copyright; Avail: CASI; **A04**, Hardcopy

A large mobile robot was used as a platform for research in continuous localization and path planning. Continuous localization is a technique that allows a robot to maintain an accurate estimate of its location by performing regular, small corrections to its odometry. Continuous localization utilizes an evidence grid representation, a common representation scheme that is used by other map- dependent processes, such as path planning. Although techniques exist for building evidence grid maps, most are not adaptive to changes in the environment. In this research, the continuous localization technique is extended by adding a learning component. This allows continuous localization to update the long-term map (evidence grid) with current sensor readings. Results show that the addition of the learning behavior to continuous localization allows the system to adapt to changes in its environment without a loss in its ability to remain localized. Continuous localization with the learning behavior was combined with a wavefront propagation path planner to produce a robust navigation system. This system was tested on a Nomad 200 mobile robot.

DTIC

*Robots; Navigation; Trajectory Planning*

**20040000326** Naval Academy, Annapolis, MD

**Speech Coding and Phoneme Classification Using a Back-Propagation Neural Network**

St. George, Brett A.; May 7, 1997; 78 pp.; In English

Report No.(s): AD-A418472; No Copyright; Avail: CASI; [A05](#), Hardcopy

Speech is a natural, unspecialized method of communication that is perhaps the ultimate machine interface. Previous attempts to provide such an interface, however, have been limited to pre-defined vocabularies of an artificial syntax. This paper presents a method for speaker-dependent speech identification that uses a back-propagation neural network to determine the phonemes present within a voice signal. The vocal tract changes slowly in time and can be modeled using the pitch and formant frequencies of the voice. These frequencies relate the position of the vocal tract to specific pronunciations and are obtained by using a homomorphic filtering process that separates the vocal tract's impulse response from the excitation source. The frequency representation of this response is concatenated with the excitation containing the pitch frequency and applied to the input layer of the neural network. From this information, the network selects combinations of features that identify the phonemes which are present. This network was trained on a set of speaker dependent phonemes, and now phonetically classifies new speech input. This classification scheme could be used to translate linguistic messages into machine code with a very high data rate. This benefit would allow for real-time interaction with machines with no specialized training. Applications could be as simple as providing quick voice to text processing or as diverse as implementing a control system with response time tied to specified voice patterns.

DTIC

*Neural Nets; Speech; Real Time Operation; Linguistics*

**20040000783** NASA Glenn Research Center, Cleveland, OH, USA

**Online Model Parameter Estimation of Jet Engine Degradation for Autonomous Propulsion Control**

Chatterjee, Santanu; Litt, Jonathan S.; October 2003; 22 pp.; In English; Guidance, Navigation, and Control Conference and Exhibit, 11-14 Aug. 2003, Austin, TX, USA

Contract(s)/Grant(s): WBS 22-704-04-03; WBS 22-765-30-01; DA Proj. 1L1-61102-AF20

Report No.(s): NASA/TM-2003-212608; ARL-TR-3033; AIAA Paper 2003-5425; NAS 1.15:212608; E-14166; No Copyright; Avail: CASI; [A03](#), Hardcopy

Jet engine components are subject to degradation over their lifetime of use, and this can lead to a deterioration in thrust performance of the engine. For autonomous propulsion control, it is desirable for the engine control system to maintain a nominal level of propulsion system thrust performance in an engine subject to changes in dynamics caused by aging and degradation. In this paper, two adaptive control techniques are investigated to recover the thrust performance of a degraded engine so that it is as close as possible to the thrust performance of a nominal (new) engine. The first technique consists of an adaptive onboard linear engine model tuned by parameter estimation using a Kalman filter, and used in closed loop with a PI controller to maintain nominal thrust performance. In the second technique, the nominal PI controller gains are adapted with a least squares method of controller parameter optimization in the frequency domain, so that the closed loop frequency response of the degraded engine and adaptive PI controller matches the closed loop frequency response of a nominal engine and nominal PI controller. Use of the new adaptive controller recovered the closed-loop transient thrust response of the degraded engine to nominal levels.

Author

*Autonomy; Jet Engines; Mathematical Models; Turbofan Engines; Control Systems Design; Propulsion System Performance; On-Line Systems*

**20040001716** Maryland Univ. Baltimore County, Catonsville, MD, USA

**An Expertise Recommender using Web Mining**

Joshi, Anupam; Chandrasekaran, Purnima; ShuYang, Michelle; Ramakrishnan, Ramya; [2001]; 8 pp.; In English

Contract(s)/Grant(s): NAS5-32337; USRA/5555-97-73/NASA; No Copyright; Avail: CASI; [A02](#), Hardcopy

This report explored techniques to mine web pages of scientists to extract information regarding their expertise, build expertise chains and referral webs, and semi automatically combine this information with directory information services to create a recommender system that permits query by expertise. The approach included experimenting with existing techniques that have been reported in research literature in recent past, and adapted them as needed. In addition, software tools were developed to capture and use this information.

Author

*World Wide Web; Data Mining; Artificial Intelligence; Architecture (Computers)*

## NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

**20040000500** NASA Stennis Space Center, Bay Saint Louis, MS, USA

### Algorithms for Ocean Bottom Albedo Determination from In-Water Natural Light Measurements

Leathers, Robert A.; McCormick, Normal J.; February 26, 1999; 25 pp.; In English; Original contains poor quality, truncated or crooked pages

Report No.(s): SE-1999-03-00011-SSC; Copyright; Avail: CASI; A03, Hardcopy

A method for determining ocean bottom optical albedo,  $R_{sub\ b}$ , from in-water upward and downward irradiance measurements at a shallow site is presented, tested, and compared with a more familiar approach that requires additional measurements at a nearby deep-water site. Also presented are two new algorithms for the estimation of  $R_{sub\ b}$  from measurements of the downward irradiance and vertically upward radiance.

Author

*Albedo; Ocean Bottom*

**20040000513** Prins Maurits Lab. TNO, Rijswijk, Netherlands

### Feasibility study on MADYMO Head Models for Blunt Trauma Assessment

vanderHorst, M. J.; vanBree, J. L. M. J.; Brands, D. W. A.; June 2003; 41 pp.; In English

Contract(s)/Grant(s): A01/KL/456

Report No.(s): TD-2002-0212; PML-2003-A38; Copyright; Avail: Other Sources

Non lethal kinetic energy weapons have become more and more important in today's military operations as the role of the military has changed from the Cold War Scenario of armored units attacking across the Iron Curtain to peace-keeping and peace-enforcing operations in various parts of the world. Non Penetrating Projectiles (NPPs) are likely to be employed in situations where the use of force is subject to stringent rules of engagement with respect to casualties, such as peace support operations and riot control. The industry offers a vast array of non-penetrating rounds; e.g. bean bags, sponge grenades, baton rounds and rubber bullets. Inaccuracy of NPPs, improper aiming and use bears the risk of severe injury or even death. Based on literature it is seen that most patients admitted to hospital suffer head-face and neck injuries, directly followed by arm and leg injuries as well as chest injuries. Abdominal injuries are observed less frequently. Head injuries are not only observed most frequently, additionally the head is considered a critical body part because of the often irreversible nature of injuries to the central nervous system. Therefore, a blunt head impact caused by NPP is considered as the most serious cause of injury. Most injuries caused by NPPs are blunt impact traumas, with a small percentage of penetrating injuries. For blunt impacts inertia, elastic and visco-elastic aspects will affect the load distribution within the body region involved. At present, several computational head injury models are available to study the effects of a given load distribution [e.g. Brands, 2002]. These models were developed for loading conditions occurring in car-accidents. This means that the models are based on injuries for low impact velocities with relatively high mass (10 ds, 5 kg) in contrast to projectile impacts in which a bullet with low mass (17-140 g) hits the head with relatively high velocity. The validity of these models for predicting brain response in NPP impacts has not yet been established. The objective is to study blunt trauma head injuries caused by NPPs through numerical modelling. More specifically, the objective of the current study is to determine the suitability of two existing MADYMO finite element human head models (TU/e head model, HUMOS head model) for blunt trauma head injuries caused by an impact of a 40 mm calibre NPP. In Chapter 2 the types of injuries due to NPPs are discussed. In Chapter 3 the numerical models of the head and the NPP are described. The methods section, Chapter 4, contains the simulation strategy and Chapter 5 the results of the impact simulation. The discussion follows in Chapter 6. Finally, conclusions and recommendations are presented in Chapter 7.

Derived from text

*Feasibility Analysis; Brain; Central Nervous System; Casualties; Head (Anatomy); Impact Velocity; Kinetic Energy*

## STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

**20040000104** NASA Marshall Space Flight Center, Huntsville, AL, USA

### Upward Flammability Testing: A Probabilistic Measurement

Davis, Samuel E.; Engel, Carl D.; Richardson, Erin R.; [2003]; 1 pp.; In English; Tenth International Symposium on

Flammability and Sensitivity of Materials in Oxygen-Enriched Atmospheres, 10-14 Nov. 2003, Brisbane, Australia; No Copyright; Avail: Other Sources; Abstract Only

Examination of NASA-STD-6001 Test 1 data suggests burn length outcome for a given environment has a large statistical variation from run to run. Large data sets show that burn length data form cumulative probability distribution curves, which describe a material's characteristic to burn in a specific environment, suggesting that the current practice of testing three samples at specific conditions is inadequate. Sufficient testing can establish material characteristics probability curves to provide the probability that a material will sustain a burn length of at least 15.24 cm (6.0 in.) or will sustain burning until all material is consumed. A simple pass/fail criterion may not be possible or practical. Future application of flammability data for some material classes may require the engineer to assess risk based on the probability of an occurrence and the probable outcome with different materials as characterized with cumulative burn length distributions for specific use conditions.

Author

*Flammability; Probability Distribution Functions; Burning Rate*

**2004000678** Georgia Inst. of Tech., Atlanta, GA, USA

**A Probabilistic Approach to Technology Identification, Evaluation, and Selection for Affordable Transport Concepts**

December 14, 2003; 199 pp.; In English

Contract(s)/Grant(s): NCC2-1193; No Copyright; Avail: CASI; [A09](#), Hardcopy

Most grant goals were accomplished over the course of the grant, albeit only partial success was achieved in applying ASDL's existing advanced design methods to HAVOC. The limited success in applying ASDL's advanced design methods occurred due to: fundamental 20 of 197 limitations in the RSM metamodeling process used; the highly computationally intensive nature of HAVOC as compared to many other advanced system synthesis and sizing codes; and the highly curved nature of low I(sub sp) rocket system spaces. These challenges encountered during the grant led to ongoing efforts in more efficient and robust sequential metamodeling/surrogate optimization based advanced design methods which are expected to overcome all of the challenges encountered with RSM during the grant. Other achievements over the course of the grant included the documentation of the existing HAVOC cost module and formulation of new cost estimation relationships in support of APS analysis of 3rd Gen RLV. Further achievements beyond the scope of the grant as originally defined were also achieved such as HAVOC code and portability improvements, historical propulsion performance and reliability regression relationships, and new visualization routines to facilitate visualization of HAVOC DOE case file results.

Derived from text

*Technology Assessment; Evaluation; Cost Estimates; Transportation*

**20040001604** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Statistical Sampling of Tide Heights Study**

[2002]; 2 pp.; In English

Report No.(s): NASA/NP-2002-04-00014-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

The goal of the study was to determine if it was possible to reduce the cost of verifying computational models of tidal waves and currents. Statistical techniques were used to determine the least number of samples required, in a given situation, to remain statistically significant, and thereby reduce overall project costs. Commercial, academic, and Federal agencies could benefit by applying these techniques, without the need to 'touch' every item in the population. For example, the requirement of this project was to measure the heights and times of high and low tides at 8,000 locations for verification of computational models of tidal waves and currents. The application of the statistical techniques began with observations to determine the correctness of submitted measurement data, followed by some assumptions based on the observations. Among the assumptions were that the data were representative of data-collection techniques used at the measurement locations, that time measurements could be ignored (that is, height measurements alone would suffice), and that the height measurements were from a statistically normal distribution. Sample means and standard deviations were determined for all locations. Interval limits were determined for confidence levels of 95, 98, and 99 percent. It was found that the numbers of measurement locations needed to attain these confidence levels were 55, 78, and 96, respectively.

Author

*Statistical Analysis; Sampling; Tides*

**SYSTEMS ANALYSIS AND OPERATIONS RESEARCH**

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

**20040000140** Carnegie-Mellon Univ., Pittsburgh, PA

**SEI Independent Research and Development Projects**

Bachmann, Felix; Bass, Len; Carney, David; Dietrich, Sven; Feiler, Peter; Sep. 2003; 68 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A418398; CMU/SEI-2003-TR-019; ESC\*-TR-2003-019; No Copyright; Avail: CASI; [A04](#), Hardcopy

Each year, the Software Engineering Institute (SEI) undertakes several Independent Research and Development (IR&D) projects. These projects serve to: (a) support feasibility studies investigating whether further work by the SEI would be of potential benefit and (b) support further exploratory work to determine if there is sufficient value in eventually funding the feasibility study work as an SEI initiative. Projects are chosen based on their potential to mature and/or transition software engineering practices, develop information that will help in deciding whether further work is worth funding, and set new directions for SEI work. This report describes the IR&D projects that were conducted during fiscal year 2003 (October 2002 through September 2003).

DTIC

*Software Engineering; Computer Programming; Research*

**20040000365** Colorado Univ., Boulder, CO, USA

**Large Scale Optimization Methods with a Focus on Chemistry Problems**

Schnabel, Robert B.; Byrd, Richard H.; Nov. 2002; 10 pp.; In English

Contract(s)/Grant(s): F49620-00-1-0162

Report No.(s): AD-A418451; AFRL-SR-AR-TR-03-0471; No Copyright; Avail: CASI; [A02](#), Hardcopy

Our research under this grant has developed general large-scale global optimization techniques in the context of solving protein structure prediction problems. Over the course of the research period the thrust of the research was primarily in two areas. The first area provided advances in our techniques for handling very large, complex proteins of arbitrary secondary and tertiary structure. The second area focused on advances in the efficiency of the algorithm on large-scale computing platforms. These advancements enabled us to significantly improve our effort in the CASP community-wide competition for protein structure prediction. During the CASP5 competition in summer of 2002, we attempted blind predictions of 20 proteins with sizes and structures far more complex than any previously attempted by our group. The results of assessment for the category of proteins which contain 'new folds' (i.e. proteins which were not known by existing databases) show that our group's predictions were in the top 10% of groups which predicted these targets. Much of this research is joint work with the bio-chemistry group headed by Dr. Teresa Head-Gordon at UC Berkeley, and the computer science group of Dr. Silvia Crivelli at Lawrence Berkeley Laboratory.

DTIC

*Mathematical Models; Optimization*

**20040000893** NASA Langley Research Center, Hampton, VA, USA

**Rapid Technology Assessment via Unified Deployment of Global Optical and Virtual Diagnostics**

Jordan, Jeffrey D.; Watkins, A. Neal; Fleming, Gary A.; Leighty, Bradley D.; Schwartz, Richard J.; Ingram, JoAnne L.; Grinstead, Keith D., Jr.; Oglesby, Donald M.; Tyler, Charles; [2003]; 12 pp.; In English; 20th International Congress on Instrumentation in Aerospace Simulation Facilities, 25-29 Aug. 2003, Gottingen, Germany; Original contains color illustrations

Contract(s)/Grant(s): IA1-568; RTA 706-96-00-62; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper discusses recent developments in rapid technology assessment resulting from an active collaboration between researchers at the Air Force Research Laboratory (AFRL) at Wright Patterson Air Force Base (WPAFB) and the NASA Langley Research Center (LaRC). This program targets the unified development and deployment of global measurement technologies coupled with a virtual diagnostic interface to enable the comparative evaluation of experimental and computational results. Continuing efforts focus on the development of seamless data translation methods to enable integration of data sets of disparate file format in a common platform. Results from a successful low-speed wind tunnel test at WPAFB in which global surface pressure distributions were acquired simultaneously with model deformation and geometry measurements are discussed and comparatively evaluated with numerical simulations. Intensity- and lifetime-based

pressure-sensitive paint (PSP) and projection moire interferometry (PMI) results are presented within the context of rapid technology assessment to enable simulation-based R&D.

Author

*Technology Assessment; Wind Tunnel Tests; Deployment; Diagnosis; Pressure Distribution*

**20040000900** NASA Langley Research Center, Hampton, VA, USA

**Scale-free Graphs for General Aviation Flight Schedules**

Alexandov, Natalia M., Technical Monitor; Kincaid, Rex K.; November 2003; 19 pp.; In English

Contract(s)/Grant(s): NCC1-03022; WU 23-762-20-21

Report No.(s): NASA/CR-2003-212648; No Copyright; Avail: CASI; [A03](#), Hardcopy

In the late 1990s a number of researchers noticed that networks in biology, sociology, and telecommunications exhibited similar characteristics unlike standard random networks. In particular, they found that the cumulative degree distributions of these graphs followed a power law rather than a binomial distribution and that their clustering coefficients tended to a nonzero constant as the number of nodes,  $n$ , became large rather than  $O(1/n)$ . Moreover, these networks shared an important property with traditional random graphs as  $n$  becomes large the average shortest path length scales with  $\log n$ . This latter property has been coined the small-world property. When taken together these three properties small-world, power law, and constant clustering coefficient describe what are now most commonly referred to as scale-free networks. Since 1997 at least six books and over 400 articles have been written about scale-free networks. In this manuscript an overview of the salient characteristics of scale-free networks. Computational experience will be provided for two mechanisms that grow (dynamic) scale-free graphs. Additional computational experience will be given for constructing (static) scale-free graphs via a tabu search optimization approach. Finally, a discussion of potential applications to general aviation networks is given.

