National Aeronautics and
Space Administration
Langley Research Center

Scientific and Technical
Information Program Office

# Scientific and Technical Aerospace Reports

# STAR

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# NASA STI Program ... in Profile

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

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- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

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- Telephone the NASA STI Help Desk at (301) 621-0390
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# 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.

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*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.

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# NASA STI Availability Information

## NASA Center for AeroSpace Information (CASI)

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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.

## The Federal Depository Library Program (FDLP)

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

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

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**Subject Term Index**

**Personal Author Index**

# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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

VOLUME 42, AUGUST 27, 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*.

**20040085545** National Renewable Energy Lab., Golden, CO
**Evaluation of RCAS Inflow Models for Wind Turbine Analysis**
Tangler, J.; Bir, G.; Feb. 2004; In English
Report No.(s): DE2004-15006904; NREL/TP-500-35109; No Copyright; Avail: National Technical Information Service (NTIS)

The finite element structural modeling in the Rotorcraft Comprehensive Analysis System (RCAS) provides a state-of-the-art approach to aeroelastic analysis. This, coupled with its ability to model all turbine components, results in a methodology that can simulate complex system interactions characteristic of large wind. In addition, RCAS is uniquely capable of modeling advanced control algorithms and the resulting dynamic responses.
NTIS
*Wind Tunnels; Aerodynamics; Aeroelasticity*

**20040085954** National Energy Technology Lab., Pittsburgh, PA
**Life Cycle Assessment of Renewable Hydrogen Production via Wind/Electrolysis**
Spath, P. L.; Mann, M. K.; Feb. 2004; 18 pp.; In English
Report No.(s): DE2004-15006927; NREL/MP-560-35404; No Copyright; Avail: Department of Energy Information Bridge

This report summarizes the results of a lifecycle assessment of a renewable hydrogen production process employing wind/electrolysis. Resource consumption, energy requirements, and emissions were determined in a cradle-to-grave manner on the operations required to transform raw materials into useful products, including the material production processes required to construct the wind turbines, electrolyzer, and hydrogen storage tanks.
NTIS
*Life (Durability); Hydrogen Production; Storage Tanks*

## 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*.

**20040085761** NASA Langley Research Center, Hampton, VA, USA
**Nonlinear Time Delayed Feedback Control of Aeroelastic Systems: A Functional Approach**
Marzocca, Piergiovanni; Librescu, Liviu; Silva, Walter A.; [2003]; 11 pp.; In English; 44th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics, and Materials Conference, 7-10 Apr. 2003, Norfolk, VA, USA
Contract(s)/Grant(s): NAG1-02011; No Copyright; Avail: CASI; A03, Hardcopy

In addition to its intrinsic practical importance, nonlinear time delayed feedback control applied to lifting surfaces can result in interesting aeroelastic behaviors. In this paper, nonlinear aeroelastic response to external time-dependent loads and stability boundary for actively controlled lifting surfaces, in an incompressible flow field, are considered. The structural model

and the unsteady aerodynamics are considered linear. The implications of the presence of time delays in the linear/nonlinear feedback control and of geometrical parameters on the aeroelasticity of lifting surfaces are analyzed and conclusions on their implications are highlighted.
Author
*Feedback Control; Aeroelasticity; Nonlinear Feedback; Control Surfaces; Time Lag*

**20040085765** NASA Langley Research Center, Hampton, VA, USA
**Identification of Experimental Unsteady Aerodynamic Impulse Responses**
Silva, Walter A.; Piatak, David J.; Scott, Robert C.; [2003]; 10 pp.; In English
Report No.(s): AIAA Paper 2003-1959; Copyright; Avail: CASI; A02, Hardcopy

The identification of experimental unsteady aerodynamic impulse responses using the Oscillating Turntable (OTT) at NASA Langley's Transonic Dynamics Tunnel (TDT) is described. Results are presented for two configurations: a Rigid Semispan Model (RSM) and a rectangular wing with a supercritical airfoil section. Both models were used to acquire unsteady pressure data due to pitching oscillations on the OTT. A deconvolution scheme involving a step input in pitch and the resultant step response in pressure, for several pressure transducers, is used to identify the pressure impulse responses. The identified impulse responses are then used to predict the pressure response due to pitching oscillations at several frequencies. Comparisons with the experimental data are presented.
Author
*Unsteady Aerodynamics; Dynamic Response; Semispan Models; Rectangular Wings; Supercritical Wings*

**20040085981** NASA Langley Research Center, Hampton, VA, USA
**A Study of Grid Resolution, Transition and Turbulence Model Using the Transonic Simple Straked Delta Wing**
Bartels, Robert E.; [2001]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Three-dimensional transonic flow over a delta wing is investigated using several turbulence models. The performance of linear eddy viscosity models and an explicit algebraic stress model is assessed at the start of vortex flow, and the results compared with experimental data. To assess the effect of transition location, computations that either fix transition aft of the leading edge or are fully turbulent are performed. These computations show that grid resolution, transition location and turbulence model significantly affect the 3D flowfield.
Author
*Transonic Flow; Turbulence Models; Three Dimensional Flow; Mathematical Models; Leading Edges; Delta Wings*

**20040086036** Federal Aviation Administration, Washington, DC
**L-853 Cylindrical Runway and Taxiway Retro-Reflective Markers Study**
Cyrus, H. M.; Jun. 2004; 26 pp.; In English
Report No.(s): PB2004-106635; DOT/FAA/AR-04/10; No Copyright; Avail: CASI; A03, Hardcopy

This report describes the evaluation of L-853 cylindrical retro-reflective markers that are used on airports to increase night identification of runway edges, centerline, and taxiway edges. Approved retro-reflective markers use either retro-reflective sheeting or tape, which are mounted on plastic-molded material that are cylindrical or flat surfaces. The minimum standard size for a cylinder-mounted marker is 96 square inches. This evaluation was performed to determine if increasing the standard size to 200 square inches would improve the markers conspicuity to aircraft and ground vehicles and to determine if the location of aircraft-mounted landing lamps have any effect on the visibility of the retro-reflective markers. Based on the results, it was determined that 96-square-inch retro-reflective material is adequate. The results of this study also indicated that aircraft landing lamps mounted closer to the observers eye gave the best visibility of the retro-reflective markers, whereas the aircraft landing lamps mounted at the wing tips gave the worst visibility of the retro-reflective markers.
NTIS
*Aircraft Landing; Cylindrical Bodies; Markers*

**20040086045** National Transportation Safety Board, Washington, DC
**National Transportation Safety Board Aircraft Accident Report: Collision With Trees on Final Approach, Federal Express Flight 1478 Boeing 727-232, N497FE, Tallahassee, Florida, on July 26, 2002**
Jun. 08, 2004; 132 pp.; In English
Report No.(s): PB2004-910402; NTSB/AAR-04/02; NOTATION-7501B; No Copyright; Avail: CASI; A07, Hardcopy

This report explains the accident involving Federal Express flight 1478, a Boeing 727-232F, N497FE, which struck trees

on sort final approach and crashed short of runway 9 at the Tallahassee Regional Airport, Tallahassee, Florida. Safety issues in this report focus on flight crew performance, flight crew decision-making, pilot fatigue, and Federal Aviation Administration (FAA) certification of pilots with color vision deficiencies. Safety recommendations concerning these issues are addressed to the FAA.
NTIS
*Aircraft Accidents; Accident Investigation; Trees*

## 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*.

**20040085511** Nebraska Univ., Omaha, NE, USA
**Journal of Air Transportation, Volume 9, No. 1**
Bowen, Brent D., Editor; 2004; ISSN 1544-6980; 132 pp.; In English; See also 20040085512 - 20040085517
Report No.(s): LC-HE976.1.1-J68; Copyright; Avail: CASI; A07, Hardcopy

The articles in this issue include: 1) Are Four Year Universities Better than Two-Year Colleges at Preparing Students to Pass the FAA Aircraft Mechanic Certification Written Examinations? 2) Assessing Perceived Risk of Consumers in Internet Airline Reservations Services; 3) Perceptions of Communication Training Among Collegiate Flight Educators; 4) Ethics Education in University Aviation Management Programs in the U.S.: Part Three - Qualitative Analysis and Recommendations; 5) Airline Flight Operations Internships Perspectives; 6) Applying Data Mining Techniques to Forecast Number of Airline Passengers in Saudi Arabia (Domestic and International Travels).
CASI
*Air Transportation; Airline Operations; Industrial Management; Market Research; Aircraft Maintenance; Ethics*

**20040085513** University of Southern Illinois, Carbondale, IL, USA
**Airline Flight Operations Internships: Perspectives**
Ruiz, Jose R.; Journal of Air Transportation, Volume 9, No. 1; 2004, pp. 86-99; In English; See also 20040085511; Copyright; Avail: CASI; A03, Hardcopy

The purpose of this study was to identify the manner in which former interns from multiple airlines perceived their airline flight operations internship experience and its value in the pursuit of career goals. The population was composed of former interns from the Southern Illinois University Carbondale (SIUC) Aviation Management and Flight (AVMAF) program. A Likert scale questionnaire was used in the study. Descriptive statistical methods and Kruskal-Wallis tests were used to analyze the data. Results of the study indicate that respondents perceived their airline flight operations internship to be a positive experience with significant value in the pursuit of career goals. There were no statistically significant differences (p \h .05) in the manner in which respondents from different airlines perceived their airline flight operations internship experience.
Author
*Airline Operations; Education; Occupation; Personnel Development*

**20040085517** King Abdul Aziz Univ., Jeddah, Saudi Arabia
**Applying Data Mining Techniques to Forecast Number of Airline Passengers in Saudi Arabia (Domestic and International Travels)**
BaFail, Abdullah Omer; Journal of Air Transportation, Volume 9, No. 1; 2004, pp. 100-115; In English; See also 20040085511; Copyright; Avail: CASI; A03, Hardcopy

This work involves forecasting the number of domestic and international airline passengers in Saudi Arabia. The method used is the neural network technique. Annual data 1975 to 1986 was used and categorized into 16 variables. The forecast was obtained using the Model Quest Miner package, which uses some historical data for developing the model then proceeds to an evaluation phase. The period used for developing the model for the number of passengers was 18 years, while the period used for evaluation was 6 years. Samples of output are presented for each model. Plots of forecasts versus the actual number are shown, together with the percentage of trend fit. Results indicated that the oil gross domestic product, population size and

per capita income were found to be the most contributing variables that affect the number of passengers in the Saudi Arabian airline sectors.
Author
*Airline Operations; Data Mining; Forecasting; Passengers; Saudi Arabia*

**20040085711** NASA Langley Research Center, Hampton, VA, USA
**Software System Safety and the NASA Aeronautics Blueprint**
Holloway, C. Michael; Hayhurst, Kelly J.; [2002]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

NASA's Aeronautics Blueprint lays out a research agenda for the Agency s aeronautics program. The word software appears only four times in this Blueprint, but the critical importance of safe and correct software to the fulfillment of the proposed research is evident on almost every page. Most of the technology solutions proposed to address challenges in aviation are software dependent technologies. Of the fifty-two specific technology solutions described in the Blueprint, forty-one depend, at least in part, on software for success. For thirty-five of these forty-one, software is not only critical to success, but also to human safety. That is, implementing the technology solutions will require using software in such a way that it may, if not specified, designed, and implemented properly, lead to fatal accidents. These results have at least two implications for the research based on the Blueprint: (1) knowledge about the current state-of-the-art and state-of-the-practice in software engineering and software system safety is essential, and (2) research into current unsolved problems in these software disciplines is also essential.
Author
*Software Engineering; Aeronautics; NASA Programs; Computer Security; Aerospace Safety*

**20040085720** NASA Langley Research Center, Hampton, VA, USA
**Application of Probability Methods to Assess Crash Modeling Uncertainty**
Lyle, Karen H.; Stockwell, Alan E.; Hardy, Robin C.; [2003]; 8 pp.; In English; American Helicopter Society 59th Annual Forum, 6-8 May 2003, Phoenix, AZ, USA; No Copyright; Avail: CASI; A02, Hardcopy

Full-scale aircraft crash simulations performed with nonlinear, transient dynamic, finite element codes can incorporate structural complexities such as: geometrically accurate models; human occupant models; and advanced material models to include nonlinear stress-strain behaviors, and material failure. Validation of these crash simulations is difficult due to a lack of sufficient information to adequately determine the uncertainty in the experimental data and the appropriateness of modeling assumptions. This paper evaluates probabilistic approaches to quantify the effects of finite element modeling assumptions on the predicted responses. The vertical drop test of a Fokker F28 fuselage section will be the focus of this paper. The results of a probabilistic analysis using finite element simulations will be compared with experimental data.
Author
*Crashes; Aircraft Models; Probability Theory; Simulation; Mathematical Models*

**20040085722** NASA Langley Research Center, Hampton, VA, USA
**Measurements of Aircraft Wake Vortex Separation at High Arrival Rates and a Proposed New Wake Vortex Separation Philosophy**
Rutishauser, David; Donohue, George L.; Haynie, Rudolph C.; [2003]; 9 pp.; In English; 5th Eurocontrol/FAA ATM Research and Development Conference, 23-27 Jun. 2003, Budapest, Hungary; No Copyright; Avail: CASI; A02, Hardcopy

This paper presents data and a proposed new aircraft wake vortex separation standard that argues for a fundamental re-thinking of international practice. The current static standard, under certain atmospheric conditions, presents an unnecessary restriction on system capacity. A new approach, that decreases aircraft separation when atmospheric conditions dictate, is proposed based upon the availability of new instrumentation and a better understanding of wake physics.
Author
*Aircraft Wakes; Vortices; Weather; Civil Aviation; Approach*

**20040085724** NASA Langley Research Center, Hampton, VA, USA
**IFR Operations at Non-Towered, Non-Radar Airports: Can we do Better Than One-at-a-Time?**
Jones, K.; Williams, D.; Consiglio, M.; Adams, C.; Abbott, T.; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-2874; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes a new concept for operations in non-radar terminal airspace around small, nontowered airports. Currently, air traffic operations in instrument meteorological conditions (IMC) at airfields without control towers and radar

service are severely constrained by what is known as the one-in/one-out paradigm. Under these conditions only one operation (either arrival or departure) is allowed to occur at a time. Since these operations can take over 15 minutes to complete, capacity at these airports is severely restricted in IMC. The proposed concept is an attempt to break this current paradigm by applying emerging airborne and ground-based technologies to enable simultaneous operations by multiple aircraft in nonradar terminal airspace around small non-towered airports in IMC. The general philosophy underlying this concept of operations is the establishment of a newly defined area surrounding these airports called a Self-Controlled Area (SCA). Aircraft operating within the SCA are required to have a specified minimum level of equipage. Within the SCA, pilots are responsible for separating themselves from other similarly equipped aircraft through the use of new onboard systems and procedures. This concept also takes advantage of newly developed automation at the airport, which provides appropriate sequencing information to the pilots for safe and improved operations. Such operations would enhance the opportunity for point-to-point air taxi or charter operations into smaller airfields that are closer to a traveler s origin and destination. A description of this concept of operations and a simulation environment used for evaluation is provided in this paper.
Author
*Airports; Airline Operations; Air Transportation; National Airspace System; Air Traffic Control; Civil Aviation*