Author

*General Aviation Aircraft; Graph Theory; Communication Networks; Schedules; Mathematical Models*

**20040000973** Cleveland State Univ., Cleveland, OH, USA

**Development of Management Metrics for Research and Technology**

Sheskin, Theodore J.; NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field; [2003], pp. 35-36; In English; See also 20040000959

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A01](#), Hardcopy

Professor Ted Sheskin from CSU will be tasked to research and investigate metrics that can be used to determine the technical progress for advanced development and research tasks. These metrics will be implemented in a software environment that hosts engineering design, analysis and management tools to be used to support power system and component research work at GRC. Professor Sheskin is an Industrial Engineer and has been involved in issues related to management of engineering tasks and will use his knowledge from this area to allow extrapolation into the research and technology management area. Over the course of the summer, Professor Sheskin will develop a bibliography of management papers covering current management methods that may be applicable to research management. At the completion of the summer work we expect to have him recommend a metric system to be reviewed prior to implementation in the software environment. This task has been discussed with Professor Sheskin and some review material has already been given to him.

Author

*Research Management; Design Analysis; Support Systems; Management Methods; Transferred Electron Devices*

## 71 ACOUSTICS

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution*. For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion and Power*.

**20040000232** Pennsylvania State Univ., University Park, PA

**Geometric Phased Beam Diver Held Sonar**

Tutwiler, Richard L.; Allen, Charles W.; Hughes, W. J.; Sep. 30, 2003; 90 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00174-98-1-0032

Report No.(s): AD-A418402; PSU/ARL-TM-03-093; No Copyright; Avail: CASI; [A05](#), Hardcopy

A design for an underwater acoustic imaging system that would be portable enough to be operated by a diver was developed utilizing the geometric phased beam or 'doily' array concept. The 'doily' array design provides multiple

beamsteering capability while drastically reducing the number of elements required. The system would operate in the 1 to 6MHz frequency range and only require 1808 channels. This report documents the state of the design at the end of the program.

DTIC

*Diving (Underwater); Underwater Acoustics*

**20040000280** Naval Research Lab., Stennis Space Center, MS

**Estimation of Low Frequency Scattering from Fish Schools on the Continental Shelf off New Jersey**

Nero, Redwood W.; Love, Richard H.; Nov. 10, 2003; 13 pp.; In English

Report No.(s): AD-A418444; NRL/MR/7180--03-8723; No Copyright; Avail: CASI; [A03](#), Hardcopy

The GeoClutter 2001 (GCOi) experiment conducted on the continental shelf of New Jersey in April and May 2001 focused on physical mechanisms causing geologically produced acoustic clutter and false targets around 400 Hz. During GCOI, a large, strong unidentified target was detected. In May 2001, backscatter measurements from the ocean volume were made in the same area at 2 to 10kHz and at 38kHz to examine scattering from fish during the Boundary Characterization (BCOI) experiment. Also, the National Marine Fisheries Service (NMFS) conducted a trawl and 38 kHz echosounder fisheries survey in the region from February to April 2001. Data from BCOI and NMFS show that large demersal and pelagic fish schools occur on the New Jersey shelf in spring. Demersal schools are most likely composed of scup, seabass, hake, or dogfish shark. Pelagic schools are probably composed of herring-like fish or butterfish. Results of modeling backscatter from these species indicate that these schools could produce significant scattering at 400 Hz and could have easily produced the large unidentified target observed during GCOI.

DTIC

*Backscattering; Fishes*

**20040000330** NASA Langley Research Center, Hampton, VA, USA

**System for Multiplexing Acoustic Emission (AE) Instrumentation**

Prosser, William H., Inventor; Perey, Daniel F., Inventor; Gorman, Michael R., Inventor; Scales, Edgar F., Inventor; September 30, 2003; 7 pp.; In English

Patent Info.: Filed 15 Jun. 1999; US-Patent-6,628,567; US-Patent-Appl-SN-333199; NASA-Case-LAR-15612-1; No Copyright; Avail: CASI; [A02](#), Hardcopy

An acoustic monitoring device has at least two acoustic sensors with a triggering mechanism and a multiplexing circuit. After the occurrence of a triggering event at a sensor, the multiplexing circuit allows a recording component to record acoustic emissions at adjacent sensors. The acoustic monitoring device is attached to a solid medium to detect the occurrence of damage.

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

*Multiplexing; Acoustic Emission; Acoustic Measurement*

**20040000554** NASA Langley Research Center, Hampton, VA, USA, Federal Aviation Administration, Cambridge, MA, USA

**Engine Installation Effects of Four Civil Transport Airplanes: Wallops Flight Facility Study**

Fleming, Gregg G.; Senzig, David A.; McCurdy, David A.; Roof, Christopher J.; Rapoza, Amanda S.; October 2003; 64 pp.; In English

Contract(s)/Grant(s): 781-20-11-01

Report No.(s): NASA/TM-2003-212433; L-18305; DTS-34-VX305-LR1; Copyright; Avail: CASI; [A04](#), Hardcopy

The National Aeronautics and Space Administration (NASA), Langley Research Center (LaRC), the Environmental Measurement and Modeling Division of the USA Department of Transportation's John A. Volpe National Transportation Systems Center (Volpe), and several other organizations (see Appendix A for a complete list of participating organizations and individuals) conducted a noise measurement study at NASA's Wallops Flight Facility (Wallops) near Chincoteague, Virginia during September 2000. This test was intended to determine engine installation effects on four civil transport airplanes: a Boeing 767-400, a McDonnell-Douglas DC9, a Dassault Falcon 2000, and a Beechcraft King Air. Wallops was chosen for this study because of the relatively low ambient noise of the site and the degree of control over airplane operating procedures enabled by operating over a runway closed to other uses during the test period. Measurements were conducted using a twenty

microphone U-shaped array oriented perpendicular to the flight path; microphones were mounted such that ground effects were minimized and low elevation angles were observed.

Author

*Boeing 767 Aircraft; Installing; Noise (Sound); Noise Measurement; Aircraft Noise*

**20040001160** NASA Langley Research Center, Hampton, VA, USA

**Concepts and Development of Bio-Inspired Distributed Embedded Wired/Wireless Sensor Array Architectures for Acoustic Wave Sensing in Integrated Aerospace Vehicles**

Ghoshal, Anindya; Prosser, William H.; Kirikera, Goutham; Schulz, Mark J.; Hughes, Derke J.; Orisamolu, Wally; [2003]; 9 pp.; In English; 4th International Workshop on Structural Health Monitoring 2003, 15-17 Sep. 2003, Stanford, CA, USA; Copyright; Avail: CASI; A02, Hardcopy

This paper discusses the modeling of acoustic emissions in plate structures and their sensing by embedded or surface bonded piezoelectric sensor arrays. Three different modeling efforts for acoustic emission (AE) wave generation and propagation are discussed briefly along with their advantages and disadvantages. Continuous sensors placed at right angles on a plate are being discussed as a new approach to measure and locate the source of acoustic waves. Evolutionary novel signal processing algorithms and bio-inspired distributed sensor array systems are used on large structures and integrated aerospace vehicles for AE source localization and preliminary results are presented. These systems allow for a great reduction in the amount of data that needs to be processed and also reduce the chances of false alarms from ambient noises. It is envisioned that these biomimetic sensor arrays and signal processing techniques will be useful for both wireless and wired sensor arrays for real time health monitoring of large integrated aerospace vehicles and earth fixed civil structures. The sensor array architectures can also be used with other types of sensors and for other applications.

Author

*Acoustic Emission; Mathematical Models; Signal Processing; Detection; Wave Propagation; Biomimetics; Wireless Communication*

## 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*.

**20030112380** NASA Langley Research Center, Hampton, VA, USA

**Electrostrictive Graft Elastomers**

Su, Ji, Inventor; Harrison, Joycelyn S., Inventor; St.Clair, Terry L., Inventor; February 04, 2003; 9 pp.; In English Patent Info.: Filed 23 Oct. 2000; US-Patent-6,515,077; US-Patent-Appl-SN-696528; US-Patent-Appl-SN-161160; US-Patent-Appl-SN-161113; NASA-Case-LAR-16038-1; No Copyright; Avail: CASI; A02, Hardcopy

An electrostrictive graft elastomer has a backbone molecule which is a non-crystallizable, flexible macromolecular chain and a grafted polymer forming polar graft moieties with backbone molecules. The polar graft moieties have been rotated by an applied electric field, e.g., into substantial polar alignment. The rotation is sustained until the electric field is removed. In another embodiment, a process for producing strain in an elastomer includes: (a) providing a graft elastomer having a backbone molecule which is a non-crystallizable, flexible macromolecular chain and a grafted polymer forming polar graft moieties with backbone molecules; and (b) applying an electric field to the graft elastomer to rotate the polar graft moieties, e.g., into substantial polar alignment.

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

*Electrostriction; Elastomers*

**20040000684** BAE Systems, Huntsville, AL, USA

**Crystallization Physics in Biomacromolecular Systems**

Chernov, A. A.; [2003]; 1 pp.; In English; International Summer School on Crystal Growth (ISSCG-12), 1-7 Aug. 2003, Berlin, Germany

Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

The crystals are built of molecules of protein, nucleic acid and their complexes, like viruses, approx.  $5 \times 10^3$  to  $3 \times 10^6$  Da in weight and 2 + 20 nm in effective diameter. This size strongly exceeds action range of molecular forces and makes a big difference with inorganic crystals. Intermolecular contacts form patches on the biomacromolecular surface.

Each patch may occupy only a small percent of the whole surface and vary from polymorph to polymorph of the same protein. Thus, under different conditions (pH, solution chemistry, temperature, any area on the macromolecular surface may form a contact. The crystal Young moduli, E approx. equals  $0.1 + 0.5$  GPa are more than 10 times lower than that of inorganics and the biomolecules themselves. Water within biocrystals (30-70%) is unable to flow unless typical deformation time is longer than approx.  $10(\text{exp } -5)$ s. This explains the discrepancy between light scattering and static measurements of E. Nucleation and Growth requires typically concentrations exceeding the equilibrium ones up to 100 times - because of the new size scale results in  $10 - 10(\text{exp } 3)$  times lower kinetic coefficients than that needed for inorganic solution growth. All phenomena observed in the latter occur with protein crystallization and are even better studied by AFM. Crystals are typically faceted. Among unexpected findings of general significance are - net molecular exchange flux at kinks is much lower than that expected from supersaturation, steps with low ( $<$  approx.  $10(\text{exp } -2)$ ) kink density at steps follow Gibbs-Thomson law only at very low supersaturations, step segment growth rate may be independent of step energy. Crystal perfection is a must of biocrystallization to achieve the major goal to find 3-D atomic structure of biomacromolecules by x-ray diffraction. Poor diffraction resolution ( $>$  3Angstrom) makes crystallization a bottleneck for structural biology. All defects typical of small molecule crystals are found in biocrystals, but the defects responsible for poor resolution are not identified. Conformational changes are one of them. Biocrystallization in microgravity reportedly results in 20% cases of better crystals. The mechanism of how lack of convection can do this is still not clear. Lower supersaturation, self-purification &om preferentially trapped homologous impurities and step bunching are viable hypotheses.

Author

*Microgravity; Biochemistry; Crystallization; Protein Crystal Growth; Nucleic Acids; Atomic Structure*

## 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*.

**2004000005** NASA Stennis Space Center, Bay Saint Louis, MS, USA

### **Optimal Reflectance, Transmittance, and Absorptance Wavebands and Band Ratios for the Estimation of Leaf Chlorophyll Concentration**

Carter, Gregory A.; Spiering, Bruce A.; October 22, 2000; 15 pp.; In English; Remote Sensing 2000 Conference, 22-25 Oct. 2000, Corpus Christi, TX, USA

Report No.(s): NASA/SE-2000-09-00007-SSC; No Copyright; Avail: CASI; [A03](#), Hardcopy

The present study utilized regression analysis to identify: wavebands and band ratios within the 400-850 nm range that could be used to estimate total chlorophyll concentration with minimal error; and simple regression models that were most effective in estimating chlorophyll concentrations were measured for two broadleaved species, a broadleaved vine, a needle-leaved conifer, and a representative of the grass family. Overall, reflectance, transmittance, and absorptance corresponded most precisely with chlorophyll concentration at wavelengths near 700 nm, although regressions were strong as well in the 550-625 nm range.

Author

*Chlorophylls; Leaves; Optical Properties*

**20040000033** Hampton Univ., VA, USA

### **Research Center for Optical Physics: Education and Technology for the 21st Century**

[2003]; 36 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NCC1-251; No Copyright; Avail: CASI; [A03](#), Hardcopy

During the past eleven years since its inception, RCOP has excelled in its two primary goals: 1) training of the scientists and engineers needed for the twenty-first century with special emphasis on underrepresented citizens and 2) research and technological development in areas of relevance to NASA. In the category of research training, as of May 2003, RCOP produced 36 Bachelors degrees, 25 Masters degrees, and 13 Doctoral degrees. Of these, all 36 Bachelors degrees, 16 of the Masters degrees and 9 of the Doctoral degrees were awarded to African Americans. Four of the Doctoral graduates and one of the Masters graduates are working at NASA Field Centers. RCOP has also provided research experiences to 130 undergraduate students and 22 high school students through a number of outreach programs held during the summer and the academic year. RCOP has also been crucial to the development of the Ph.D. program in physics at Hampton University by providing high quality research training and technical electives required for a Doctoral degree in physics. RCOP has also

excelled in research and technological development. Since 1992, RCOP researchers have leveraged over 8 million dollars in additional research funding, published 152 papers in refereed journals and proceedings, and given 125 presentations at refereed international conferences in the USA and eight other countries. RCOP also developed numerous collaborations with other research centers, universities and industries. In recognition of this outstanding work, RCOP is the first research center in the USA invited to join the Joint Open Laboratory for Laser Crystals and Precise Laser Systems headed by Dr. Alexander Kaminiskii of the Russian Academy of Sciences.

Author

*Universities; Research Facilities; Optics*

**20040000234** Texas Univ., Austin, TX, USA

**Optical True-Time Delay Module (OTTDM) for Wideband Multiple Beam Phased Array Operation**

Chen, Ray T.; Nov. 13, 2003; 53 pp.; In English

Contract(s)/Grant(s): Proj-F49620-02-1-0298

Report No.(s): AD-A418425; AFRL-SR-AR-TR-03-0478; No Copyright; Avail: CASI; A04, Hardcopy

There are many communication and radar applications requiring antennas with high directionality and narrow beam width. Typically, the width and directivity of the radiation pattern of a single radiating antenna element is insufficient for these applications. One method of improving these limitations is to increase the element aperture. A typical approach is to place the radiating element at the focal point of a large parabolic dish. However, for many mobile platform applications this is not a practical approach. With a narrow radiation pattern the antenna aperture must be steered to direct the signal in the desired direction. For a large dish antenna it may be difficult to position the aperture quickly enough due to inertia effects of the massive antenna. A better method to increase the antenna aperture without the adverse consequences of a large dish structure is to use an antenna array, which is an assembly of radiating elements in a given geometrical pattern. The beam pattern of an array antenna can be adjusted by any of five parameters: the geometrical configuration of the array, the displacement between the elements, the excitation amplitude, the excitation phase, and the radiation pattern of the individual elements. As will be shown, by adjusting the phase of the signal delivered to each element it is possible to control the steering angle of the beam without physically repositioning the antenna aperture. Such an antenna is called a phased array antenna (PAA) because a phased array antenna does not need to be physically repositioned, its reaction time can be several orders of magnitude faster than a large dish antenna. This allows PAA systems to be multifunctional, meaning they can perform many different tasks simultaneously.

DTIC

*Fiber Optics; Antenna Arrays; Phased Arrays; Antenna Radiation Patterns*

**20040000477** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Characterization of a 2-mm thick, 16x16 Cadmium-Zinc-Telluride Pixel Array**

Gaskin, Jessica; Richardson, Georgia; Mitchell, Shannon; Ramsey, Brian; Seller, Paul; Sharma, Dharma; [2003]; 1 pp.; In English; IEEE's Symposium on Nuclear Power Systems, 19-25 Oct. 2003, Portland, OR, USA; No Copyright; Avail: Other Sources; Abstract Only

The detector under study is a 2-mm-thick, 16x16 Cadmium-Zinc-Telluride pixel array with a pixel pitch of 300 microns and inter-pixel gap of 50 microns. This detector is a precursor to that which will be used at the focal plane of the High Energy Replicated Optics (HERO) telescope currently being developed at Marshall Space Flight Center. With a telescope focal length of 6 meters, the detector needs to have a spatial resolution of around 200 microns in order to take full advantage of the HERO angular resolution. We discuss to what degree charge sharing will degrade energy resolution but will improve our spatial resolution through position interpolation. In addition, we discuss electric field modeling for this specific detector geometry and the role this mapping will play in terms of charge sharing and charge loss in the detector.