**20040085725** NASA Langley Research Center, Hampton, VA, USA
**An Aircraft Encounter with Turbulence in the Vicinity of a Thunderstorm**
Hamilton, David W.; Proctor, Fred H.; [2003]; 11 pp.; In English; 21st AIAA Applied Aerodynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA
Report No.(s): AIAA Paper 2003-4075; No Copyright; Avail: CASI; A03, Hardcopy

Large eddy simulations of three convective turbulence events are investigated and compared with observational data. Two events were characterized with severe turbulence and the other with moderate turbulence. Two of the events occurred during NASA s turbulence flight experiments during the spring of 2002, and the third was an event identified by the Flight Operational Quality Assurance (FOQA) Program. Each event was associated with developing or ongoing convection and was characterized by regions of low to moderate radar reflectivity. Model comparisons with observations are favorable. The data sets from these simulations can be used to test turbulence detection sensors.
Author
*Thunderstorms; Turbulence; Flight Operations; Commercial Aircraft; Mathematical Models*

**20040085800** NASA Langley Research Center, Hampton, VA, USA
**Distribution of Causes in Selected US Aviation Accident Reports Between 1996 and 2003**
Holloway, C. M.; Johnson, C. W.; [2004]; 10 pp.; In English; 22nd International System Safety Conference, 2-6 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 23-090-21-TF; Copyright; Avail: CASI; A02, Hardcopy

This paper describes the results of an independent analysis of the probable and contributory causes of selected aviation accidents in the USA between 1996 and 2003. The purpose of the study was to assess the comparative frequency of a variety of causal factors in the reporting of these adverse events. Although our results show that more of these high consequence accidents were attributed to human error than to any other single factor, a large number of reports also mentioned wider systemic issues, including the managerial and regulatory context of aviation operations. These wider issues are more likely to appear as contributory rather than primary causes in this set of accident reports.
Author
*Aircraft Accidents; Frequencies*

**20040085921** NASA Johnson Space Center, Houston, TX, USA
**A Comparison of Transportation Systems for Human Missions to Mars**
Thomas, Brent; Vaughan, Diane; Drake, Bret; Griffin, Brand; Woodcock, Gordon; [2004]; 15 pp.; In English; 2004 JPC, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: CASI; A03, Hardcopy

There are many ways to send humans to Mars. Credible technical reports can be traced to the 1950's. More recently, NASA has funded major studies that depict a broad variety of trajectories, technologies, stay times, and costs. Much of this data is still valid with direct application to today's exploration planning. This paper presents results comparing these studies with particular emphasis on the in-space transportation aspects of the mission. Specifically, comparisons are made on propulsion systems used for getting the crew and mission equipment from Earth orbit to Mars orbit, descending and ascending from the surface, and returning to Earth orbit. Areas of comparison for each of these phases include crew size, mission mass,

propellant mass, delta v, specific impulse, transit time, surface stay time, aero-braking, and others. Data is analyzed to demonstrate either strong trends toward particular technologies or diverging solutions.
Author
*Manned Mars Missions; Space Transportation System; Mars (Planet); Space Missions*

**20040085964** North Carolina State Univ., Raleigh, NC, USA
**Situation Awareness Implications of Adaptive Automation of Air Traffic Controller Information Processing Functions**
Kaber, David B.; McClernon, Christopher K.; Perry, Carlene M.; Segall, Noa; [2004]; 72 pp.; In English
Contract(s)/Grant(s): NAG1-03022; No Copyright; Avail: CASI; A04, Hardcopy

The goal of this research was to define a measure of situation awareness (SA) in an air traffic control (ATC) task and to assess the influence of adaptive automation (AA) of various information processing functions on controller perception, comprehension and projection. The measure was also to serve as a basis for defining and developing an approach to triggering dynamic control allocations, as part of AA, based on controller SA. To achieve these objectives, an enhanced version of an ATC simulation (Multitask (copyright)) was developed for use in two human factors experiments. The simulation captured the basic functions of Terminal Radar Approach Control (TRACON) and was capable of presenting to operators four different modes of control, including information acquisition, information analysis, decision making and action implementation automation, as well as a completely manual control mode. The SA measure that was developed as part of the research was based on the Situation Awareness Global Assessment Technique (SAGAT), previous goal-directed task analyses of enroute control and TRACON, and a separate cognitive task analysis on the ATC simulation. The results of the analysis on Multitask were used as a basis for formulating SA queries as part of the SAGAT-based approach to measuring controller SA, which was used in the experiments. A total of 16 subjects were recruited for both experiments. Half the subjects were used in Experiment #1, which focused on assessing the sensitivity and reliability of the SA measurement approach in the ATC simulation. Comparisons were made of manual versus automated control. The remaining subjects were used in the second experiment, which was intended to more completely describe the SA implications of AA applied to specific controller information processing functions, and to describe how the measure could ultimately serve as a trigger of dynamic function allocations in the application of AA to ATC. Comparisons were made of the sensitivity of the SA measure to automation manipulations impacting both higher-order information processing functions, such as information analysis and decision making, versus lower-order functions, including information acquisition and action implementation. All subjects were exposed to all forms of AA of the ATC task and the manual control condition. The approach to AA used in both experiments was to match operator workload, assessed using a secondary task, to dynamic control allocations in the primary task. In total, the subjects in each experiment participated in 10 trials with each lasting between 45 minutes and 1 hour. In both experiments, ATC performance was measured in terms of aircraft cleared, conflicting, and collided. Secondary task (gauge monitoring) performance was assessed in terms of a hit-to-signal ratio. As part of the SA measure, three simulation freezes were conducted during each trial to administer queries on Level 1, 2, and 3 SA.
Author (revised)
*Situational Awareness; Adaptive Control; Air Traffic Control; Air Traffic Controllers (Personnel); Mental Performance*

**20040085966** Massachusetts Inst. of Tech., Cambridge, MA, USA
**Impact of Operating Context on the Use of Structure in Air Traffic Controller Cognitive Processes**
Davison, Hayley J.; Histon, Jonathan M.; Ragnarsdottir, Margret Dora; Major, Laura M.; Hansman, R. John; [2004]; 14 pp.; In English
Contract(s)/Grant(s): FAA-SA-1603JB; Purchase Order 1-000244882; FAA-95-G-017; NAG2-1299; NAG1-0206; Copyright; Avail: CASI; A03, Hardcopy

This paper investigates the influence of structure on air traffic controllers cognitive processes in the TRACON, En Route, and Oceanic environments. Radar data and voice command analyses were conducted to support hypotheses generated through observations and interviews conducted at the various facilities. Three general types of structure-based abstractions (standard flows, groupings, and critical points) have been identified as being used in each context, though the details of their application varied in accordance with the constraints of the particular operational environment. Projection emerged as a key cognitive process aided by the structure-based abstractions, and there appears to be a significant difference between how time-based versus spatial-based projection is performed by controllers. It is recommended that consideration be given to the value provided by the structure-based abstractions to the controller as well as to maintain consistency between the type (time or spatial) of information support provided to the controller.
Author
*Air Traffic Control; Flight Operations; Cognitive Psychology; Civil Aviation; Air Traffic Controllers (Personnel)*