Author

*Cadmium Tellurides; Spatial Resolution; Zinc Tellurides; Angular Resolution; Pixels; Detectors*

**20040000695** Texas A&M Univ., Corpus Christi, TX, USA

**Design of a Borescope for Extravehicular Non-Destructive Applications**

Bachnak, Rafic; [2003]; 2 pp.; In English; 16th Annual Symposium on Electronic Imaging, 18-22 Jan. 2004, San Jose, CA, USA

Contract(s)/Grant(s): NAG9-1459; No Copyright; Avail: Other Sources; Abstract Only

Anomalies such as corrosion, structural damage, misalignment, cracking, stress fractures, pitting, or wear can be detected

and monitored by the aid of a borescope. A borescope requires a source of light for proper operation. Today's current lighting technology market consists of incandescent lamps, fluorescent lamps and other types of electric arc and electric discharge vapor lamp. Recent advances in LED technology have made LEDs viable for a number of applications, including vehicle stoplights, traffic lights, machine-vision-inspection, illumination, and street signs. LEDs promise significant reduction in power consumption compared to other sources of light. This project focused on comparing images taken by the Olympus IPLEX, using two different light sources. One of the sources is the 50-W internal metal halide lamp and the other is a 1 W LED placed at the tip of the insertion tube. Images acquired using these two light sources were quantitatively compared using their histogram, intensity profile along a line segment, and edge detection. Also, images were qualitatively compared using image registration and transformation [1]. The gray-level histogram, edge detection, image profile and image registration do not offer conclusive results. The LED light source, however, produces good images for visual inspection by an operator. Analysis using pattern recognition using Eigenfaces and Gaussian Pyramid in face recognition may be more useful.

Author

*Light Sources; Light Emitting Diodes*

## 75

### PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**2004000047** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

#### **Spectroscopic Determination of the Physical Conditions in Hot Optically Thin Sources**

Brickhouse, Nancy S.; Oliverson, Ronald J., Technical Monitor; October 21, 2003; 6 pp.; In English

Contract(s)/Grant(s): Rept-7; NAG5-3559; No Copyright; Avail: CASI; **A02**, Hardcopy

The Astrophysics Plasma Emission Code and Database (APEC/APED), developed in part under this grant, have been upgraded to ATOMDB Version 1.3.1: and are now beginning to find widespread applications to X-ray spectral data from Chandra and XMM-Newton (37 citations in published work, according to the ADS, plus numerous other conference and prepublication papers). ATOMDB is now linked through the Plasma Gate website: <http://plasma-gate.weizmann.ac.il/DBfAPP.html>. The major difference from Version 1.3.0 is that the new models now extend to 50 keV rather than stopping at 10 keV. This means that ATOMDB can be used with redshifted observations. There are minor differences in emissivities due to radiative recombination and cascades. Stellar coronae are being used to benchmark the atomic data in APED as part of the Emission Line Project. The models appear to be in good agreement with the observations for most of the strong lines; however, we have identified significant discrepancies in the 3s/3d line ratios not only for Fe XVII, but also for Fe XVIII and XIX. The Fe XVII problem has been known from solar observations, and is currently being tested under EBIT laboratory conditions by two groups. The Fe XVIII problem is substantially worse, but perhaps will shed light on the relevant underlying theoretical issues. Ming-Feng Gu has recently published new calculations, which we are comparing with APEC and with the observations. His calculations appear to improve the emissivities of lines affected by cascades, but other problems remain.

Derived from text

*Spectroscopy; Stellar Coronas*

**20040000361** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **The Deflection Plate Analyzer: A Technique for Space Plasma Measurements Under Highly Disturbed Conditions**

Wright, Kenneth H., Jr.; Dutton, Ken; Martinez, Nelson; Smith, Dennis; Stone, Nobie H.; [2003]; 1 pp.; In English; 8th Spacecraft Charging Technology Conference, 20-24 Oct. 2003, Huntsville, AL, USA; Copyright; Avail: Other Sources; Abstract Only

A technique has been developed to measure the characteristics of space plasmas under highly disturbed conditions; e.g., non-Maxwellian plasmas with strong drifting populations and plasmas contaminated by spacecraft outgassing. The present method is an extension of the capabilities of the Differential Ion Flux Probe (DIFP) to include a mass measurement that does not include either high voltage or contamination sensitive devices such as channeltron electron multipliers or microchannel plates. This reduces the complexity and expense of instrument fabrication, testing, and integration of flight hardware as compared to classical mass analyzers. The new instrument design is called the Deflection Plate Analyzer (DPA) and can deconvolve multiple ion streams and analyze each stream for ion flux intensity (density), velocity (including direction of motion), mass, and temperature (or energy distribution). The basic functionality of the DPA is discussed. The performance characteristics of a flight instrument as built for an electrodynamic tether mission, the Propulsive Small Expendable Deployer

System (ProSEDS), and the instrument's role in measuring key experimental conditions are also discussed.

Author

*Space Plasmas; Outgassing; Contamination; Flux Density; Channel Multipliers; Microchannel Plates*

**20040000732** NASA Marshall Space Flight Center, Huntsville, AL, USA, National Space Science and Technology Center, Huntsville, AL, USA

**Double Layers in Expanding Plasmas and Their Relevance to the Auroral Plasma Processes**

Singh, Nagendra; Khazanov, George; Journal of Geophysical Research; 2003; ISSN 0148-0227; Volume 108, No. A4, pp. 8-1 - 8-16; In English; Original contains color illustrations

Contract(s)/Grant(s): NSF ATM-98-14571; Copyright; Avail: Other Sources

When a dense plasma consisting of a cold and a sufficiently warm electron population expands, a rarefaction shock forms [Bezzerrides et al., 1978]. In the expansion of the polar wind in the magnetosphere, it has been previously shown that when a sufficiently warm electron population also exists, in addition to the usual cold ionospheric one, a discontinuity forms in the electrostatic potential distribution along the magnetic field lines [Barakat and Schunk, 1984]. Despite the lack of spatial resolution and the assumption of quasi-neutrality in the polar wind models, such discontinuities have been called double layers (DLs). Recently similar discontinuities have been invoked to partly explain the auroral acceleration of electrons and ions in the upward current region [Ergun et al., 2000]. By means of one-dimensional Vlasov simulations of expanding plasmas, for the first time we make here the connection between (1) the rarefaction shocks, (2) the discontinuities in the potential distributions, and (3) DLs. We show that when plasmas expand from opposite directions into a deep density cavity with a potential drop across it and when the plasma on the high-potential side contains hot and cold electron populations, the temporal evolution of the potential and the plasma distribution generates evolving multiple double layers with an extended density cavity between them. One of the DLs is the rarefaction-shock (RFS) and it forms by the reflections of the cold electrons coming from the high-potential side; it supports a part of the potential drop approximately determined by the hot electron temperature. The other DLs evolve from charge separations arising either from reflection of ions coming from the low-potential side or stemming from plasma instabilities; they support the rest of the potential drop. The instabilities forming these additional double layers involve electron-ion (e-i) Buneman or ion-ion (i-i) two-stream interactions. The electron-electron two-stream interactions on the high-potential side of the RFS generate electron-acoustic waves, which evolve into electron phase-space holes. The ion population originating from the low-potential side and trapped by the RFS is energized by the e-i and i-i instabilities and it eventually precipitates into the high-potential plasma along with an electron beam. Applications of these findings to the auroral plasma physics are discussed.

Author

*Auroras; Dense Plasmas; Magnetic Fields; Elementary Particle Interactions; Magnetohydrodynamic Stability; Plasma Layers*

**20040000779** NASA Glenn Research Center, Cleveland, OH, USA

**Characterization of Downstream Ion Energy Distributions From a High Current Hollow Cathode in a Ring Cusp Discharge Chamber**

Foster, John E.; Patterson, Michael J.; October 2003; 20 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Report No.(s): NASA/TM-2003-212589; AIAA Paper 2003-4865; E-14146; No Copyright; Avail: CASI; A03, Hardcopy

The presence of energetic ions produced by a hollow cathodes operating at high emission currents (greater than 10 Angstroms) has been documented in the literature. As part of an ongoing effort to uncover the underlying physics of the formation of these ions, ion efflux from a high current hollow cathode operating in an ion thruster discharge chamber was investigated. Using a spherical sector electrostatic energy analyzer located downstream of the discharge cathode, the ion energy distribution over a 0 to 60 eV energy range was measured. The sensitivity of the ion energy distribution function to zenith angle was also assessed at 3 different positions: 0, 15, and 25 degrees. The measurements suggest that the majority of the ion current at the measuring point falls into the analyzer with an energy approximately equal to the discharge voltage. The ion distribution, however, was found to be quite broad. The high energy tail of the distribution function tended to grow with increasing discharge current. Sensitivity of the profiles to flow rate at fixed discharge current was also investigated. A simple model is presented that provides a potential mechanism for the production of ions with energies above the discharge voltage.

Author

*Hollow Cathodes; Energetic Particles; High Current; Ion Distribution; Ring Discharge*

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*.

**2004000098** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Transient Torque Method: A Fast and Non-Intrusive Technique to Simultaneously Determine Viscosity and Electrical Conductivity of Semiconducting and Metallic Melts**

Li, C.; Ban, H.; Lin, B.; Scripa, R. N.; Su, C.; Lehoczky, S. L.; Zhu, S.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

A transient torque method was developed to rapidly and simultaneously determine the viscosity and electrical conductivity of semiconducting or metallic melts. The experimental setup is similar to that for the oscillation cup technique. The melt sample is sealed inside a fused silica ampoule, and the ampoule is suspended by a long quartz fiber to form a torsional oscillation system. A rotating magnetic field is used to induce a rotating flow in the conductive melt, which causes the ampoule to rotate along its axis. A sensitive angular detector is used to measure the deflection angle of the ampoule. Based on the transient behavior of the deflection angle as the rotating magnetic field is applied, the electrical conductivity and viscosity of the melt can be obtained simultaneously by numerically fitting the data to a set of governing equations. The transient torque viscometer was applied successfully to measure the viscosity and electrical conductivity of high purity mercury at 53.4 C. The results were in excellent agreement with the published data. The main advantage of the technique is that the measurement can be completed in one or two minutes, as opposed to the one or two-hour measurement time required by the oscillation cup technique. The method is non-intrusive; capable of rapid measurement of the viscosity of toxic, high vapor pressure melts at elevated temperatures. In addition, the transient torque viscometer can also be operated as an oscillation cup viscometer if desired.

Author

*Torque; Nonintrusive Measurement; Viscosity; Electrical Resistivity; Semiconductors (Materials); Melts (Crystal Growth); Mercury (Metal)*

**2004000188** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Antiferromagnetic Interlayer Exchange Coupling in All-Semiconducting EuS/PbS/EuS Trilayers**

Smits, C. J. P.; Filip, A. T.; Swagten, H. J. M.; Koopmans, B.; deJonge, W. J. M.; Chernyshova, M.; Kowalczyk, L.; Graszka, K.; Szczerbakow, A.; Story, T., et al.; [2003]; 1 pp.; In English

Contract(s)/Grant(s): NAS8-02096; Copyright; Avail: Other Sources; Abstract Only

A comprehensive experimental study on the antiferromagnetic interlayer exchange coupling in high quality epitaxial all-semiconducting EuSPbSEuS trilayers is reported. The influence of substrates, the thickness of the non-magnetic PbS spacer layer, and of temperature, was investigated by means of SQUID magnetometry. In trilayers with a PbS thickness between 4 and 12 deg A the low temperature hysteresis loops showed the signature of antiferromagnetic coupling. The value of the interlayer exchange coupling energy was determined by simulating the data with a modified Stoner model, including Zeeman, anisotropy, and exchange coupling energies. An important observation was of a strong dependence of the interlayer exchange coupling energy on temperature, consistent with a power law dependence of the exchange coupling constant on the saturation magnetization of the EuS layers. While no theoretical description is readily available, we conjecture that the observed behavior is due to a dependence of the interlayer exchange coupling energy on the exchange splitting of the EuS conduction band.

Author

*Antiferromagnetism; Coupling; Semiconductors (Materials); Composite Structures*

**2004000691** NASA Johnson Space Center, Houston, TX, USA

**X-Ray Crystallography Reagent**

Morrison, Dennis R., Inventor; Mosier, Benjamin, Inventor; July 29, 2003; 22 pp.; In English

Patent Info.: Filed 24 Jan. 2001; US-Patent-6,599,449; US-Patent-Appl-SN-774169; US-Patent-Appl-SN-079766; US-Patent-Appl-SN-349169; NASA-Case-MS-C-22936-4; No Copyright; Avail: CASI; A03, Hardcopy

Microcapsules prepared by encapsulating an aqueous solution of a protein, drug or other bioactive substance inside a semi-permeable membrane by are disclosed. The microcapsules are formed by interfacial coacervation under conditions where the shear forces are limited to 0-100 dynes per square centimeter at the interface. By placing the microcapsules in a high osmotic dewatering solution. the protein solution is gradually made saturated and then supersaturated. and the controlled nucleation and crystallization of the protein is achieved. The crystal-filled microcapsules prepared by this method can be

conveniently harvested and stored while keeping the encapsulated crystals in essentially pristine condition due to the rugged, protective membrane. Because the membrane components themselves are x-ray transparent, large crystal-containing microcapsules can be individually selected, mounted in x-ray capillary tubes and subjected to high energy x-ray diffraction studies to determine the 3-D structure of the protein molecules. Certain embodiments of the microcapsules of the invention have composite polymeric outer membranes which are somewhat elastic, water insoluble, permeable only to water, salts, and low molecular weight molecules and are structurally stable in fluid shear forces typically encountered in the human vascular system.

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

*Crystallography; X Rays; Reagents; Protein Crystal Growth; Encapsulating*

## 77

### PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics*, *73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

**2004000845** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Review of the High Performance Antiproton Trap (HiPAT) Experiment**

Martin, James J.; Lewis, Raymond A.; Pearson, J. Boise; Sims, W. Herb; Chakrabarti, Suman; Fant, Wallace E.; McDonald, Stan; [2003]; 1 pp.; In English; APS DPP Meeting, 27-31 Oct. 2003, Albuquerque, NM, USA; No Copyright; Avail: Other Sources; Abstract Only

Many space propulsion concepts exist that use matter-antimatter reactions. Current antiproton production rates are enough to conduct proof-of-principle evaluation of these concepts. One enabling technology for such experiments is portable storage of low energy antiprotons, to transport antiprotons to experimental facilities. To address this need, HiPAT is being developed, with a design goal of containing  $10^{12}$  particles for up to 18 days. HiPAT is a Penning-Malmberg trap with a 4 Tesla superconductor, 20kV electrodes, radio frequency (RF) network, and  $10^{-13}$  Torr vacuum. 'Normal' matter is being used to evaluate the system. An electron beam ionizes background gas in situ, and particle beams are captured dynamically. The experiment examines ion storage lifetimes, RF plasma diagnostics, charge exchange with background gases, and dynamic ion beam capture.

Author

*Antiprotons; Traps; Ion Storage; Radio Frequencies; Plasmas (Physics); Ionized Gases; Ion Beams*

**20040001173** National Inst. of Standards and Technology, Gaithersburg, MD, USA

#### **Characteristics and Identification of Super- Effective Thermal Fire-Extinguishing Agents**

Pitts, William M.; Yang, Jiann C.; Bryant, Rodney A.; Blevins, Linda G.; Huber, Marcia L.; Jul. 13, 2001; 137 pp.; In English Report No.(s): AD-A418433; No Copyright; Avail: CASI; A07, Hardcopy

This report summarizes the findings of a three- year investigation designed to assess the potential for fire-extinguishing agents that act primarily by thermal means to replace the chemically active halons whose production has been banned due to their deleterious effects on stratospheric ozone. The project had four major components: 1) Extensive searches of thermodynamic databases maintained by NIST were carried out to identify% chemical compounds that are predicted to extract large amounts of heat from a combustion zone, 2) two liquids that were identified as being particularly interesting during the database search, were tested experimentally for their extinguishing effectiveness, 3) detailed chemical- kinetic modeling and experimental studies of extinguishing volume fractions in simple flame systems were used to improve the understanding of the effects of thermal agents on diffusion flames, and 4) empirical heat transfer correlations for spray cooling of a surface were used to estimate the efficiencies of surface cooling by thermal agents. The fluorinated ether methoxy-nonafluorobutane was identified as a potential replacement. It was also noted that agents released as liquids seem to be more effective than predicted based simply on their ability to absorb heat. Recommendations for additional studies are provided.