**20040085977** NASA Langley Research Center, Hampton, VA, USA

**Airborne Use of Traffic Intent Information in a Distributed Air-Ground Traffic Management Concept: Experiment Design and Preliminary Results**

Wing, David J.; Adams, Richard J.; Barmore, Bryan E.; Moses, Donald; [2001]; 11 pp.; In English; 4th USA/Europe Air Traffic Management R and D Seminar, 3-7 Dec. 2001, Santa Fe, NM, USA; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents initial findings of a research study designed to provide insight into the issue of intent information exchange in constrained en-route air-traffic operations and its effect on pilot decision making and flight performance. The piloted simulation was conducted in the Air Traffic Operations Laboratory at the NASA Langley Research Center. Two operational modes for autonomous operations were compared under conditions of low and high operational complexity. The tactical mode was characterized primarily by the use of state information for conflict detection and resolution and an open-loop means for the pilot to meet operational constraints. The strategic mode involved the combined use of state and intent information, provided the pilot an additional level of alerting, and allowed a closed-loop approach to meeting operational constraints. Operational constraints included separation assurance, schedule adherence, airspace hazard avoidance, flight efficiency, and passenger comfort. Potential operational benefits of both modes are illustrated through several scenario case studies. Subjective pilot ratings and comments comparing the tactical and strategic modes are presented.

Author

*Air Traffic Control; Pilot Ratings; Flight Characteristics; Feedback Control; Experiment Design*

**20040085994** NASA Langley Research Center, Hampton, VA, USA

**Analysis of Adverse Events in Identifying GPS Human Factors Issues**

Adams, Catherine A.; Hwoschinsky, Peter V.; Adams, Richard J.; [2004]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The purpose of this study was to analyze GPS related adverse events such as accidents and incidents (A/I), Aviation Safety Reporting System (ASRS) reports and Pilots Deviations (PDs) to create a framework for developing a human factors risk awareness program. Although the occurrence of directly related GPS accidents is small the frequency of PDs and ASRS reports indicated there is a growing problem with situational awareness in terminal airspace related to different types of GPs operational issues. This paper addresses the findings of the preliminary research and a brief discussion of some of the literature on related GPS and automation issues.

Author

*Aircraft Safety; Global Positioning System; Human Factors Engineering; Accident Investigation*

**20040086068** Army Research Lab., Hampton, VA, USA

**Crash Simulation of a Vertical Drop Test of a B737 Fuselage Section with Overhead Bins and Luggage**

Jackson, Karen E.; Fasanella, Edwin L.; [2004]; 19 pp.; In English

Contract(s)/Grant(s): DTFA03-98-X-90031; No Copyright; Avail: CASI; A03, Hardcopy

The focus of this paper is to describe a crash simulation of a 30-ft/s vertical drop test of a Boeing 737 (B737) fuselage section. The drop test of the 10-ft. long fuselage section of a B737 aircraft was conducted in November of 2000 at the FAA Technical Center in Atlantic City, NJ. The fuselage section was outfitted with two different commercial overhead stowage bins. In addition, 3,229-lbs. of luggage were packed in the cargo hold to represent a maximum take-off weight condition. The main objective of the test was to evaluate the response and failure modes of the overhead stowage bins in a narrow-body transport fuselage section when subjected to a severe, but survivable, impact. A secondary objective of the test was to generate experimental data for correlation with the crash simulation. A full-scale 3-dimensional finite element model of the fuselage section was developed and a crash simulation was conducted using the explicit, nonlinear transient dynamic code, MSC.Dytran. Pre-test predictions of the fuselage and overhead bin responses were generated for correlation with the drop test data. A description of the finite element model and an assessment of the analytical/experimental correlation are presented. In addition, suggestions for modifications to the model to improve correlation are proposed.

Derived from text

*Boeing 737 Aircraft; Drop Tests; Fuselages; Cargo*

**20040086069** NASA Langley Research Center, Hampton, VA, USA

**Crash Simulation of a Boeing 737 Fuselage Section Vertical Drop Test**

Fasanella, Edwin L.; Jackson, Karen E.; Jones, Yvonne T.; Frings, Gary; Vu, Tong; [2004]; 14 pp.; In English

Contract(s)/Grant(s): DTFA03-98-X-90031; No Copyright; Avail: CASI; A03, Hardcopy

A 30-ft/s vertical drop test of a fuselage section of a Boeing 737 aircraft was conducted in October of 1999 at the FAA Technical Center in Atlantic City, NJ. This test was performed to evaluate the structural integrity of a conformable auxiliary fuel tank mounted beneath the floor and to determine its effect on the impact response of the airframe structure and the occupants. The test data were used to compare with a finite element simulation of the fuselage structure and to gain a better understanding of the impact physics through analytical/experimental correlation. To perform this simulation, a full-scale 3-dimensional finite element model of the fuselage section was developed using the explicit, nonlinear transient-dynamic finite element code, MSC.Dytran. The emphasis of the simulation was to predict the structural deformation and floor-level acceleration responses obtained from the drop test of the B737 fuselage section with the auxiliary fuel tank.
Derived from text
*Boeing 737 Aircraft; Drop Tests; Fuselages; Structural Failure; Crashes*

## 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*.

**20040085930** Massachusetts Inst. of Tech., Cambridge, MA, USA
**Structure, Intent and Conformance Monitoring in ATC**
Reynolds, Tom G.; Histon, Jonathan M.; Davison, Hayley J.; Hansman, R. John; [2004]; 10 pp.; In English
Contract(s)/Grant(s): FAA-SA-1603JB; Purchase Order 1-000244882; FAA-95-G-017; NAG2-1299; NAG1-0206; No Copyright; Avail: CASI; A02, Hardcopy

Infield studies of current Air Traffic Control operations it is found that controllers rely on underlying airspace structure to reduce the complexity of the planning and conformance monitoring tasks. The structure appears to influence the controller's working mental model through abstractions that reduce the apparent cognitive complexity. These structure-based abstractions are useful for the controller's key tasks of planning, implementing, monitoring, and evaluating tactical situations. In addition, the structure-based abstractions appear to be important in the maintenance of Situation Awareness. The process of conformance monitoring is analyzed in more detail and an approach to conformance monitoring which utilizes both the structure-based abstractions and intent is presented.
Author
*Air Traffic Control; Cognition; Civil Aviation; Automatic Control*

**20040086543** Massachusetts Inst. of Tech., Cambridge, MA, USA
**Identification of Communication and Coordination Issues in the US Air Traffic Control System**
Davison, Hayley J.; Hansman, R. John; June 2001; 140 pp.; In English
Contract(s)/Grant(s): NAG2-1299
Report No.(s): ICAT-2001-2; No Copyright; Avail: CASI; A07, Hardcopy

Today's air traffic control system is approaching the point of saturation, as evidenced by increasing delays across the National Airspace System (NAS). There exists an opportunity to enhance NAS efficiency and reduce delays by improving strategic communication throughout the ATC system. Although several measures have been taken to improve communication (e.g., Collaborative Decision Making tools), communication issues between ATC facilities remain. It is hypothesized that by identifying the key issues plaguing inter-facility strategic communication, steps can be taken to enhance these communications, and therefore ATC system efficiency. In this report, a series of site visits were performed at Boston and New York ATC facilities as well as at the Air Traffic Control System Command Center. The results from these site visits were used to determine the current communication and coordination structure of Traffic Management Coordinators, who hold a pivotal role in inter-facility communications. Several themes emerged from the study, including: ambiguity of organizational structure in the current ATC system, awkward coordination between ATC facilities, information flow issues, organizational culture issues, and negotiation behaviors used to cope with organizational culture issues.
Author
*Air Traffic Control; Decision Making; National Airspace System; System Effectiveness; Coordination*

## 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*.

**20040085710** NASA Langley Research Center, Hampton, VA, USA
**Composite Bending Box Section Modal Vibration Fault Detection**
Werlink, Rudy; [2002]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

One of the primary concerns with Composite construction in critical structures such as wings and stabilizers is that hidden faults and cracks can develop operationally. In the real world, catastrophic sudden failure can result from these undetected faults in composite structures. Vibration data incorporating a broad frequency modal approach, could detect significant changes prior to failure. The purpose of this report is to investigate the usefulness of frequency mode testing before and after bending and torsion loading on a composite bending Box Test section. This test article is representative of construction techniques being developed for the recent NASA Blended Wing Body Low Speed Vehicle Project. The Box section represents the construction technique on the proposed blended wing aircraft. Modal testing using an impact hammer provides an frequency fingerprint before and after bending and torsional loading. If a significant structural discontinuity develops, the vibration response is expected to change. The limitations of the data will be evaluated for future use as a non-destructive in-situ method of assessing hidden damage in similarly constructed composite wing assemblies. Modal vibration fault detection sensitivity to band-width, location and axis will be investigated. Do the sensor accelerometers need to be near the fault and or in the same axis? The response data used in this report was recorded at 17 locations using tri-axial accelerometers. The modal tests were conducted following 5 independent loading conditions before load to failure and 2 following load to failure over a period of 6 weeks. Redundant data was used to minimize effects from uncontrolled variables which could lead to incorrect interpretations. It will be shown that vibrational modes detected failure at many locations when skin de-bonding failures occurred near the center section. Important considerations are the axis selected and frequency range.
Author
*Fault Detection; Vibration Mode; Blended-Wing-Body Configurations; Composite Structures; Bending Vibration; Aircraft Models*

**20040085717** NASA Langley Research Center, Hampton, VA, USA
**Preliminary Design and Analysis of the ARES Atmospheric Flight Vehicle Thermal Control System**
Gasbarre, J. F.; Dillman, R. A.; [2003]; 13 pp.; In English
Report No.(s): SAE-2003-01-2686; No Copyright; Avail: CASI; A03, Hardcopy

The Aerial Regional-scale Environmental Survey (ARES) is a proposed 2007 Mars Scout Mission that will be the first mission to deploy an atmospheric flight vehicle (AFV) on another planet. This paper will describe the preliminary design and analysis of the AFV thermal control system for its flight through the Martian atmosphere and also present other analyses broadening the scope of that design to include other phases of the ARES mission. Initial analyses are discussed and results of trade studies are presented which detail the design process for AFV thermal control. Finally, results of the most recent AFV thermal analysis are shown and the plans for future work are discussed.
Author
*Temperature Control; Aircraft Configurations; Mars Missions; Control Systems Design*

**20040085727** NASA Langley Research Center, Hampton, VA, USA
**Mechanization and Control Concepts for Biologically Inspired Micro Aerial Vehicles**
Raney, David L.; Slominski, Eric C.; [2003]; 12 pp.; In English; AIAA Guidance, Navigation and Control Conference, 11-14 Aug. 2003, Austin, TX, USA
Report No.(s): AIAA Paper 2003-5345; Copyright; Avail: CASI; A03, Hardcopy

It is possible that MAV designs of the future will exploit flapping flight in order to perform missions that require extreme agility, such as rapid flight beneath a forest canopy or within the confines of a building. Many of nature's most agile flyers generate flapping motions through resonant excitation of an aeroelastically tailored structure: muscle tissue is used to excite a vibratory mode of their flexible wing structure that creates propulsion and lift. A number of MAV concepts have been proposed that would operate in a similar fashion. This paper describes an ongoing research activity in which mechanization and control concepts with application to resonant flapping MAVs are being explored. Structural approaches, mechanical design, sensing and wingbeat control concepts inspired by hummingbirds, bats and insects are examined. Experimental results

from a testbed capable of generating vibratory wingbeat patterns that approximately match those exhibited by hummingbirds in hover, cruise, and reverse flight are presented.
Author
*Mechanization; Control Theory; Structural Design; Aerospace Vehicles; Biology*

**20040085728** NASA Langley Research Center, Hampton, VA, USA
**Evaluation and Analysis of F-16XL Wind Tunnel Data from Dynamic Tests**
Kim, Sungwan; Murphy, Patrick C.; Klein, Vladislav; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-5396; No Copyright; Avail: CASI; A03, Hardcopy

A series of wind tunnel tests were conducted in the NASA Langley Research Center as part of an ongoing effort to develop and test mathematical models for aircraft rigid-body aerodynamics in nonlinear unsteady flight regimes. Analysis of measurement accuracy, especially for nonlinear dynamic systems that may exhibit complicated behaviors, is an essential component of this ongoing effort. In this paper, tools for harmonic analysis of dynamic data and assessing measurement accuracy are presented. A linear aerodynamic model is assumed that is appropriate for conventional forced-oscillation experiments, although more general models can be used with these tools. Application of the tools to experimental data is demonstrated and results indicate the levels of uncertainty in output measurements that can arise from experimental setup, calibration procedures, mechanical limitations, and input errors.
Author
*Aerodynamic Characteristics; Dynamic Tests; Mathematical Models; Wind Tunnel Tests; F-16 Aircraft*

**20040085729** NASA Langley Research Center, Hampton, VA, USA
**Validation of Methodology for Estimating Aircraft Unsteady Aerodynamic Parameters from Dynamic Wind Tunnel Tests**
Murphy, Patrick C.; Klein, Vladislav; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-5397; No Copyright; Avail: CASI; A03, Hardcopy

A basic problem in flight dynamics is the mathematical formulation of the aerodynamic model for aircraft. This study is part of an ongoing effort at NASA Langley to develop a more general formulation of the aerodynamic model for aircraft that includes nonlinear unsteady aerodynamics and to develop appropriate test techniques that facilitate identification of these models. A methodology for modeling and testing using wide-band inputs to estimate the unsteady form of the aircraft aerodynamic model was developed previously but advanced test facilities were not available at that time to allow complete validation of the methodology. The new model formulation retained the conventional static and rotary dynamic terms but replaced conventional acceleration terms with more general indicial functions. In this study advanced testing techniques were utilized to validate the new methodology for modeling. Results of static, conventional forced oscillation, wide-band forced oscillation, oscillatory coning, and ramp tests are presented.
Author
*Unsteady Aerodynamics; Wind Tunnel Tests; Mathematical Models; Aerodynamic Characteristics; Methodology*

**20040085730** NASA Langley Research Center, Hampton, VA, USA
**Use of a Prototype Airborne Separation Assurance System for Resolving Near-Term Conflicts During Autonomous Aircraft Operations**
Barhydt, Richard; Eischeid, Todd M.; Palmer, Michael T.; Wing, David J.; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-5401; Copyright; Avail: CASI; A03, Hardcopy