DTIC

*Flames; Heat Transfer; Thermodynamic Properties; Fire Extinguishers*

**SOCIAL AND INFORMATION SCIENCES (GENERAL)**

Includes general research topics related to sociology; educational programs and curricula. For specific topics in these areas see *categories 81 through 85*.

**20040000198** Norfolk State Univ., VA, USA

**NASA/NSU Pre-Service Teacher Program Report: Narrative and Program Outcomes**

[2003]; 18 pp.; In English

Contract(s)/Grant(s): NCC1-01057; No Copyright; Avail: CASI; [A03](#), Hardcopy

The NASA/NSU Pre-Service Teacher Program seeks to address the critical role that NASA Langley Research Center and Norfolk State University, working in tandem with other institutions around the country, can play in support of pre-service teacher education. Pre-service teachers are selected from designated institutions that serve large minority populations. The program consists of a National Conference and a Summer Institute.

Author

*Instructors; Education*

**ADMINISTRATION AND MANAGEMENT**

Includes management planning and research.

**20040000553** Hampton Univ., VA, USA

**[Activities of Hampton University College of Continuing Education Aerospace Center]**

Taylor, Wade; Reaves, Cato L.; [2003]; 23 pp.; In English

Contract(s)/Grant(s): NAG5-10015; Copyright; Avail: CASI; [A03](#), Hardcopy

Our outlook is more focused than ever. We are to make certain that we provide an opportunity for qualified students to attend the best equipped, most efficiently managed aviation maintenance training facility possible. We purpose to learn from the technology of yesterday, provide access to the technology of today and adjust to the change that is to come.

Derived from text

*Aerospace Sciences; Education; Maintenance Training*

**20040000559** Virginia Univ., Charlottesville, VA, USA

**NASA Aviation Safety Program Systems Analysis/Program Assessment Metrics Review**

Louis, Garrick E.; Anderson, Katherine; Ahmad, Tisan; Bouabid, Ali; Siriwardana, Maya; Guilbaud, Patrick; [2003]; 60 pp.; In English

Contract(s)/Grant(s): NAG1-02102

Report No.(s): UVA-116508-101-GD10025-31350; No Copyright; Avail: CASI; [A04](#), Hardcopy

The goal of this project is to evaluate the metrics and processes used by NASA's Aviation Safety Program in assessing technologies that contribute to NASA's aviation safety goals. There were three objectives for reaching this goal. First, NASA's main objectives for aviation safety were documented and their consistency was checked against the main objectives of the Aviation Safety Program. Next, the metrics used for technology investment by the Program Assessment function of AvSP were evaluated. Finally, other metrics that could be used by the Program Assessment Team (PAT) were identified and evaluated. This investigation revealed that the objectives are in fact consistent across organizational levels at NASA and with the FAA. Some of the major issues discussed in this study which should be further investigated, are the removal of the Cost and Return-on-Investment metrics, the lack of the metrics to measure the balance of investment and technology, the interdependencies between some of the metric risk driver categories, and the conflict between 'fatal accident rate' and 'accident rate' in the language of the Aviation Safety goal as stated in different sources.

Author

*NASA Programs; Aircraft Safety; Flight Safety; Systems Analysis; Assessments*

**20040000740** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Schedule Risk Assessment**

Smith, Greg; July 2003; 12 pp.; In English; 1st Annual Development Day, 24 Oct. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: CASI; [A03](#), Hardcopy

Schedule risk assessments determine the likelihood of finishing on time. Each task in a schedule has a varying degree of probability of being finished on time. A schedule risk assessment quantifies these probabilities by assigning values to each task. This viewgraph presentation contains a flow chart for conducting a schedule risk assessment, and profiles applicable several methods of data analysis.

CASI

*Schedules; Risk; Assessments*

**20040001146** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Propulsion Ground Testing: Planning for the Future**

Bruce, Robert; [2003]; 5 pp.; In English; 41st AIAA Aerospace Sciences Meeting, 6-9 Jan. 2003, Reno, NV, USA  
Report No.(s): SE-2003-01-00085-SSC; AIAA Paper 2003-0278; No Copyright; Avail: CASI; [A01](#), Hardcopy

Advanced planners are constantly being asked to plan for the provision of future test capability. Historically, this capability is provided either by substantial investment in new test facility capabilities, or in the substantial investment in the modification of pre-existing test facilities. The key words in the previous sentence are 'substantial investment.' In the evolving environment of increasingly constrained resources, how is an advanced planner to plan for the provisions of such capabilities? Additionally, the conundrum exists that program formulation decisions are being made based on both life cycle cost decisions in an environment in which the more immediate challenge of front-end capital investment oftentimes is the linchpin upon which early decisions are made. In such an environment, how are plans and decisions made? This paper cites examples of decisions made in the past in the area of both major test facility upgrades, as well as major new test facility investment.

Author

*Management Planning; Ground Tests; Test Facilities*

**20040002076** Young (Tom), USA

**Class Act**

Young, Tom; ASK Magazine; December 2003, No. 15, pp. 6-8; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper presents a discussion about Tom Young's considerations when deciding to join more than one project team.

Author

*Project Management; NASA Space Programs*

**20040002077** Defense Acquisition Univ., Fort Belvoir, VA, USA

**Would You Raise Your Hand?**

Owen Gadeken; ASK Magazine; December 2003; 9-11, No. 15; 3 pp.; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper presents a discussion on new vision for project management training at the Department of Defense. This vision would enable students to actually see the impact of their early decisions on project outcomes.

CASI

*Project Management; Defense Program; NASA Programs; Education*

**20040002079** Maryland Univ., College Park, MD, USA

**Small Wins**

Laufer, Alexander, Editor; ASK Magazine; December 2003, No. 15, pp. 44; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

While it might not seem so radical these days to see the words 'story' and 'business' in the same sentence, that certainly wasn't the case when I set out to put together my first collection of business stories. Procter & Gamble hired me in the early 1990's as a management consultant. I participated in training programs, procedural reviews, and the like-but I wasn't satisfied with these traditional approaches. I sought to inspire significant change in the way that project practitioners approached their work, and I thought I had found the right vehicle: stories. I wanted to collect the stories of some of the most successful project managers and share them with others in the company. First, I found a sponsor with enough vision to support my idea, and then I assembled a team of eight highly successful project managers who were willing to examine the idea of writing stories about their project work. My long-term goal was to collect their stories in a full-length book.

Derived from text

*Industries; Management Methods; Project Management*

**20040002081** Proctor and Gamble Co., USA

**The Long Journey**

Cameron, W. Scott; ASK Magazine; December 2003, No. 15, pp. 24-25; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

In analyzing people's careers it should be define and write down one to three things they must have in an assignment, and as many wants as they wish. Compare people's list to the must and wants of potential assignments we can see if there is match. We should discuss career coaching with another manager. Career development by definition is a long journey. As coach help shape the career of other, it does him no good to forget that his own careers will continue to develop.

CASI

*Occupation; Personnel Management*

**20040002082** Missile Defense Agency, USA

**Sink or Swim**

Little, Terry; ASK Magazine; December 2003, No. 15, pp. 26-27; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

The traditional view of career development in the government goes something like this: Start your career as a functional apprentice. Become a functional expert over time by exhibiting technical leadership (whatever that means). Over time, seek out positions of increasingly greater responsibility with corresponding job titles. Make a gradual transition from a specialty focus to a managerial focus. Along the way submit to some vaccinations such as getting a Masters or PhD degree, attending some prestige courses, accepting a Headquarters assignment, and working at two or more field locations. Show some significant persistence and heaps of personal sacrifice. Avoid the big mistake. Burn no bridges.

Derived from text

*Leadership; Occupation*

**20040002083** NASA Ames Research Center, Moffett Field, CA, USA

**The Enterprise Project**

Dolci, Wendy; ASK Magazine; December 2003, No. 15, pp. 28-33; In English; See also 20040002075; No Copyright; Avail: CASI; [A02](#), Hardcopy

Let us look at this thing with two agendas in mind. Agenda number one was to give the class a problem, which was challenging and stimulating. Agenda number two was to see if a bright group of people might come up with some notions about how to bridge these worlds of technology development and flight system development. Here is an opportunity to get some bright folks who bring a lot of capability to the table. Explain the problem to them and see if they can offer some fresh insights and ideas. It s a very powerful process and one that already put to use in MSL in a number of different areas: getting people who haven't been in the middle of the forest, but are still very strong technically, to step in and think about the problem for a while and offer their observations.

Derived from text

*Stimulation; Education*

**20040002084** NASA Ames Research Center, Moffett Field, CA, USA

**Fly on the Wall**

Mulenburg, Gerald; ASK Magazine; December 2003, No. 15, pp. 34-37; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

The email was addressed not only to me, but also to all the Project Knowledge Sharing Community at Ames Research Center. We were invited to sit in on a major project review as a new experiment in knowledge sharing. This first-of-its-kind opportunity had been conceived by Claire Smith, who leads the knowledge sharing program, as well as heading up the Center's Project Leadership Development Program and serving as coordinator of the APPL-West program at Ames. The objective was to offer Ames project practitioners the opportunity to observe project-review processes as they happen. Not that I haven't participated in my share of project reviews, but this seemed like a great way for me to get up-to-date about a new project, the Kepler mission, and to experience a review from a new perspective. Typically, when you're being reviewed, it's difficult to see what's happening objectively-the same way it is on a project. Presenters are always thinking, 'Okay, what's on my slides? How much time do I have left? What are they going to ask me?' So when Claire's email pinged on my computer, I quickly responded by asking her to save a place for me. It was to be an informational review about progress on the project: what the team had done, where they were going, and what they needed to do to get there. There were people on the project

team from all over the USA, and it was the first time for them to get together from all aspects of the project. For our part, as observers, we were asked to abide by a couple of rules: Don't ask any questions. and don't talk about the specifics of what we saw or heard. The idea was that we weren't supposed to be noticed. We weren't to buzz around and bother people. Hence the name for this experiment: Fly on the Wall.

Derived from text

*Project Management; NASA Programs; Management Methods*

**20040002085** NASA, Washington, DC, USA

**ASK Talks with Dennis Grounds**

ASK Magazine; December 2003, No. 15, pp. 38-43; In English; See also 20040002075; No Copyright; Avail: CASI; [A02](#), Hardcopy

Dennis Grounds recently finished a one-year assignment at NASA Headquarters in the Office of Bioastronautics as the Acting Flight Program Manager. He has returned to Johnson Space Center (JSC), where he is Director of the International Space Station Bioastronautics Research Program Office with the NASA Life Sciences Projects Division. Under his management, the Human Research Facility (HRF) was developed to support a broad range of scientific investigations pertaining to human adaptation to the spaceflight environment and issues of human space exploration. The HRF rack was developed to international standards in order to be compatible with payloads developed anywhere in the world, thereby streamlining the process of getting payloads on the Space Station. Grounds has worked with NASA for more than 15 years. Prior to joining ISS, he worked with General Electric as a manager of payloads and analysis in support of the NASA Life Science Projects Division at JSC. ASK spoke with Grounds in Washington, D.C., during his Headquarters assignment.

Author

*Project Management; NASA Programs*

**20040002086** EduTech Ltd., Silver Spring, MD, USA

**Oh, Develop**

Post, Todd; ASK Magazine; December 2003, No. 15, pp. 3; In English; See also 20040002075; No Copyright; Avail: CASI; [A01](#), Hardcopy

In a mature view of the subject, career development is not simply four years of college or a week at training, culminating in a diploma or a certificate to hang on an office wall. That's why we wanted to take a broad look at career development in this issue of ASK. Take for example, Dr. Gerald Mulenburg's contribution, Fly on the Wall. When Mulenburg and other members of a knowledge-sharing group at Ames were invited to observe an upcoming project review, Mulenburg thought it would be interesting to learn how another project does its reviews. Note that Mulenburg is no fresh out who's never attended a NASA project review. Not only has he been through a fair share of them as the reviewed, he has also been on the other side of the table as a reviewer. This experienced project manager recognizes that at any stage of a career there is room to grow and develop one's repertoire. Too often people associate career development with textbooks and role classroom training, far removed from project life. But classroom training need not be like this, as you'll find in our Special Feature, The Enterprise Project by Wendy Dolci, which sprung out of an APPL Advanced Project Management class in July 2003 at Ames Research Center. In addition to Dolci, some of her classmates contribute to the story. Mike Sander of the Jet Propulsion Laboratory, project manager for the Mars Science Laboratory mission, who provided the assignment on which the story is based, also has a cameo in the story. We think Dolci's story is an inspiring example of what classroom training can be if it's approached imaginatively and made to serve a practical purpose. Another story from Ames, by Frank Larsen, takes a different twist on career development. At the annual Experimental Aircraft Association Fly-in in Oshkosh, Wisconsin, Larsen represented Ames at a NASA booth. While there, Larsen met a colleague from Glenn Research Center. Months later on a project with a quick turnaround, he remembered his colleague from Glenn who had equipment that might help Larsen save time and money on his project. Although they had never worked together and they had to unravel a lot of red tape before they could collaborate, they managed a way to get the job done. There are other stories in this issue that deal directly with this theme of career development. Then there are others in which it is less explicit. But if you take the view that career development happens all the time, and is as necessary to your survival as breathing, then you can read almost any story in ASK with your career development in mind. In that case, all the best, and so then-start developing.

Derived from text

*Project Management; Occupation; Education; Project Planning*

## 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*.

**2004000018** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

### **IKONOS Data for Mapping Industrial Forest Land in Stillman Creek, Washington**

Spruce, Joseph P.; Zaroni, Vicki; Hilbert, Kent; March 20, 2002; 2 pp.; In English; Poster for JACIE High Spatial Resolution Commercial Imagery Workshop, 25-27 Mar. 2003, Reston, VA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00030-SSC; Copyright; Avail: CASI; [A01](#), Hardcopy

This study assessed the ability of IKONOS imagery to map industrial forest features in southwest Washington. Located in Stillman Creek, Washington, the study area is largely managed as a sustainable industrial forest, producing saw timber and pulpwood. This region is mountainous and is dominated by Douglas fir forest that is managed on a 40 -50 year growing cycle and harvested primarily through clearcutting. Silvicultural practices include harvesting, seedling planting, periodic biocide applications, occasional fertilization, and selective thinning on the better sites. Some red alder forest occurs, usually along waterways.

Derived from text

*Conifers; Forests; Imagery; Silviculture; Thematic Mapping*

**20040000118** Army Engineer Research and Development Center, Hanover, NH, USA

### **Dugway Proving Ground Installation Restoration Program GIS. Software Documentation and Training Materials**

Cedfeldt, Paul T.; Schlagel, Joel D.; Finnegan, David C.; Jul. 2003; 45 pp.; In English

Report No.(s): AD-A418345; ERDC/CRREL-SR-03-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

At the request of U.S. Army Dugway Proving Ground's Installation Restoration Program, the U.S. Army Engineer Research and Development Center's Cold Regions Research and Engineering Lab developed a Geographic Information System (GIS) for management and analysis of environmental restoration data. The GIS software can be used to compare and analyze datasets of diverse types, e.g., orthophotos, contaminant information stored in a database, and geospatial datalayers such as sample locations, roads, and buildings. Powerful chemical query capabilities allow the user to search for analytical results either basewide or at a particular site. Users can also query one or multiple contaminants by a specific detection threshold level, or return all sample results regardless of detection level. Query results can then be mapped to the screen to highlight clusters and/or possible contamination trends, or exported to a spreadsheet program. Hard-copy maps can also be printed from the software.

DTIC

*Computer Programs; Documentation; Geographic Information Systems*

**20040000738** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

### **The NASA John C. Stennis Environmental Geographic Information System**

Cohan, Tyrus; Grant, Kerry; March 04, 2002; 3 pp.; In English; Live Software Demonstration at the 2002 NASA Environmental Management and Energy Conference, 12-14 Mar. 2002, Norfolk, VA, USA

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2002-03-00015-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

In addition to the Environmental Geographic Information System (EGIS) presentation, we will present two live demonstrations of a portion of the work being performed in support of environmental operations onsite and NASA-wide. These live demonstrations will showcase the NASA EGIS database through working versions of two software packages available from Environmental Systems Research Institute, Inc. (ESRI, Inc.): ArcIMS 3.0 and either ArcView 3.2a or ArcGIS 8.0.2. Using a standard web browser, the ArcIMS demo will allow users to access a project file containing several data layers found in the EGIS database. ArcIMS is configured so that a single computer can be used as the data server and as the user interface, which allows for maximum Internet security because the computer being used will not actually be connected to the World Wide Web. Further, being independent of the Internet, the demo will run at an increased speed. This demo will include several data layers that are specific to Stennis Space Center. The EGIS database demo is a representative portion of the entire EGIS project sent to NASA Headquarters last year. This demo contains data files that are readily available at various government agency Web sites for download. Although these files contain roads, rails, and other infrastructure details, they are

generalized and at a small enough scale that they provide only a general idea of each NASA center's surroundings rather than specific details of the area.