NASA is currently investigating a new concept of operations for the National Airspace System, designed to improve capacity while maintaining or improving current levels of safety. This concept, known as Distributed Air/Ground Traffic Management (DAGTM), allows appropriately equipped autonomous aircraft to maneuver freely for flight optimization while resolving conflicts with other traffic and staying out of special use airspace and hazardous weather. In order to perform these tasks, pilots use prototype conflict detection, prevention, and resolution tools, collectively known as an Airborne Separation Assurance System (ASAS). While ASAS would normally allow pilots to resolve conflicts before they become hazardous, evaluation of system performance in sudden, near-term conflicts is needed in order to determine concept feasibility. An experiment was conducted in NASA Langley's Air Traffic Operations Lab to evaluate the prototype ASAS for enabling pilots to resolve near-term conflicts and examine possible operational effects associated with the use of lower separation minimums. Sixteen commercial airline pilots flew a total of 32 traffic scenarios that required them to use prototype ASAS tools to resolve close range pop-up conflicts. Required separation standards were set at either 3 or 5 NM lateral spacing, with 1000 ft vertical

separation being used for both cases. Reducing the lateral separation from 5 to 3 NM did not appear to increase operational risk, as indicated by the proximity to the intruder aircraft. Pilots performed better when they followed tactical guidance cues provided by ASAS than when they didn't follow the guidance. In an effort to improve compliance rate, ASAS design changes are currently under consideration. Further studies will of evaluate these design changes and consider integration issues between ASAS and existing Airborne Collision Avoidance Systems (ACAS).
Author
*Autonomy; Flight Operations; Prototypes; Air Traffic Control; Civil Aviation; Systems Engineering*

**20040085732** NASA Langley Research Center, Hampton, VA, USA
**Non-Gaussian PDF Modeling of Turbulent Boundary Layer Fluctuating Pressure Excitation**
Steinwolf, Alexander; Rizzi, Stephen A.; [2003]; 15 pp.; In English; 8th International Conference on Recent Advances in Structural Dynamics, 14-16 Jul. 2003, Southampton, UK
Report No.(s): Paper 8; Copyright; Avail: CASI; A03, Hardcopy

The purpose of the study is to investigate properties of the probability density function (PDF) of turbulent boundary layer fluctuating pressures measured on the exterior of a supersonic transport aircraft. It is shown that fluctuating pressure PDFs differ from the Gaussian distribution even for surface conditions having no significant discontinuities. The PDF tails are wider and longer than those of the Gaussian model. For pressure fluctuations upstream of forward-facing step discontinuities and downstream of aft-facing step discontinuities, deviations from the Gaussian model are more significant and the PDFs become asymmetrical. Various analytical PDF distributions are used and further developed to model this behavior.
Author
*Pressure Oscillations; Turbulent Boundary Layer; Probability Density Functions; Mathematical Models; Supersonic Transports*

**20040085741** NASA Langley Research Center, Hampton, VA, USA
**Aeroelastic Stability of a Four-Bladed Semi-Articulated Soft-Inplane Tiltrotor Model**
Nixon, Mark W.; Langston, Chester W.; Singleton, Jeffrey D.; Piatak, David J.; Kvaternik, Raymond G.; Corso, Lawrence M.; Brown, Ross K.; [2003]; 11 pp.; In English; 2003 International Forum on Aeroelasticity and Structural Dynamics, 4-6 Jun. 2003, Amsterdam, Netherlands; No Copyright; Avail: CASI; A03, Hardcopy

A new four-bladed, semi-articulated, soft-inplane rotor system, designed as a candidate for future heavy-lift rotorcraft, was tested at model scale on the Wing and Rotor Aeroelastic Testing System (WRATS), a 1/5-size aeroelastic wind-tunnel model based on the V-22. The experimental investigation included a hover test with the model in helicopter mode subject to ground resonance conditions, and a forward flight test with the model in airplane mode subject to whirl-flutter conditions. An active control system designed to augment system damping was also tested as part of this investigation. Results of this study indicate that the new four-bladed, soft-inplane rotor system in hover has adequate damping characteristics and is stable throughout its rotor-speed envelope. However, in airplane mode it produces very low damping in the key wing beam-bending mode, and has a low whirl-flutter stability boundary with respect to airspeed. The active control system was successful in augmenting the damping of the fundamental system modes, and was found to be robust with respect to changes in rotor speed and airspeed. Finally, conversion-mode dynamic loads were measured on the rotor and these were found to be signi.cantly lower for the new soft-inplane hub than for the previous baseline stiff - inplane hub.
Author
*Aeroelasticity; Stability; Tilt Rotor Aircraft; Wind Tunnel Models; Dynamic Structural Analysis; Rotor Blades (Turbomachinery); Semispan Models*

**20040085742** NASA Langley Research Center, Hampton, VA, USA
**An Active Smart Material Control System for F/A-18 Buffet Alleviation**
Sheta, Essam F.; Moses, Robert W.; Huttsell, Lawrence J.; Harrand, Vincent J.; [2003]; 14 pp.; In English; International Forum on Aeroelasticity and Structural Dynamics, 4-6 Jun. 2003, Amsterdam, Netherlands; Copyright; Avail: CASI; A03, Hardcopy

The vertical tail buffet problem of fighter aircraft occurs at high angles of attack when the vortical flow breaks down ahead of the vertical tails resulting in unsteady and unbalanced pressure loads on the vertical tails. The buffet loads imposed upon the vertical tails resulted in a premature fatigue failure of the tails, and consequently limits the performance and super maneuverability of twin-tail fighter aircraft. An active smart material control system using distributed piezoelectric actuators has been developed for buffet alleviation and is presented. The inboard and outboard surfaces of the vertical tail are equipped

with piezoelectric actuators to control the buffet responses in the first bending and torsion modes. The electrodynamics of the piezoelectric actuators are expressed with a three-dimensional finite-element model. A single-input-single-output controller is designed to drive the active piezoelectric actuators. High-fidelity multidisciplinary analysis modules for the fluid dynamics, structure dynamics, electrodynamics of the piezoelectric actuators, control law, fluid structure interfacing, and grid motion are integrated into a multidisciplinary computing environment that controls the temporal synchronization of the analysis modules. At 30 degree angle of attack, RMS values of tip acceleration are reduced by as much as 12%. The peak values of the power spectral density of tail-tip acceleration are reduced by as much as 22% in the first bending mode and by as much as 82% in the first torsion mode. The actively controlled piezoelectric actuators were also effective in adding damping at wide range of angles of attack.
Author
*F-18 Aircraft; Control Systems Design; Smart Materials; Aeroservoelasticity; Buffeting; Computational Fluid Dynamics*

**20040085756** NASA Langley Research Center, Hampton, VA, USA
**Evaluation of Operational Procedures for Using a Time-Based Airborne Inter-arrival Spacing Tool**
Oseguera-Lohr, Rosa M.; Lohr, Gary W.; Abbott, Terence S.; Eischeid, Todd M.; [2002]; 11 pp.; In English
Report No.(s): AIAA Paper 2002-5824; Copyright; Avail: CASI; A03, Hardcopy