Derived from text

*Geographic Information Systems; Data Bases; Applications Programs (Computers)*

**20040000747** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA

**Disaster Response and Preparedness Application: Emergency Environmental Response Tool (EERT)**

Smoot, James; Carr, Hugh; Jester, Keith; November 5, 2003; 3 pp.; In English

Contract(s)/Grant(s): NAS13-650

Report No.(s): SE-2003-08-00066-SSC; Copyright; Avail: CASI; [A01](#), Hardcopy

In 2000, the National Aeronautics and Space Administration (NASA) Environmental Office at the John C. Stennis Space Center (SSC) developed an Environmental Geographic Information Systems (EGIS) database. NASA had previously developed a GIS database at SSC to assist in the NASA Environmental Office's management of the Center. This GIS became the basis for the NASA-wide EGIS project, which was proposed after the applicability of the SSC database was demonstrated. Since its completion, the SSC EGIS has aided the Environmental Office with noise pollution modeling, land cover assessment, wetlands delineation, environmental hazards mapping, and critical habitat delineation for protected species. At SSC, facility management and safety officers are responsible for ensuring the physical security of the facilities, staff, and equipment as well as for responding to environmental emergencies, such as accidental releases of hazardous materials. All phases of emergency management (planning, mitigation, preparedness, and response) depend on data reliability and system interoperability from a variety of sources to determine the size and scope of the emergency operation. Because geospatial data are now available for all NASA facilities, it was suggested that this data could be incorporated into a computerized management information program to assist facility managers. The idea was that the information system could improve both the effectiveness and the efficiency of managing and controlling actions associated with disaster, homeland security, and other activities. It was decided to use SSC as a pilot site to demonstrate the efficacy of having a baseline, computerized management information system that ultimately was referred to as the Emergency Environmental Response Tool (EERT).

Author

*Geographic Information Systems; Management Information Systems; Research Facilities; Safety Management; Emergencies*

**20040000754** NASA, Washington, DC, USA, USA Centennial of Flight Commission, USA

**Wilbur and Orville Wright: A Reissue of a Chronology Commemorating the Hundredth Anniversary of the Birth of Orville Wright, August 19, 1871**

Renstrom, Arthur George, Compiler; [2003]; 134 pp.; In English; Original contains black and white illustrations

Report No.(s): NASA/SP-2003-4532; LC-2003-051363; No Copyright; Avail: CASI; [A07](#), Hardcopy

During the year 2003, hundreds of events will mark the one-hundredth anniversary of the Wright brothers historic first flights at Kitty Hawk, North Carolina. The centennial year will witness exhibitions, lectures, television documentaries, films, air shows, flight recreations of Wright aircraft, the issuing of postage stamps and medals, the publication of dozens of new books and articles, and numerous other commemorative activities. One of these events, although not likely to make the evening news, is among the most important of all in terms of a lasting contribution to the observance of this ultimate aviation milestone: the reprinting of Arthur G. Renstrom *Wilbur & Orville Wright: A Chronology Commemorating the Hundredth Anniversary of the Birth of Orville Wright, August 19, 1871*. Since its appearance in 1975, *Wilbur and Orville Wright: A Chronology* has become indispensable to students and authors concerned with the life and work of the famous brothers. No doubt every book on the subject published in the last quarter century, including three of my own, was written with this treasure close at hand. This volume is far more than a simple compilation of dates and facts. Renstrom was a master reference librarian and bibliographer with a passion for aviation and the Wright brothers. He brought his considerable research skills to bear on the topic, and the result is a richly detailed, ever-informative, often entertaining walk through the lives and achievements of these two extraordinary individuals. Renstrom was not content to offer a date with a one-line tidbit. His entries are brimming with information. This is a highly readable reference work that, believe it or not, can be enjoyably read from cover to cover. The project was clearly a labor of love by a talented professional. During most of the last twenty years, I have been privileged to be the curator of the 1903 Wright Flyer at the Smithsonian Institution's National Air and Space Museum. The position brings a steady stream of inquiries about the Wright airplane and the endlessly fascinating brothers who created it. I do not know how I would have done this job without Renstrom's superb volume on my bookshelf. It is the first place I go to check anything on the Wright brothers, and I typically find what I am looking for in its pages. Arthur Renstrom also published two other classic reference works on the Wright brothers: *Wilbur & Orville Wright: A Bibliography Commemorating the Hundredth Anniversary of the Birth of Wilbur Wright, April 16, 1867*, in 1968 (an updated revision was published by the National

Aeronautics and Space Administration in 2002) and Wilbur & Orville Wright, *Pictorial Materials: A Documentary Guide* in 1982, completing a series of research tools for which there are few peers on any subject. He was also part of the team that produced the landmark two-volume compilation of the Wrights letters, notebooks, and diaries in 1953, *The Papers of Wilbur and Orville Wright*, edited by Marvin W. McFarland. Renstrom's contribution to the documentation and preservation of the Wright story is a lasting legacy that will serve researchers, students, and general enthusiasts for generations to come. In this busy, high-profile anniversary year, the reprinting of a nearly thirty-year-old reference book may seem a mundane and quiet contribution to the celebration surrounding the Wright brothers world-changing achievement, but it is perhaps one of the most important. The U.S. Centennial of Flight Commission and NASA are to be commended for their foresight.

Author

*Bibliographies; Flying Personnel; Preserving; Chronology; Graphic Arts*

**20040001660** Lockheed Martin Corp., Bay Saint Louis, MS, USA

**Software for Managing an Archive of Images**

Hallai, Charles; Jones, Helene; Callac, Chris; September 25, 2003; 2 pp.; In English

Report No.(s): NASA/NP-2003-09-00040-SSC; No Copyright; Avail: Other Sources; Abstract Only

This is a revised draft by Innovators concerning the report on Software for Managing and Archive of Images. The SSC Multimedia Archive is an automated electronic system to manage images, acquired both by film and digital cameras, for the Public Affairs Office (PAO) at Stennis Space Center (SSC). Previously, the image archive was based on film photography and utilized a manual system that, by today's standards, had become inefficient and expensive. Now, the SSC Multimedia Archive, based on a server at SSC, contains both catalogs and images for pictures taken both digitally and with a traditional film-based camera, along with metadata about each image.

Author

*Multimedia; Data Management*

**85**

**TECHNOLOGY UTILIZATION AND SURFACE TRANSPORTATION**

Includes aerospace technology transfer; urban technology; surface and mass transportation. For related information see also *03 Air Transportation and Safety*, *16 Space Transportation and Safety*, and *44 Energy Production and Conversion*. For specific technology transfer applications see also the category where the subject is treated.

**20040000274** NASA Kennedy Space Center, Cocoa Beach, FL, USA

**Process for Nitrogen Oxide Waste Conversion to Fertilizer**

Lueck, Dale E., Inventor; Parrish, Clyde F., Inventor; November 04, 2003; 33 pp.; In English

Patent Info.: Filed 17 Feb. 2000; No Copyright; Avail: CASI; A03, Hardcopy

The present invention describes a process for converting vapor streams from sources containing at least one nitrogen-containing oxidizing agent therein to a liquid fertilizer composition comprising the steps of: a) directing a vapor stream containing at least one nitrogen-containing oxidizing agent to a first contact zone; b) contacting said vapor stream with water to form nitrogen oxide(s) from said at least one nitrogen-containing oxidizing agent; c) directing said acid(s) as a second stream to a second contact zone; d) exposing said second stream to hydrogen peroxide which is present within said second contact zone in a relative amount of at least 0.1% by weight of said second stream within said second contact zone to convert at least some of any nitrogen oxide species or ions other than in the nitrate form present within said second stream to nitrate ion; e) sampling said stream within said second contact zone to determine the relative amount of hydrogen peroxide within said second contact zone; f) adding hydrogen peroxide to said second contact zone when a level of hydrogen peroxide less than 0.1 % by weight in said second stream is determined by said sampling; g) adding a solution comprising potassium hydroxide to said second stream to maintain a pH between 6.0 and 11.0 within said second stream within said second contact zone to form a solution of potassium nitrate; and h) removing said solution of potassium nitrate from said second contact zone. Official Gazette of the U.S. Patent and Trademark Office

*Nitrogen Oxides; Waste Utilization; Fertilizers; Vapors; Oxidation*

**20040000490** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Precision Agriculture: Changing the Face of Farming**

Rickman, D.; Luvall, J.; Mask, P.; Shaw, J.; Kissel, D.; Sullivan, D.; GeoTimes; 2003, pp. 26-29; In English; No Copyright;

Avail: Other Sources; Abstract Only

To a large extent our work has grown out of the remote sensing technology and conceptual framework developed by geologists. For example the drive to look at the physics of reflectance and atmospheric corrections is rooted in work done in the early 1980s by the USA Geological Survey and NASA. Our work on emissivity and thermal behavior of plants pulls on research done using the Thermal Infrared Multispectral Scanner, an instrument originally conceived for geologic applications. Even our ability to geometrically map the airborne imagery onto the globe was explicitly developed because of need to map sediment flow patterns in along the coast of Louisiana. Growing from this base we have learned much in the last few years and believe our integration of geologic remote sensing with the other fields of expertise was a wise investment. Clearly none of the specialties alone could develop, let alone test, the basic approach we are now finding so powerful. This is the path that will ultimately give the information needed by the farmer. We also recognize how small a portion of the total problem has been solved. Having developed the basic logic, built proto-type tools and performed initial tests everything else remains to be done. And problems, scientific and practical, are everywhere. We have not established sensitivities. We have not robustly segregated the contributions of crop residue, soil moisture, shadows, plant and soil to the energy leaving the surface. What we do is extremely expensive and difficult. It is experimental in methodology and uses research oriented tools. We are constantly alive to the practicality of moving our results into commercial applications. We know another airborne instrument will have to be available. Atmospheric parameters will have to be measured automatically. The software will have to be re-written for speed. At times the list of problems seems endless. But the potential is also enormous. Agriculture is a huge portion of our economy. Just a one percent increase in efficiency is a \$2,000,000 change. We all depend on farmers, literally for the bread we eat. No other activity of man even has an impact on the land that farming has. If application of precision agriculture can help farmers manage their land better, we all may benefit.

Author

*Agriculture; Technology Utilization; Remote Sensing*

**2004000556** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Overview of Probabilistic Methods for SAE G-11 Meeting for Reliability and Uncertainty Quantification for DoD TACOM Initiative with SAE G-11 Division**

Singhal, Surendra N.; [2003]; 1 pp.; In English; SAE G-11 Reliability, Maintainability, Supportability and Logistics Division Meeting, 6-8 Oct. 2003, Sterling Heights, MI, USA; No Copyright; Avail: Other Sources; Abstract Only

The SAE G-11 RMSL Division and Probabilistic Methods Committee meeting during October 6-8 at the Best Western Sterling Inn, Sterling Heights (Detroit), Michigan is co-sponsored by US Army Tank-automotive & Armaments Command (TACOM). The meeting will provide an industry/government/academia forum to review RMSL technology; reliability and probabilistic technology; reliability-based design methods; software reliability; and maintainability standards. With over 100 members including members with national/international standing, the mission of the G-11's Probabilistic Methods Committee is to 'enable/facilitate rapid deployment of probabilistic technology to enhance the competitiveness of our industries by better, faster, greener, smarter, affordable and reliable product development.'

Author

*Reliability; Maintainability; Automobiles*

**20040001048** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Innovative, High-Pressure, Cryogenic Control Valve: Short Face-to-Face, Reduced Cost**

May 09, 2002; 2 pp.; In English

Report No.(s): NASA/NP-2002-05-00019-SSC; NAS 1.83:05-00019-SSC; No Copyright; Avail: CASI; A01, Hardcopy

A control valve that can throttle high-pressure cryogenic fluid embodies several design features that distinguish it over conventional valves designed for similar applications. Field and design engineers worked together to create a valve that would simplify installation, trim changes, and maintenance, thus reducing overall cost. The seals and plug stem packing were designed to perform optimally in cryogenic temperature ranges. Unlike conventional high-pressure cryogenic valves, the trim size can be changed independent of the body. The design feature that provides flexibility for changing the trim is a split body. The body is divided into an upper and a lower section with the seat ring sandwiched in between. In order to maintain the plug stem packing at an acceptable sealing temperature during cryogenic service, heat-exchanging fins were added to the upper body section. The body is made of stainless steel. The seat ring is made of a nickel-based alloy having a coefficient of thermal expansion less than that of the body material. Consequently, when the interior of the valve is cooled cryogenically, the body surrounding the seat ring contracts more than the seat ring. This feature prevents external leakage at the body-seat joint. The seat ring has been machined to have small, raised-face sealing surfaces on both sides of the seal groove. These sealing surfaces concentrate the body bolt load over a small area, thereby preventing external leakage. The design of the body bolt circle is different from that of conventional highpressure control valves. Half of the bolts clamp the split body together from the top,

and half from the bottom side. This bolt-circle design allows a short, clean flow path, which minimizes frictional flow losses. This bolt-circle design also makes it possible to shorten the face-to-face length of the valve, which is 25.5 in. (65 cm). In contrast, a conventional, high-pressure control valve face-to-face dimension may be greater than 40 in. (>1 m) long.

Author

*Control Valves; Cryogenic Fluids; Technology Utilization; Aerospace Technology Transfer*

**20040001412** NASA Stennis Space Center, Bay Saint Louis, MS, USA

### **Multiple-Path-Length Optical Absorbance Cell**

July 17, 2001; 2 pp.; In English

Report No.(s): NASA/NP-2001-10-00019-SSC; No Copyright; Avail: CASI; [A01](#), Hardcopy

An optical absorbance cell that offers a selection of multiple optical path lengths has been developed as part of a portable spectrometric instrument that measures absorption spectra of small samples of water and that costs less than does a conventional, non-portable laboratory spectrometer. The instrument is intended, more specifically, for use in studying colored dissolved organic matter (CDOM) in seawater, especially in coastal regions. Accurate characterization of CDOM is necessary for building bio-optical mathematical models of seawater. The multiple path lengths of the absorption cell afford a wide range of sensitivity needed for measuring the optical absorbances associated with the wide range of concentrations of CDOM observed in nature. The instrument operates in the wavelength range of 370 to 725 nm. The major subsystems of the instrument (see figure) include a color-balanced light source; the absorption cell; a peristaltic pump; a high-precision, low-noise fiber optic spectrometer; and a laptop or other personal computer. A fiber-optic cable transmits light from the source to the absorption cell. Other optical fibers transmit light from the absorption cell to the spectrometer.

Derived from text

*Technology Utilization; Portable Equipment; Spectrometers; Absorption Spectra; Water Sampling; Dissolved Organic Matter*

## 88

### SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

**20040000370** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **How to Do Science From an Engineering Organization**

Suggs, Robert M.; [2003]; 1 pp.; In English; Presentation, 3 Oct. 2003, Las Cruces, NM, USA; No Copyright; Avail: Other Sources; Abstract Only

MSFC's Space Environments Team performs engineering support for a number of NASA spaceflight projects by defining the space environment, developing design requirements, supporting the design process, and supporting operations. Examples of this type of support are given including meteoroid environment work for the Jovian Icy Moon Orbiter mission, ionizing radiation support for the Chandra X-Ray Observatory, and astronomical/geophysical observation planning for International Space Station.

Author

*Aerospace Environments; NASA Programs; Ionizing Radiation; Meteoroid Concentration*

**20040000692** NASA Marshall Space Flight Center, Huntsville, AL, USA

### **Microfossils in CI and CO Carbonaceous Meteorites**

Hoover, Richard B.; Rozanov, Alexei Y.; Jerman, Gregory; Costen, James; [2003]; 1 pp.; In English; International Society for Optical Science and Technology 48th Annual Meeting, 3-8 Aug. 2003, San Diego, CA, USA; Copyright; Avail: CASI; [A01](#), Hardcopy

Secondary and backscatter electron images and x-ray spectral data of selected CI (Alais, Orgueil, and Tagish Lake) and CO<sub>3</sub> (Rainbow and Dar al Gani 749) carbonaceous meteorites have recently been obtained using Field Emission and Environmental Scanning Electron Microscopes. These studies indicate the presence of a large assemblage of biomarkers and complex lithified and carbonized remains of bodies that we interpret as indigenous microfossils. We discuss the meteorites, provide images of many of the biogenic forms found embedded in the freshly fractured meteorite surfaces.

Author

*Alais Meteorite; Carbonaceous Meteorites; Fossils; Backscattering; Scanning Electron Microscopy; Field Emission*

89  
**ASTRONOMY**

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

**2004000011** NASA, Washington, DC, USA

**What is Your Cosmic Connection to the Elements?**

Lochner, J.; [2003]; 32 pp.; In English

Report No.(s): NASA/EG-2003-7-023-GSFC; No Copyright; Avail: CASI; **A03**, Hardcopy

This booklet provides information and classroom activities covering topics in astronomy, physics, and chemistry. Chemistry teachers will find information about the cosmic origin of the chemical elements. The astronomy topics include the big bang, life cycles of small and large stars, supernovae, and cosmic rays. Physics teachers will find information on fusion processes, and physical principles important in stellar evolution. While not meant to replace a textbook, the information provided here is meant to give the necessary background for the theme of 'our cosmic connection to the elements.' The activities can be used to re-enforce the material across a number of disciplines, using a variety of techniques, and to engage and excite students about the topic. Additional activities, and on-line versions of the activities published here, are available at <http://imagine.gsfc.nasa.gov/docs/teachers/elements/>.

Derived from text

*Astronomy; Physics; Chemistry; Cosmic Rays; Stellar Evolution*

**2004000030** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Studies of the Hot Gas in the Galactic halo and Local Bubble**

Shelton, Robin L.; [2003]; 5 pp.; In English

Contract(s)/Grant(s): NAG5-10807; No Copyright; Avail: CASI; **A01**, Hardcopy

This paper presents a report on the progress made on Studies of the Hot Gas in the Galactic halo and Local Bubble at Johns Hopkins University. The broad goals of this project are to determine the physical conditions and history of the hot phase of the Galaxy's interstellar medium. Such gas resides in the Galactic halo, the Local Bubble surrounding the solar neighborhood, other bubbles, and supernova remnants. A better understanding of the hot gas and the processes occurring within it requires several types of work, including ultraviolet and X-ray data analyses and computer modeling.

CASI

*High Temperature Gases; Interstellar Gas; Galactic Halos; Emission Spectra*

**2004000086** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**HST Snapshot Study of Variable Stars in Globular Clusters: Inner Region of NGC 6441**

Pritzl, Barton J.; Smith, Horace A.; Stetson, Peter B.; Catelan, Marcio; Sweigart, Allen V.; Layden, Andrew C.; Rich, R. Michael; [2003]; 28 pp.; In English

Contract(s)/Grant(s): NAS5-26555; DIPUC-2002-04E; FONDECYT-1030954

Report No.(s): astro-ph/030539v1; Copyright; Avail: CASI; **A03**, Hardcopy

We present the results of a Hubble Space Telescope snapshot program to survey the inner region of the metal-rich globular cluster NGC 6441 for its variable stars. A total of 57 variable stars was found including 38 RR Lyrae stars, 6 Population II Cepheids, and 12 long period variables. Twenty-four of the RR Lyrae stars and all of the Population II Cepheids were previously undiscovered in ground-based surveys. Of the RR Lyrae stars observed in this survey, 26 are pulsating in the fundamental mode with a mean period of 0.753 d and 12 are first-overtone mode pulsators with a mean period of 0.365 d. These values match up very well with those found in ground-based surveys. Combining all the available data for NGC 6441, we find mean periods of 0.759 d and 0.375 d for the RRab and RRc stars, respectively. We also find that the RR Lyrae in this survey are located in the same regions of a period-amplitude diagram as those found in ground-based surveys. The overall ratio of RRc to total RR Lyrae is 0.33. Although NGC 6441 is a metal-rich globular cluster and would, on that ground, be expected either to have few RR Lyrae stars, or to be an Oosterhoff type I system, its RR Lyrae more closely resemble those in Oosterhoff type II globular clusters. However, even compared to typical Oosterhoff type II systems, the mean period of its RRab stars is unusually long. We also derived I-band period-luminosity relations for the RR Lyrae stars. Of the six Population II Cepheids, five are of W Virginis type and one is a BL Herculis variable star. This makes NGC 6441, along with NGC 6388, the most metal-rich globular cluster known to contain these types of variable stars. Another variable, V118, may also be a Population II Cepheid given its long period and its separation in magnitude from the RR Lyrae stars. We examine the period-luminosity relation for these Population II Cepheids and compare it to those in other globular clusters and in the Large Magellanic Cloud.

We argue that there does not appear to be a change in the period-luminosity relation slope between the BL Herculis and W Virginis stars, but that a change of slope does occur when the RV Tauri stars are added to the period-luminosity relation.

Author

*Globular Clusters; Variable Stars; Hubble Space Telescope; Lyra Constellation*

**20040000101** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Challenging Cosmic Ray Propagation with Antiprotons: Evidence for a 'Fresh' Nuclei Component?**

Moskalenko, Igor V.; Strong, Andrew W.; Mashnik, Stepan G.; Ormes, Jonathan F.; [2002]; 39 pp.; In English; Copyright; Avail: CASI; [A03](#), Hardcopy

Recent measurements of the cosmic ray (CR) antiproton flux have been shown to challenge existing CR propagation models. It was shown that the reacceleration models designed to match secondary to primary nuclei ratio (e.g., Boron/Carbon) produce too few antiprotons, while the traditional non-reacceleration models can reproduce the antiproton flux but fall short of explaining the low-energy decrease in the secondary to primary nuclei ratio. Matching both the secondary to primary nuclei ratio and antiproton flux requires artificial breaks in the diffusion coefficient and the primary injection spectrum suggesting the need for other approaches. In the present paper we discuss one possibility to overcome these difficulties. Using the measured antiproton flux to fix the diffusion coefficient, we show that the spectra of primary nuclei as measured in the heliosphere may contain a fresh local unprocessed component at low energies, thus decreasing the measured secondary to primary nuclei ratio. A model reproducing antiprotons, B/C ratio, and abundances up to Ni is presented.

Author

*Antiprotons; Cosmic Rays; Propagation; Nuclei (Nuclear Physics)*

**20040000213** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Precise Location of the Soft Gamma Repeater SGR 1627-41 with Chandra**

Wachter, S.; Kouveliotou, C.; Patel, S. K.; Tennant, A. F.; Woods, P. M.; Eichler, D.; Lyubarsky, Y.; Bouchet, P.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

We report the precise localization of the Soft Gamma Repeater SGR 1627-41 with the Chandra X-ray Observatory. The best position for SGR 1627-41 was determined to be RA=16:35:51.844, DEC=-47:35:23.31 (J2000) with an accuracy of 0.6 arcsec. We present the results of our search for an IR counterpart to SGR 1627-41 and compare our results to the existing detections and limits of other magnetar infrared and optical observations in the literature. We also present new observations of SGR 1806-20 obtained during the recent reactivation of the source. In addition, we have determined a precise location for archival Chandra observations and reanalyzed archival IR data in the search for a counterpart.

Author

*Gamma Ray Sources (Astronomy); Gamma Ray Astronomy; Position (Location); Infrared Astronomy*

**20040000265** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**Formation of Brown Dwarfs LTSA 2001**

Luhman, Kevin L.; Oliversen, Ronald J., Technical Monitor; November 2003; 2 pp.; In English

Contract(s)/Grant(s): NAG5-11627

Report No.(s): Rept-2; No Copyright; Avail: CASI; [A01](#), Hardcopy

The goals of the work funded by this grant are: 1) The measurement of the mass function and minimum mass of free-floating brown dwarfs down to the mass of Jupiter; 2) The measurement of the frequency of wide brown dwarf and planetary companions down to the mass of Jupiter as function of primary mass (0.02-2 Msun), age (1-10 Myr), and environment (clusters vs. dispersed regions). For the first objective, we have completed the design of guaranteed SIRTf observations of nearby star-forming regions. With the successful launch of the SIRTf mission in August of 2003, we now await the execution of these observations, which should begin in early 2004. In support of these upcoming observations, in the fall of 2002 and spring of 2003 we obtained optical spectroscopy at the MMT, the 1.5 meter telescope at Fred Lawrence Whipple Observatory, and Magellan Observatory for several hundred candidate young low-mass stars and brown dwarfs in the IC348, Taurus, and Chamaeleon star-forming regions. All of these data have been published in three papers in *The Astrophysical Journal*. We also recently used the MMT to obtain deep near-IR images of IC348 to accompany the SIRTf images and have time in the next month at the IRTF and Keck for spectroscopy of candidate brown dwarfs in IC348 and Taurus. We have submitted proposals for deep optical and near-IR imaging of the SIRTf fields in Chamaeleon and Ophiuchus for spring 2004 with Magellan and the AAT. Results from this research have been presented in invited talks at UU Symposium 221 (July 2003) and at the SIRTf Galactic Science Workshop (August 2003). For the second objective, we have used deep

HST WFPC2 images to search for young giant planets and brown dwarfs around approx. 100 low-mass stars and brown dwarfs in the nearby cluster IC348. We have completed all data reduction and have checked these data for candidate companions. We expect to submit the paper describing these observations to The Astrophysical Journal by the end of the year. In addition, in SIRTf guaranteed time observations we plan to search for wide substellar companions (>10 sec) around the youngest nearby field stars (ages of 30-100 Myr,  $d < 30$  pc). We have submitted a proposal to use Keck adaptive optics imaging to search these same stars for close-in planets and brown dwarfs at 0.1-10 sec, which will perfectly complement our SIRTf observations.

Author

*Brown Dwarf Stars; Stellar Mass; Extrasolar Planets; Planet Detection; Sky Surveys (Astronomy)*

**20040000702** Washington Univ., Seattle, WA, USA

**The Counterparts of the Luminous, Bursting X-ray Sources in Globular Clusters-LTSA98**

Anderson, Scott F.; [2003]; 3 pp.; In English

Contract(s)/Grant(s): NRA-98-03-LTSA-045; NAG5-7932; No Copyright; Avail: CASI; **A01**, Hardcopy

Under the fifth year of the LTSA, we have extended our HST and Chandra work to a number of additional globular clusters. The remarkable sensitivity and positional accuracy of the Chandra observations are enabling us to maximally exploit HST for UV/optical identifications for X-ray binaries in the cores of multiple globular clusters. The dozens of lower-luminosity X-ray sources in each globular cluster deeply examined thus far have moved us firmly into the era of studies which encompass populations of close; the large range of cluster properties we are studying have, for the first time, established a firm empirical confirmation of the (long-suspected theoretically) high importance that close binaries play in the dynamical stability and evolution of globular clusters. The LTSA support has been a cornerstone of our success over the past 5 years in studies of globular cluster X-ray sources and their counterparts.

Derived from text

*Globular Clusters; X Ray Sources; Stellar Evolution*

**90**

**ASTROPHYSICS**

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

**20040000131** Catholic Univ. of America, Washington, DC

**Characterization of the Large-Scale Solar Corona**

Brosius, J.; Nov. 5, 2003; 13 pp.; In English

Contract(s)/Grant(s): F49620-00-1-0012

Report No.(s): AD-A418377; AFRL-SR-AR-TR-03-0476; No Copyright; Avail: CASI; **A03**, Hardcopy

Coronal mass ejections (CMEs) from the Sun constitute one of the primary causes of geomagnetic storms. CMEs also drive shocks, which in turn accelerate solar energetic particles (SEPs) that pose radiation hazards for technological systems in space. With support from AFOSR, researchers from the Catholic University developed an empirical CME arrival (ECA) model that takes as input the CME speed from coronagraph observations and outputs the arrival time of CMEs at 1 AU. This model has recently been extended to predict the arrival time of shocks. This empirical shock arrival model (ESA) predicts the arrival time of interplanetary shocks on Earth based on the remote-sensing observations of CMEs by coronagraphs such as the Large Angle and Spectrometric Coronagraph (LASCO) on board the Solar and Heliospheric Observatory (SOHO) satellite. The input to the model is the sky plane speed measured from coronagraph images of CMEs. An important step in the model is to show that the interplanetary shocks behave like gas-dynamic shocks for a large number of shocks of solar cycle 23. This means the shock arrival can be predicted from CME arrival because there is a definite relation between a CME and its shock. Once the CME speed is measured, the shock travel time from Sun to Earth can be obtained from a table. The ESA model is capable of providing 1-3 day advance warning of the impending arrival of CME-driven shocks on Earth. This is a very useful lead-time for space weather applications. As a result of this study, a complete catalog of all the CMEs observed by the SOHO mission has been created and provided online to the scientific community ([http://cdaw.gsfc.nasa.gov/CME\\_list](http://cdaw.gsfc.nasa.gov/CME_list)). This study revealed that long-wavelength radio bursts detected by Wind/WAVES experiment are indicative of a special population of CMEs that are wider and faster than regular CMEs. Further correlative studies were used to improve the empirical CME arrival model to predict the arrival of CMEs at 1 AU.

DTIC

*Shock Waves; Air Water Interactions; Magnetic Storms; Solar Corona*

**20040000279** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**Multi-Temperature Emission and Abundances in the Hot Gaseous Halo**

Kim, Dong-Woo; Mushotzky, Richard F., Technical Monitor; November 25, 2003; 25 pp.; In English

Contract(s)/Grant(s): NAG5-9965; No Copyright; Avail: CASI; [A03](#), Hardcopy

We present the results of XMM-Newton observations of NGC 507, a dominant elliptical galaxy in a small group of galaxies. After carefully considering various systematic effects on abundance measurements, we report 'super-solar' metal abundances (both Fe and  $\alpha$ -elements) present in the hot ISM:  $Z_{\text{Fe}} = 2\text{-}3$  times solar with an observational limit of as high as 4 times solar inside the D25 ellipse of NGC 507. This is the highest  $Z_{\text{Fe}}$  reported so far, and fully consistent with those expected by the stellar evolution models where heavy elements are enriched by both type II and Ia supernovae ejecta. No unusual constraint either on the SNe rate or IMF is required. Among various factors affecting the accurate abundance measurement, we find that selecting a proper emission model is most important. As opposed to the X-ray spectral data with limited  $s/n$  and poor spatial/spectral resolution obtained in the previous missions, the spatially resolved XMM spectra provide enough statistics to untie the model-Z degeneracy and statistically require at least 3 emission components in each concentric shell (2 thermal components representing a finite range of  $kT$  in the hot ISM + 1 hard LMXB component). We show that a simpler model (such as a two-component model) produce a much lower best-fit  $Z_{\text{Fe}}$ . The abundances of  $\alpha$ -elements (most accurately determined by Si) is also found to be super-solar and its ratio to Fe is close to the solar ratio, suggesting a considerably contribution of heavy elements from Type Ia SNe. We estimate approx. 70% of MFe in the hot ISM originate from Type Ia.

Author

*Emission Spectra; Abundance; Galactic Halos; Elliptical Galaxies*

**20040000391** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**ISO Key Project: Exploring the Full Range of Quasar/Agn Properties**

Wilkes, Belinda; Oliverson, Ronald J., Technical Monitor; November 2003; 4 pp.; In English

Contract(s)/Grant(s): NAG5-8847

Report No.(s): Rept-4; No Copyright; Avail: CASI; [A01](#), Hardcopy

While most of the work on this program has been completed, as previously reported, the portion of the program dealing with the subtopic of ISO LWS data analysis and reduction for the LWS Extragalactic Science Team and its leader, Dr. Howard Smith, is still active. This program in fact continues to generate results, and newly available computer modeling has extended the value of the datasets. As a result the team requests a one-year no-cost extension to this program, through 31 December 2004. The essence of the proposal is to perform ISO spectroscopic studies, including data analysis and modeling, of star-formation regions using an ensemble of archival space-based data from the Infrared Space Observatory's Long Wavelength Spectrometer and Short Wavelength Spectrometer, but including as well some other spectroscopic databases. Four kinds of regions are considered in the studies: (1) disks around more evolved objects; (2) young, low or high mass pre-main sequence stars in star-formation regions; (3) star formation in external, bright IR galaxies; and (4) the galactic center. One prime focus of the program is the OH lines in the far infrared. The program has the following goals: 1) Refine the data analysis of ISO observations to obtain deeper and better SNR results on selected sources. The ISO data itself underwent 'pipeline 10' reductions in early 2001, and additional 'hands-on data reduction packages' were supplied by the ISO teams in 2001. The Fabry-Perot database is particularly sensitive to noise and slight calibration errors; 2) Model the atomic and molecular line shapes, in particular the OH lines, using revised Monte-Carlo techniques developed by the SWAS team at the Center for Astrophysics; 3) Attend scientific meetings and workshops; 4) Perform E&PO activities related to infrared astrophysics and/or spectroscopy.

Derived from text

*Quasars; Active Galactic Nuclei; Astronomical Spectroscopy; Infrared Spectroscopy; Star Formation; Infrared Astronomy*

**20040000466** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**The Evolution of Dust in the Multiphase Interstellar Medium**

Oliverson, Ronald J., Technical Monitor; Slavin, Jonathan; November 2003; 7 pp.; In English

Contract(s)/Grant(s): NAG5-11233; No Copyright; Avail: CASI; [A02](#), Hardcopy

Interstellar dust has a profound effect on the structure and evolution of the interstellar medium (ISM) and on the processes by which stars form from it. Dust obscures regions of star formation from view, and the uncertain quantities of elements in dust makes it difficult to measure accurately the abundances of the elements in low density regions. Despite the central importance of dust in astrophysics, we cannot answer some of the most basic questions about it: Why is it that most of the refractory elements are in dust grains? What determines the sizes of interstellar grains? It has been the goal of our proposed

theoretical investigations to address these questions by studying the destruction of interstellar grains, and to develop observational diagnostics that can test the models we develop.