An airborne tool has been developed based on the concept of an aircraft maintaining a time-based spacing interval from the preceding aircraft. The Advanced Terminal Area Approach Spacing (ATAAS) tool uses Automatic Dependent Surveillance-Broadcast (ADS-B) aircraft state data to compute a speed command for the ATAAS-equipped aircraft to obtain a required time interval behind another aircraft. The tool and candidate operational procedures were tested in a high-fidelity, full mission simulator with active airline subject pilots flying an arrival scenario using three different modes for speed control. The objectives of this study were to validate the results of a prior Monte Carlo analysis of the ATAAS algorithm and to evaluate the concept from the standpoint of pilot acceptability and workload. Results showed that the aircraft was able to consistently achieve the target spacing interval within one second (the equivalent of approximately 220 ft at a final approach speed of 130 kt) when the ATAAS speed guidance was autothrottle-coupled, and a slightly greater (4-5 seconds), but consistent interval with the pilot-controlled speed modes. The subject pilots generally rated the workload level with the ATAAS procedure as similar to that with standard procedures, and also rated most aspects of the procedure high in terms of acceptability. Although pilots indicated that the head-down time was higher with ATAAS, the acceptability of head-down time was rated high. Oculometer data indicated slight changes in instrument scan patterns, but no significant change in the amount of time spent looking out the window between the ATAAS procedure versus standard procedures.
Author
*Airspeed; Broadcasting; Oculometers; Simulators; Speed Control*

**20040085758** NASA Langley Research Center, Hampton, VA, USA
**An Iterative Decambering Approach for Post-Stall Prediction of Wing Characteristics using known Section Data**
Mukherjee, Rinku; Gopalarathnam, Ashok; Kim, Sung Wan; [2003]; 12 pp.; In English; 41st AIAA Aerospace Sciences Meeting, 6-9 Jan. 2003, Reno, NV, USA
Contract(s)/Grant(s): NAG1-01119
Report No.(s): AIAA Paper 2003-1097; Copyright; Avail: CASI; A03, Hardcopy

An iterative decambering approach for the post stall prediction of wings using known section data as inputs is presented. The method can currently be used for incompressible .ow and can be extended to compressible subsonic .ow using Mach number correction schemes. A detailed discussion of past work on this topic is presented first. Next, an overview of the decambering approach is presented and is illustrated by applying the approach to the prediction of the two-dimensional C(sub l) and C(sub m) curves for an airfoil. The implementation of the approach for iterative decambering of wing sections is then discussed. A novel feature of the current e.ort is the use of a multidimensional Newton iteration for taking into consideration the coupling between the di.erent sections of the wing. The approach lends itself to implementation in a variety of finite-wing analysis methods such as lifting-line theory, discrete-vortex Weissinger's method, and vortex lattice codes. Results are presented for a rectangular wing for a from 0 to 25 deg. The results are compared for both increasing and decreasing directions of a, and they show that a hysteresis loop can be predicted for post-stall angles of attack.
Author
*Wings; Angle of Attack; Vortices*

**20040085762** NASA Langley Research Center, Hampton, VA, USA

**Modeling and Validation of Damped Plexiglas Windows for Noise Control**

Buehrle, Ralph D.; Gibbs, Gary P.; Klos, Jacob; Mazur, Marina; [2003]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Windows are a significant path for structure-borne and air-borne noise transmission in general aviation aircraft. In this paper, numerical and experimental results are used to evaluate damped plexiglas windows for the reduction of structure-borne and air-borne noise transmitted into the interior of an aircraft. In contrast to conventional homogeneous windows, the damped plexiglas windows were fabricated using two or three layers of plexiglas with transparent viscoelastic damping material sandwiched between the layers. Transmission loss and radiated sound power measurements were used to compare different layups of the damped plexiglas windows with uniform windows of the same nominal thickness. This vibro-acoustic test data was also used for the verification and validation of finite element and boundary element models of the damped plexiglas windows. Numerical models are presented for the prediction of radiated sound power for a point force excitation and transmission loss for diffuse acoustic excitation. Radiated sound power and transmission loss predictions are in good agreement with experimental data. Once validated, the numerical models were used to perform a parametric study to determine the optimum configuration of the damped plexiglas windows for reducing the radiated sound power for a point force excitation.

Author

*Windows (Apertures); Polymethyl Methacrylate; Sound Transmission; Noise Reduction*

**20040085766** NASA Langley Research Center, Hampton, VA, USA

**Contributions of the NASA Langley Research Center to the DARPA/AFRL/NASA/ Northrop Grumman Smart Wing Program**

Florance, Jennifer P.; Burner, Alpheus W.; Fleming, Gary A.; Martin, Christopher A.; [2003]; 20 pp.; In English; AIAA Dynamics Specialists Conference, 9-10 Apr. 2003, Norfolk, VA, USA

Report No.(s): AIAA Paper 2003-1961; Copyright; Avail: CASI; A03, Hardcopy

An overview of the contributions of the NASA Langley Research Center (LaRC) to the DARPA/AFRL/NASA/ Northrop Grumman Corporation (NGC) Smart Wing program is presented. The overall objective of the Smart Wing program was to develop smart** technologies and demonstrate near-flight-scale actuation systems to improve the aerodynamic performance of military aircraft. NASA LaRC s roles were to provide technical guidance, wind-tunnel testing time and support, and Computational Fluid Dynamics (CFD) analyses. The program was divided into two phases, with each phase having two wind-tunnel entries in the Langley Transonic Dynamics Tunnel (TDT). This paper focuses on the fourth and final wind-tunnel test: Phase 2, Test 2. During this test, a model based on the NGC Unmanned Combat Air Vehicle (UCAV) concept was tested at Mach numbers up to 0.8 and dynamic pressures up to 150 psf to determine the aerodynamic performance benefits that could be achieved using hingeless, smoothly-contoured control surfaces actuated with smart materials technologies. The UCAV-based model was a 30% geometric scale, full-span, sting-mounted model with the smart control surfaces on the starboard wing and conventional, hinged control surfaces on the port wing. Two LaRC-developed instrumentation systems were used during the test to externally measure the shapes of the smart control surface and quantify the effects of aerodynamic loading on the deflections: Videogrammetric Model Deformation (VMD) and Projection Moire Interferometry (PMI). VMD is an optical technique that uses single-camera photogrammetric tracking of discrete targets to determine deflections at specific points. PMI provides spatially continuous measurements of model deformation by computationally analyzing images of a grid projected onto the model surface. Both the VMD and PMI measurements served well to validate the use of on-board (internal) rotary potentiometers to measure the smart control surface deflection angles. Prior to the final entry, NASA LaRC also performed three-dimensional unstructured Navier Stokes CFD analyses in an attempt to predict the potential aerodynamic impact of the smart control surface on overall model forces and moments. Eight different control surface shapes were selected for study at Mach = 0.6, Reynolds number = 3.25 x 10(exp 6), and + 2 deg., 3 deg., 8 deg., and 10 deg.model angles-of-attack. For the baseline, undeflected control surface geometry, the CFD predictions and wind-tunnel results matched well. The agreement was not as good for the more complex aero-loaded control surface shapes, though, because of the inability to accurately predict those shapes. Despite these results, the NASA CFD study served as an important step in studying advanced control effectors.

Author

*Aerodynamic Characteristics; Aerodynamic Loads; Computational Fluid Dynamics; Deformation; Wings*

**20040085771** NASA Langley Research Center, Hampton, VA, USA

**Aircraft Engine Noise Scattering - A Discontinuous Spectral Element Approach**

Stanescu, D.; Hussaini, M. Y.; Farassat, F.; 2002; 11 pp.; In English; Original contains color illustrations

Report No.(s): AIAA Paper 2002-0800; Copyright; Avail: CASI; A03, Hardcopy

The paper presents a time-domain method for computation of sound radiation from aircraft engine sources to the far-field. The effects of nonuniform flow around the aircraft and scattering of sound by fuselage and wings are accounted for in the formulation. Our approach is based on the discretization of the inviscid flow equations through a collocation form of the Discontinuous Galerkin spectral element method. An isoparametric representation of the underlying geometry is used in order to take full advantage of the spectral accuracy of the method. Largescale computations are made possible by a parallel implementation based on message passing. Results obtained for radiation from an axisymmetric nacelle alone are compared with those obtained when the same nacelle is installed in a generic con.guration, with and without a wing.