Author

*Cosmic Dust; Astronomical Models; Evolution (Development); Destruction; Shock*

**20040000488** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The 2001 April Burst Activation of SGR 1900-14: Pulse Properties and Torque**

Woods, P. M.; Kouveliotou, C.; Goegues, E.; Finger, M. H.; Feroci, M.; Mereghetti, S.; Swank, J. H.; Hurley, K.; Heise, J.; Smith D., et al.; *Astrophysical Journal*; October 10, 2003; Volume 596, pp. 464-469; In English

Contract(s)/Grant(s): NAG5-11608; NAG5-9350; NCC8-200; Copyright; Avail: Other Sources

We report on observations of SGR 1900+14 made with the Rossi X-Ray Timing Explorer (RXTE) and BeppoSAX during the 2001 April burst activation of the source. Using these data, we measure the spin-down torque on the star and confirm earlier findings that the torque and burst activity are not directly correlated. We compare the X-ray pulse profile to the gamma-ray profile during the April 18 intermediate flare and show that (1) their shapes are similar and (1) the gamma-ray profile aligns closely in phase with the X-ray pulsations. The good phase alignment of the gamma-ray and X-ray profiles suggests that there was no rapid spin-down following this flare of the magnitude inferred for the August 27 giant flare. We discuss how these observations further constrain magnetic field reconfiguration models for the large flares of SGRs.

Author

*X Ray Timing Explorer; Torque; Gamma Rays; Magnetic Fields; X Rays*

**20040000492** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Chandra Observations of Magnetic White Dwarfs and their Theoretical Implications**

Musielak, Z. E.; Noble, M.; Porter, J. G.; Winget, D. E.; *The Astrophysical Journal*; August 10, 2003; Volume 593, pp. 481-485; In English

Contract(s)/Grant(s): GO1-2003A; Copyright; Avail: Other Sources

Observations of cool DA and DB white dwarfs have not yet been successful in detecting coronal X-ray emission, but observations of late-type dwarfs and giants show that coronae are common for these stars. To produce coronal X-rays, a star must have dynamo-generated surface magnetic fields and a well-developed convection zone. There is some observational evidence that the DA star LHS 1038 and the DB star GD 358 have weak and variable surface magnetic fields. It has been suggested that such fields can be generated by dynamo action, and since both stars have well-developed convection zones, theory predicts detectable levels of coronal X-rays from these white dwarfs. However, we present analysis of Chandra observations of both stars showing no detectable X-ray emission. The derived upper limits for the X-ray fluxes provide strong constraints on theories of formation of coronae around magnetic white dwarfs. Another important implication of our negative Chandra observations is the possibility that the magnetic fields of LHS 1038 and GD 358 are fossil fields.

Author

*Magnetic Fields; White Dwarf Stars; X Rays; Magnetic Stars; Coronas*

**20040000496** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**A Numerical Gamma-Ray Burst Simulation Using Three-Dimensional Relativistic Hydrodynamics: The Transition from Spherical to Jet-like Expansion**

Cannizzo, John K.; Gehrels, Neil; Vishniac, Ethan T.; [2003]; 20 pp.; In English

Report No.(s): astro-ph/0310113v1; Copyright; Avail: CASI; [A03](#), Hardcopy

Utilizing 3D relativistic hydrodynamical calculations, we have examined the evolution of an expanding relativistic blob of gas intended to be representative of a jet associated with ejecta from an extremely energetic event such as a hypernova, that produces a gamma-ray burst (Aloy et al. 2000; Tan, Matzner, & McKee 2001; MacFadyen, Woosley, & Heger 2001, Zhang, Woosley, & Heger 2003, Zhang, Woosley, & MacFadyen 2003). Since these are the first such calculations applied to the blob during the time in which the afterglow radiation is produced, we have purposely kept them simple in an effort to concentrate on the most fundamental aspects of the physics. We restrict our attention to the transition from spherical to jetlike expansion that occurs during the time that the Lorentz factor becomes less than the reciprocal of the jet spreading angle. We have not yet attached specific numbers to our results. From the SRHD equations, one sees that the relevant quantities are the ratios of pressure to density, and of distance to time. If we specify either one of these two sets of numbers, the other one is also determined.

Derived from text

*Gamma Ray Bursts; Hydrodynamics; Relativity; Three Dimensional Models; Gas Expansion; Computerized Simulation*

**2004000729** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**The Physics of Accretion in X-Ray Binaries**

Oliveresen, Ronald, Technical Monitor; Vrtilek, Saeqa Dil; December 2003; 3 pp.; In English

Contract(s)/Grant(s): NAG5-6711; No Copyright; Avail: CASI; A01, Hardcopy

This project consists of several related investigations directed to the study of mass transfer processes in X-ray binaries. Models developed over several years be tested on a balanced mix of existing data and planned observations with both ground and space-based observatories. The extended time coverage of the observations and the existence of simultaneous X-ray, ultraviolet, and optical observations will be particularly beneficial for studying the accretion flows. These investigations, which take as detailed a look at the accretion process in X-ray binaries as is now possible, test current models to their limits, and force us to extend them. We now have the ability to do simultaneous ultraviolet/X-ray/optical spectroscopy with HST, Chandra, XMM, and ground-based observatories. The rich spectroscopy that these observations give us must be interpreted principally by reference to detailed models, the development of which is already well underway; tests of these essential interpretive tools are an important product of the proposed investigations.

Author

*X Ray Binaries; Mass Transfer; X Ray Optics; Deposition*

**20040001064** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**Target Characterization and Follow-Up Observations in Support of the Kepler Mission**

Latham, David W.; December 2003; 6 pp.; In English

Contract(s)/Grant(s): NCC2-1390

Report No.(s): Rept-1; No Copyright; Avail: CASI; A02, Hardcopy

A variety of experiments were carried out to investigate the number and characteristics of the stars to be included in the Kepler Input Catalog. One result of this work was the proposal that the 2MASS Catalog of astrometry and photometry in the infrared be used as the primary source for the initial selection of candidate target stars, because this would naturally decrease the number of unsuitable hot blue stars and would also increase the number of desirable solar-type dwarf stars. Another advantage of the 2MASS catalogue is that the stellar positions have more than adequate astrometric accuracy for the Kepler target selection. The original plan reported in the Concept Study Report was to use the parallaxes and multi-band photometry from the FAME mission to provide the information needed for reliable separation of giants and dwarfs. As a result of NASA's withdrawal of support for FAME an alternate approach was needed. In November 2002 we proposed to the Kepler Science Team that a ground-based multi-band photometric survey could help alleviate the loss of the FAME data. The Science Team supported this proposal strongly, and we undertook a survey of possible facilities for such a survey. We concluded that the SAO's 4Shooter CCD camera on the 1.2-m telescope at the Whipple Observatory on Mount Hopkins, Arizona, showed promise for this work.

Derived from text

*Catalogs (Publications); Astrometry; Parallax; Main Sequence Stars*

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*.

**20040000202** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Nitrogen Isotopic Ratio in Jupiter's Atmosphere from Observations by Composite Infrared Spectrometer (CIRS) on the Cassini Spacecraft**

Abbas, M. M.; LeClair, A.; Owen, T.; Conrath, B. J.; Flasar, F. M.; Kunde, V. G.; Nixon, C. A.; Achterberg, R. K.; Bjoraker, G.; Jennings, D. J., et al.; [2003]; 2 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

The Composite Infrared Spectrometer (CIRS) on the Cassini spacecraft made infrared observations of Jupiter's atmosphere during the flyby in December 2000 to January 2001. The unique database in the 600-1400/cm region with 0.53 and 2.8/cm spectral resolutions obtained from the observations permits retrieval of global maps of the thermal structure and composition of Jupiter's atmosphere including the distributions of (14)NH<sub>3</sub> and (15)NH<sub>3</sub>. Analysis of Jupiter's ammonia distributions from three isolated (15)NH<sub>3</sub> spectral lines in eight latitudes is presented for evaluation of the nitrogen isotopic ratio. The nitrogen isotopic ratio (14)N/(15)N (or (15)N/(14)N) in Jupiter's atmosphere in this analysis is calculated to be: 448 +/- 62 ((2.23 +/- 0.31) x 10(exp -3)). This value of the ratio determined from CIRS data is found to be in very close agreement

with the value previously obtained from the measurements by the Galileo Probe Mass Spectrometer. Some possible mechanisms to account for the variation of Jupiter's observed isotopic ratio relative to various astrophysical environments are discussed.

Author

*Jupiter Atmosphere; Nitrogen Isotopes; Isotope Ratios; Atmospheric Composition*

**2004000605** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Synthesis of Sol-Gel Precursors for Ceramics from Lunar and Martian Soil Simulants**

Sibille, L.; Gavira-Gallardo, J. A.; Hourlier-Bahloul, D.; [2003]; 1 pp.; In English; 55th Pacific Coast Regional and Basic Science Division Fall Meeting, 19-22 Oct. 2003, Oakland, CA, USA

Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

Recent NASA mission plans for the human exploration of our Solar System has set new priorities for research and development of technologies necessary to enable a long-term human presence on the Moon and Mars. The recovery and processing of metals and oxides from mineral sources on other planets is under study to enable use of ceramics, glasses and metals by explorer outposts. We report initial results on the production of sol-gel precursors for ceramic products using mineral resources available in martian or lunar soil. The presence of SiO<sub>2</sub>, TiO<sub>2</sub>, and Al<sub>2</sub>O<sub>3</sub> in both martian (44 wt.% SiO<sub>2</sub>, 1 wt.% TiO<sub>2</sub>, 7 wt.% Al<sub>2</sub>O<sub>3</sub>) and lunar (48 wt.% SiO<sub>2</sub>, 1.5 wt.% TiO<sub>2</sub>, 16 wt.% Al<sub>2</sub>O<sub>3</sub>) soils and the recent developments in chemical processes to solubilize silicates using organic reagents and relatively little energy indicate that such an endeavor is possible. In order to eliminate the risks involved in the use of hydrofluoric acid to dissolve silicates, two distinct chemical routes are investigated to obtain soluble silicon oxide precursors from lunar and martian soil simulants. Clear solutions of sol-gel precursors have been obtained by dissolution of silica from lunar soil simulant in basic ethylene glycol (C<sub>2</sub>H<sub>4</sub>(OH)<sub>2</sub>) solutions to form silicon glycolates. Similarly, sol-gel solutions produced from martian soil simulants reveal higher contents of iron oxides. The elemental composition and structure of the precursor molecules were characterized. Further concentration and hydrolysis of the products was performed to obtain gel materials for evaluation as ceramic precursors.

Author

*Sol-Gel Processes; Ceramics; Lunar Soil; Chemical Composition; Silicon Dioxide; Aluminum Oxides; Ethylene Compounds; Mineral Deposits; Titanium Oxides*

**2004000865** California Univ., San Diego, CA, USA

**Isotopic, Chemical and Mineralogical Investigation's of Extraterrestrial Materials**

Lugmair, G. W.; [2003]; 5 pp.; In English

Contract(s)/Grant(s): NAG5-8172; No Copyright; Avail: CASI; A01, Hardcopy

During the grant period we have concentrated on the following main topics: 1. Enstatite meteorites and original heterogeneity of Mn-53 distribution in the solar nebula. We have completed our studies of the enstatite chondrites. 2. Processes of planetary differentiation. We have completed our study of silicate clasts from the mesosiderite Vaca Muerta and found that the global Mn/Cr fractionation event that established mantle source reservoirs on the parent body of the Vaca Muerta silicate clasts occurred approx. 2 Ma after a similar event on the howardite-eucrite-diogenite (HED) parent body. 3. Carbonaceous chondrites. Much effort has been devoted during the last three years to the investigation of this important class of meteorites. 4. Early solar system timescales. Based on the studies of the Mn-53 - Cr-53 isotope system in various meteorites and using results obtained with other isotope chronometers we constructed an absolute time-scale for events in the early solar system. 5. Unusual meteorites. We have studied the anomalous pallasite Eagle Station. 6. The chromium isotopic composition as a tracer for extraterrestrial material on Earth. Based on the observed difference in the Cr-53/Cr-52 ratios between Earth and the other solar system objects we developed a method for detecting cosmic materials on Earth using the Cr-53/Cr-52 ratio as a tracer.

Derived from text

*Meteorites; Manganese Isotopes; Carbonaceous Chondrites; Iron Meteorites; Meteoritic Composition*

**2004000884** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**A Case for Microorganisms on Comets, Europa and the Polar Ice Caps of Mars**

Hoover, Richard B.; Pikuta, Elena V.; [2003]; 1 pp.; In English; International Society for Optical Science and Technology 48th annual Meeting Proceedings: Instruments, Methods, and Missions for Astrobiology VII (Volume 5163), 3-8 Aug. 2003, San Diego, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

Microbial extremophiles live on Earth wherever there is liquid water and a source of energy. Observations by

ground-based observatories, space missions, and satellites have provided strong evidence that water ice exists today on comets, Europa, Callisto, and Ganymede and in the snow, permafrost, glaciers and polar ice caps of Mars. Studies of the cryoconite pools and ice bubble systems of Antarctica suggest that solar heating of dark rocks entrained in ice can cause localized melting of ice providing ideal conditions for the growth of microbial communities with the creation of micro-environments where trapped metabolic gasses produce entrained isolated atmospheres as in the Antarctic ice-bubble systems. It is suggested that these considerations indicate that several groups of microorganisms should be capable of episodic growth within liquid water envelopes surrounding dark rocks in cometary ices and the permafrost and polar caps of Mars. We discuss some of the types of microorganisms we have encountered within the permafrost and snow of Siberia, the cryoconite pools of Alaska, and frozen deep within the Antarctic ice sheet above Lake Vostok.

Author

*Comets; Europa; Mars Surface; Microorganisms; Polar Caps; Exobiology*

**20040000989** NASA Kennedy Space Center, Cocoa Beach, FL, USA

#### **Stardust's Wild Ride**

Covault, Craig; Aviation Week and Space Technology; December 22, 2003, pp. 53-55; In English; Copyright; Avail: Other Sources

The U.S. and Europe are poised to go barnstorming the solar system in 2004 with the most diverse set of planetary operations ever in a single year. The NASA Star-dust spacecraft will inaugurate the action Jan. 2 by diving through the head of the comet Wild 2 for imagery of the nucleus and the collection of comet dust for return to Earth in 2006. The events through the encounter are shown.

Derived from text

*Cometary Atmospheres; Comets; Imagery; Interplanetary Dust*

**20040001189** NASA Langley Research Center, Hampton, VA, USA

#### **Computational Aeroheating Predictions for Mars Lander Configurations**

Edquist, Karl T.; Alter, Stephen J.; [2003]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The proposed Mars Science Laboratory (MSL) mission is intended to deliver a large rover to the Martian surface within 10 km of the target site. This paper presents computational fluid dynamics (CFD) predictions of forebody heating rates for two MSL entry configurations with fixed aerodynamic trim tabs. Results are compared to heating on a 70-deg sphere-cone reference geometry. All three heatshield geometries are designed to trim hypersonically at a 16 deg angle of attack in order to generate the lift-to-drag ratio (L/D) required for precision landing. Comparisons between CFD and tunnel data are generally in good agreement for each configuration, but the computations predict more flow separation and higher heating on a trim tab inclined 10 deg relative to the surface. CFD solutions at flight conditions were obtained using an 8-species Mars gas in chemical and thermal nonequilibrium. Laminar and Baldwin-Lomax solutions were used to estimate the effects of the trim tabs and turbulence on heating. A tab extending smoothly from the heatshield flank is not predicted to increase laminar or turbulent heating rates above the reference levels. Laminar heating on a tab deflected 10 deg from the conical heatshield is influenced by flow separation and is up to 35% above the baseline heating rate. The turbulent solution on the inclined tab configuration predicts attached flow and a 43% heating increase above the reference level.

Author

*Aerodynamic Heating; Computational Fluid Dynamics; Mars Surface; Mars Landing; Mars Missions*

## 92

### SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

**20040000097** NASA Marshall Space Flight Center, Huntsville, AL, USA

#### **Gauging the Nearness and Size of Cycle Maximum**

Wilson, Robert M.; Hathaway, David H.; November 2003; 1 pp.; In English

Report No.(s): NASA/TP-2003-212927; M-1092; No Copyright; Avail: Other Sources; Abstract Only

A simple method for monitoring the nearness and size of conventional cycle maximum for an ongoing sunspot cycle is examined. The method uses the observed maximum daily value and the maximum monthly mean value of international sunspot number and the maximum value of the 2-mo moving average of monthly mean sunspot number to effect the estimation. For cycle 23, a maximum daily value of 246, a maximum monthly mean of 170.1, and a maximum 2-mo moving

average of 148.9 were each observed in July 2000. Taken together, these values strongly suggest that conventional maximum amplitude for cycle 23 would be approx. 124.5, occurring near July 2002 +/-5 mo, very close to the now well-established conventional maximum amplitude and occurrence date for cycle 23-120.8 in April 2000.

Author

*Sunspot Cycle; Sunspots; Solar Activity*

**2004000215** NASA Marshall Space Flight Center, Huntsville, AL, USA

**A Slow Streamer Blowout at the Sun and Ulysses**

Suess, S. T.; Bemporad, A.; Poletto, G.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

On 10 June 2000 a streamer on the southeast limb slowly disappeared from LASCO/C2 over a period of 17 hours. Within this interval, a small CME was reported in C2. Nothing was reported in C3. The ejecta was later detected at Ulysses, which was at quadrature with the Sun and SOHO at the time. The interplanetary CME (ICME) displayed all the properties of a typical ICME. Slow streamer blowouts such as this have long been known but are little studied.

Author

*Solar Activity; Coronal Mass Ejection*

**2004000380** NASA Marshall Space Flight Center, Huntsville, AL, USA

**High Voltage Solar Array ARC Testing for a Direct Drive Hall Effect Thruster System**

Schneider, T.; Vaughn, J.; Carruth, M. R.; Mikellides, I. G.; Jongeward, G. A.; Peterson, T.; Kerslake, T. W.; Snyder, D.; Ferguson, D.; Hoskins, A.; August 18, 2003; 1 pp.; In English; 8th Spacecraft Charging Conference, 20-24 Oct. 2003, Huntsville, AL, USA; Copyright; Avail: Other Sources; Abstract Only

The deleterious effects of spacecraft charging are well known, particularly when the charging leads to arc events. The damage that results from arcing can severely reduce system lifetime and even cause critical system failures. On a primary spacecraft system such as a solar array, there is very little tolerance for arcing. Motivated by these concerns, an experimental investigation was undertaken to determine arc thresholds for a high voltage (200-500 V) solar array in a plasma environment. The investigation was in support of a NASA program to develop a Direct Drive Hall-Effect Thruster (112HET) system. By directly coupling the solar array to a Hall-effect thruster, the D2HET program seeks to reduce mass, cost and complexity commonly associated with the power processing in conventional power systems. In the investigation, multiple solar array technologies and configurations were tested. The cell samples were biased to a negative voltage, with an applied potential difference between them, to imitate possible scenarios in solar array strings that could lead to damaging arcs. The samples were tested in an environment that emulated a low-energy, HET-induced plasma. Short duration 'trigger' arcs as well as long duration 'sustained' arcs were generated. Typical current and voltage waveforms associated with the arc events are presented. Arc thresholds are also defined in terms of voltage, (current and power. The data will be used to propose a new, high-voltage (>300 V) solar array design for which the likelihood of damage from arcing is minimal.

Author

*High Voltages; Spacecraft Charging; Solar Arrays; Electric Potential; Hall Effect*

**2004000498** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Differential Velocity Between Solar Wind Protons and Alpha Particles in Pressure Balance Structures**

Yamauchi, Y.; Suess, S. T.; Steinberg, J. T.; Sakurai, T.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Pressure balance structures (PBSs) are a common high plasma beta feature in high latitude, high speed solar wind. They have been proposed as remnants of coronal plumes. If true, they should reflect the observation that plumes are rooted in unipolar magnetic flux concentrations in the photosphere and are heated as oppositely directed flux is advected into and reconnects with the flux concentration. A minimum variance analysis (MVA) of magnetic discontinuities in PBSs showed there is a larger proportion of tangential discontinuities than in the surrounding high speed wind, supporting the hypothesis that plasmoids or extended current sheets are formed during reconnection at the base of plumes. To further evaluate the character of magnetic field discontinuities in PBSs, differential streaming between alpha particles and protons is analyzed here for the same sample of PBSs used in the MVA. Alpha particles in high speed wind generally have a higher radial flow speed than protons. However, if the magnetic field is folded back on itself, as in a large amplitude Alfvén wave, alpha particles will locally have a radial flow speed less than protons. This characteristic is used here to distinguish between folded back magnetic fields (which would contain rotational discontinuities) and tangential discontinuities using Ulysses high latitude, high speed solar wind data. The analysis indicates that almost all reversals in the radial magnetic field in PBSs are folded back field lines. This

is found to also be true outside PBSs, supporting existing results for typical high speed, high latitude wind. There remains a small number of cases that appear not to be folds in the magnetic field and which may be flux tubes with both ends rooted in the Sun. The distinct difference in MVA results inside and outside PBSs remains unexplained.

Author

*Alpha Particles; Solar Wind; Protons; Wind Measurement; Wind Pressure*

**20040000595** NASA Ames Research Center, Moffett Field, CA, USA

**Multivariate Analysis of Solar Spectral Irradiance Measurements**

Pilewskie, P.; Rabbette, M.; Journal of Geophysical Research; May 16, 2001; ISSN 0148-0227; Volume 106, No. D9, pp. 9685-9696; In English

Contract(s)/Grant(s): NCC2-1164

Report No.(s): Paper-2000JD900582; Copyright; Avail: Other Sources

Principal component analysis is used to characterize approximately 7000 downwelling solar irradiance spectra retrieved at the Southern Great Plains site during an Atmospheric Radiation Measurement (ARM) shortwave intensive operating period. This analysis technique has proven to be very effective in reducing a large set of variables into a much smaller set of independent variables while retaining the information content. It is used to determine the minimum number of parameters necessary to characterize atmospheric spectral irradiance or the dimensionality of atmospheric variability. It was found that well over 99% of the spectral information was contained in the first six mutually orthogonal linear combinations of the observed variables (flux at various wavelengths). Rotation of the principal components was effective in separating various components by their independent physical influences. The majority of the variability in the downwelling solar irradiance (380-1000 nm) was explained by the following fundamental atmospheric parameters (in order of their importance): cloud scattering, water vapor absorption, molecular scattering, and ozone absorption. In contrast to what has been proposed as a resolution to a clear-sky absorption anomaly, no unexpected gaseous absorption signature was found in any of the significant components.

Author

*Solar Spectra; Radiation Measurement; Atmospheric Radiation; Variability; Multivariate Statistical Analysis*

**20040000671** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**Interaction of Comets and the Solar Wind**

Wagner, William, Technical Monitor; Raymond, John C.; December 2003; 2 pp.; In English

Contract(s)/Grant(s): NAG5-12814; No Copyright; Avail: CASI; A01, Hardcopy

We had originally planned to analyze UVCS observations of Comet Machholz, but we obtained higher quality observations of Comet Kudo-Fujikawa in January 2003 at its 0.19 AU perihelion. Besides a large and rapidly increasing water outgassing rate, we detected a bright tail in doubly ionized carbon. The amount of carbon was greater than could be accounted for by GO photodissociation, and we attribute the carbon to evaporation of organics from dust. A spectacular disconnection event was apparent in the C III tail, and it coincides within the uncertainties with the position of the heliospheric current sheet. A paper is in press in Science, and it will be the subject of a press release. We are also analyzing two sungrazing comets. Comet C/2001 C2 shows evidence for sub-fragments and for a very long lasting source of neutrals, which we tentatively identify as evaporation of pyroxene dust grains. Comet C/2002 S2 shows a sudden 2 magnitude drop in optical brightness and an equally sudden recovery. UVCS observations during that time show a steadily increasing outgassing rate. We have derived solar wind densities for both comets, but we are still sorting out the ambiguities involving the fragmentation and optical behavior. We are collaborating with Philippe Lamy on the LASCO measurements.

Derived from text

*Solar Wind; Interactions; Carbon; Comet Tails*

**20040000688** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Asymmetric Stokes-V Profiles at the Penumbra Boundary of a Sunspot**

Choudhary, Debi Prasad; Balasubramaniam, K. S.; Suematsu, Yoshinori; [2003]; 1 pp.; In English; Fifth Solar-B Science Meeting, 12-14 Nov. 2003, Roppongi, Japan; Copyright; Avail: Other Sources; Abstract Only

We present the spectropolarimetric measurements of a sunspot in the active region NOAA 6958 (15S03W), situated near the central meridian disk passage. The follower polarity sunspot was somewhat symmetrically round shaped with an elongated penumbra. There were several opposite polarity magnetic elements at, and beyond the penumbral boundary. The H-alpha images of the sunspot show the bright emission regions near the penumbral boundary towards the sun-center, which was of

opposite polarity with respect to the main spot. The net-circular polarization (NCP) map shows that NCP is negative in the inner part of the spot and positive at the penumbral boundary and near the H-alpha plage. The Doppler velocities were determined by measuring the center-of-gravity (COG) of the Stokes-I profile and zero-crossing (ZC) wavelength of the Stokes-V profiles. The COG velocity map in general agrees with the Evershed flow. In addition, it shows the up flow in the penumbral region. The ZC velocities show the strong down flow at the penumbral boundary. Double-lobed Stokes-V profiles are observed at the locations, where the penumbral fibrils terminate coinciding the H-alpha plage. The Double lobed profiles had an unshifted component similar to the Stokes-V profiles of the sunspot penumbra and a shifted component with a velocity of about 5 km/s. The amplitude of the second component increases along the penumbral fibril as a function of the distance from the center of the sunspot. In this paper we discuss the role of emerging flux in generating the observed double lobed profiles. Based on our present observations, we propose to observe with the Solar-B Spectropolarimeter for understanding the nature of emerging flux near the sunspots.

Author

*Polarimetry; Sunspots; Circular Polarization; Asymmetry; Penumbra; H Alpha Line*

**20040000924** United Applied Technologies, Inc., Huntsville, AL, USA

**Hard X-Ray, Soft X-Ray, and EUV Studies of Solar Eruptions**

Sterling, Alphonse C.; Wagner, William, Technical Monitor; December 17, 2003; 6 pp.; In English

Contract(s)/Grant(s): NASW-02006

Report No.(s): DCN588AR2; No Copyright; Avail: CASI; [A02](#), Hardcopy

Document study the hard X-ray (HXR), soft X-ray (SXR), EUV, and magnetic nature of solar eruptions, with the objective of elucidating the physics of the eruption process. In particular, it was examine the viability of two specific eruption mechanisms, detailed in our proposal. These mechanisms are the 'breakout model', and the 'tether cutting model'. During the second year, it was a significant progress in the goals to Data Sets Utilized. In the publications during this second year of the grant period, the data was used from the E W Imaging Telescope (EIT) and the Michelson Doppler Imager (MDI) instruments on SOHO, and from the Soft X-ray Telescope (SXT), Hard X-ray Telescope (HXT), and the Bragg Crystal Spectrometer (BCS) on Yohoh.

Derived from text

*Solar Activity; Crystals; Extreme Ultraviolet Radiation; Imaging Techniques*

**99**

**GENERAL**

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

**20040000460** NASA Marshall Space Flight Center, Huntsville, AL, USA

**The Development of the Chandra X-Ray Observatory**

Weisskopf, Martin C.; [2003]; 1 pp.; In English; Chandra Fellows Symposium, 8 Oct. 2003, Cambridge, MA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Chandra X-Ray Observatory traces its origins almost to the beginning of the field of X-Ray astronomy. We will present the history of the development of this Great Observatory from the perspective of the Project Scientist.

Author

*X Ray Astrophysics Facility; X Ray Astronomy; Development*

**20040000609** NASA Stennis Space Center, Bay Saint Louis, MS, USA

**Stennis Space Center Test-Facility Capability Handbook**

Taliancich, Paula, Editor; Bruce, Robert, Editor; April 16, 2002; 158 pp.; In English

Report No.(s): NASA/NP-2001-11-00021-SSC; No Copyright; Avail: CASI; [A08](#), Hardcopy

Test facilities at Stennis Space Center are described. This handbook should be considered a living and evolving document.

Author

*Test Facilities; Handbooks*

**20040000618** NASA Glenn Research Center, Cleveland, OH, USA

**Technology Requirements for the 21st Century: A NASA Perspective**

Whitlow, Woodrow, Jr.; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 13-33; In English; See also 20040000616; Original contains color illustrations; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report provides an overview on the following: NASA Vision and Mission; Aeronautics Technology; Space Technology; and Education Programs.

Author

*Aeronautical Engineering; NASA Space Programs*

**20040000629** Albany International Techniweave, Inc., Rochester, NH, USA

**Overview of Seal Development at Albany-Techniweave**

Bond, Bruce; 2002 NASA Seal/Secondary Air System Workshop; September 2003; Volume 1, pp. 299-308; In English; See also 20040000616; Original contains color and black and white illustrations; No Copyright; Avail: CASI; [A02](#), Hardcopy

Albany International Techniweave, Inc. (AIT) has been fabricating a wide variety of rope seals since 1990 for NASA and other aerospace companies. Each customer typically tested the seals as they deemed necessary for their individual application. AIT is now developing standardized testing protocols for its family of high temperature seals in order to provide basic engineering data to its customers. Although testing at high temperature would be ideal, the difficulty and cost makes it prohibitive. AIT is developing room temperature data to establish a baseline. It is anticipated that selected tests at high temperature will provide the basis for establishing correlations between the room temperature data and performance at elevated temperatures. Thus we are working on establishing baseline compression, resiliency, and leakage data.

Derived from text

*Sealing; Temperature Effects; Standardization; Protocol (Computers)*

**20040000959** Ohio Aerospace Inst., Cleveland, OH, USA

**NASA-OAI Collaborative Aerospace Research and Fellowship Program at NASA Glenn Research Center at Lewis Field**

Heyward, Ann O.; Montegani, Francis J.; [2003]; 49 pp.; In English; See also 20040000960 - 20040000974

Contract(s)/Grant(s): NCC3-979; No Copyright; Avail: CASI; [A03](#), Hardcopy

During the summer of 2002, a 10-week activity for university faculty entitled the NASA-OAI Collaborative Aerospace Research and Fellowship Program (CFP) was conducted at the NASA Glenn Research Center in collaboration with the Ohio Aerospace Institute (OAI). This is a companion program to the highly successful NASA Faculty Fellowship Program and its predecessor, the NASA- ASEE Summer Faculty Fellowship Program, that operated for 38 years at Glenn. This year's program began officially on June 3, 2002 and continued through August 9, 2002. This report is intended primarily to summarize the research activities comprising the 2002 CFP Program at Glenn. Fifteen research summaries are included.

Derived from text

*Microgravity; Yaw; Aircraft Engines*

**20040001144** NASA, Washington, DC, USA

**National Aeronautics and Space Administration Biological and Physical Research Enterprise Strategy**

[2003]; 104 pp.; In English

Report No.(s): NASA/NP-2003-10-298-HQ; No Copyright; Avail: CASI; [A06](#), Hardcopy

As the 21st century begins, NASA's new Vision and Mission focuses the Agency's Enterprises toward exploration and discovery. The Biological and Physical Research Enterprise has a unique and enabling role in support of the Agency's Vision and Mission. Our strategic research seeks innovations and solutions to enable the extension of life into deep space safely and productively. Our fundamental research, as well as our research partnerships with industry and other agencies, allow new knowledge and technologies to bring improvements to life on Earth. Our interdisciplinary research in the unique laboratory of microgravity addresses opportunities and challenges on our home planet as well as in space environments. The Enterprise maintains a key role in encouraging and engaging the next generation of explorers from primary school through the graduate level via our direct student participation in space research. The Biological and Physical Research Enterprise encompasses three themes. The biological sciences research theme investigates ways to support a safe human presence in space. This theme addresses the definition and control of physiological and psychological risks from the space environment, including radiation, reduced gravity, and isolation. The biological sciences research theme is also responsible for the development of human support systems technology as well as fundamental biological research spanning topics from genomics to ecologies.

The physical sciences research theme supports research that takes advantage of the space environment to expand our understanding of the fundamental laws of nature. This theme also supports applied physical sciences research to improve safety and performance of humans in space. The research partnerships and flight support theme establishes policies and allocates space resources to encourage and develop entrepreneurial partners access to space research. Working together across research disciplines, the Biological and Physical Research Enterprise is performing vital research and technology development to extend the reach of human space flight.

Derived from text

*NASA Programs; Life Sciences; Aerospace Environments*

**20040002075** NASA, Washington, DC, USA

**ASK Magazine, No. 15**

Laufer, Alexander, Editor; Post, Todd, Editor; Brady, Jody Lannen, Editor; December 2003; 47 pp.; In English; See also 20040002076 - 20040002086

Report No.(s): NP-2003-10-316-HQ; No Copyright; Avail: CASI; [A03](#), Hardcopy

WELCOME to THE ACADEMY of PROGRAM and PROJECT Leadership (APPL) and ASK Magazine. APPL helps NASA managers and project teams accomplish today's missions and meet tomorrow's challenges by providing performance enhancement services and tools, supporting career development programs, sponsoring knowledge sharing events and publications, and creating opportunities for project management collaboration with universities, professional associations, industry partners, and other government agencies. ASK Magazine grew out of APPL's Knowledge Sharing Initiative. The stories that appear in ASK are written by the best of the best project managers, primarily from NASA, but also from other government agencies and industry. In a mature view of the subject career development is not simply four years of college or a week at training, culminating in a diploma or a certificate to hang on an office wall. That's why we wanted to take a broad look at career development in this issue of ASK.

Derived from text

*Occupation; Leadership*

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