Author

*Aircraft Engines; Engine Noise; Time Domain Analysis; Sound Waves; Aeroacoustics; Acoustic Scattering*

**20040085773** NASA Langley Research Center, Hampton, VA, USA

**Automated Modeling and Simulation Using the Bond Graph Method for the Aerospace Industry**

Granda, Jose J.; Montgomery, Raymond C.; [2003]; 11 pp.; In English

Report No.(s): AIAA Paper 2003-5527; Copyright; Avail: CASI; A03, Hardcopy

Bond graph modeling was originally developed in the late 1950s by the late Prof. Henry M. Paynter of M.I.T. Prof. Paynter acted well before his time as the main advantage of his creation, other than the modeling insight that it provides and the ability of effectively dealing with Mechatronics, came into fruition only with the recent advent of modern computer technology and the tools derived as a result of it, including symbolic manipulation, MATLAB, and SIMULINK and the Computer Aided Modeling Program (CAMPG). Thus, only recently have these tools been available allowing one to fully utilize the advantages that the bond graph method has to offer. The purpose of this paper is to help fill the knowledge void concerning its use of bond graphs in the aerospace industry. The paper first presents simple examples to serve as a tutorial on bond graphs for those not familiar with the technique. The reader is given the basic understanding needed to appreciate the applications that follow. After that, several aerospace applications are developed such as modeling of an arresting system for aircraft carrier landings, suspension models used for landing gears and multibody dynamics. The paper presents also an update on NASA's progress in modeling the International Space Station (ISS) using bond graph techniques, and an advanced actuation system utilizing shape memory alloys. The later covers the Mechatronics advantages of the bond graph method, applications that simultaneously involves mechanical, hydraulic, thermal, and electrical subsystem modeling.

Author

*Aerospace Engineering; Aerospace Industry; Bond Graphs; Computerized Simulation; Automatic Control; Mathematical Models*

**20040085776** NASA Langley Research Center, Hampton, VA, USA

**Noise Transmission Characteristics of Damped Plexiglas Windows**

Gibbs, Gary P.; Buehrle, Ralph D.; Klos, Jacob; Brown, Sherilyn A.; [2002]; 9 pp.; In English; 8th AIAA/CEAS Aeroacoustics Conference, 16-18 Jun. 2002, Breckenridge, Co, USA

Report No.(s): AIAA Paper 2002-2416; Copyright; Avail: CASI; A02, Hardcopy

Most general aviation aircraft utilize single layer plexiglas material for the windshield and side windows. Adding noise control treatments to transparent panels is a challenging problem. In this paper, damped plexiglas windows are evaluated for replacement of conventional windows in general aviation aircraft to reduce the structure-borne and airborne noise transmitted into the interior. In contrast to conventional solid windows, the damped plexiglas window panels are fabricated using two or three layers of plexiglas with transparent viscoelastic damping material sandwiched between the layers. Results from acoustic tests conducted in the NASA Langley Structural Acoustic Loads and Transmission (SALT) facility are used to compare different designs of the damped plexiglas panels with solid windows of the same nominal thickness. Comparisons of the solid and damped plexiglas panels show reductions in the radiated sound power of up to 8 dB at low frequency resonances and as large as 4.5 dB over a 4000 Hz bandwidth. The weight of the viscoelastic treatment was approximately 1% of the panel mass. Preliminary FEM/BEM modeling shows good agreement with experimental results for radiated sound power.

Author

*Fabrication; Polymethyl Methacrylate; Viscoelastic Damping; Aircraft Noise; General Aviation Aircraft; Windows (Apertures)*

**20040085778** NASA Langley Research Center, Hampton, VA, USA
**Pneumatic Channel Wing Powered-Lift Advanced Super-STOL Aircraft**
Englar, Robert J.; Campbell, Bryan A.; [2002]; 11 pp.; In English; 1st AIAA Flow Control Conference, 24-27 Jun. 2002, Saint Louis, MO, USA
Report No.(s): AIAA Paper 2002-3275; Copyright; Avail: CASI; A03, Hardcopy

The powered-lift Channel Wing concept has been combined with pneumatic Circulation Control aerodynamic and propulsive technology to generate a Pneumatic Channel Wing configuration intended to have Super-STOL or VSTOL capability while eliminating many of the operational problem areas of the original Channel Wing vehicle. A preliminary design study of this pneumatic vehicle based on previous windtunnel and flight-test data for the two technologies integrated into a simple Pneumatic Channel Wing (PCW) configuration showed very strong Super-STOL potential. Wind-tunnel development and evaluations of a PCW powered model conducted at Georgia Tech Research Institute (GTRI) have shown substantial lift capabilities for the blown configuration (C(sub L) values of 8.5 to 9.0). Variation in blowing of the channel was shown to be more efficient than variation in propeller thrust. Also revealed was the ability to operate unstalled at very high angles of attack of 40 deg. - 45 deg., or to achieve very high lift at much lower angle of attack to increase visibility and controllability. In order to provide greater flexibility in Super- STOL takeoffs and landings, the blown model also displayed the ability to interchange thrust and drag by varying blowing without any moving parts. This paper presents these experimental results, discusses variations in the configuration geometry under development, and extends this integrated technology to advanced design studies of PCW-type vehicles.
Author
*Pneumatics; V/STOL Aircraft; Wind Tunnels; Supercritical Flow; Channel Wings*

**20040085782** NASA Langley Research Center, Hampton, VA, USA
**Structural Stability of a Stiffened Aluminum Fuselage Panel Subjected to Combined Mechanical and Internal Pressure Loads**
Rouse, Marshall; Young, Richard D.; Gehrki, Ralph R.; [2003]; 10 pp.; In English
Report No.(s): AIAA Paper 2003-1423; Copyright; Avail: CASI; A02, Hardcopy

Results from an experimental and analytical study of a curved stiffened aluminum panel subjected to combined mechanical and internal pressure loads are presented. The panel loading conditions were simulated using a D-box test fixture. Analytical buckling load results calculated from a finite element analysis are presented and compared to experimental results. Buckling results presented indicate that the buckling load of the fuselage panel is significantly influenced by internal pressure loading. The experimental results suggest that the stress distribution is uniform in the panel prior to buckling. Nonlinear finite element analysis results correlates well with experimental results up to buckling.
Author
*Aluminum; Fuselages; Structural Stability; Curved Panels; Pressure Distribution*

**20040085783** Army Research Lab., Hampton, VA, USA
**Response of Damaged and Undamaged Tailored Extension-Shear-Coupled Composite Panels**
Baker, Donald J.; [2003]; 16 pp.; In English
Report No.(s): AIAA Paper 2003-1461; No Copyright; Avail: CASI; A03, Hardcopy

The results of an analytical and experimental investigation of the response of composite I-stiffener panels with extension-shear coupling are presented. This tailored concept, when used in the panel cover skins of a tiltrotor aircraft wing has the potential for increasing the aeroelastic stability margins and improving the aircraft productivity. The extension-shear coupling is achieved by using unbalanced +/- 45 deg. plies in the skin. Experimental and STAGS analysis results are compared for eight I-stiffener panel specimens. The results indicate that the tailored concept would be feasible to use in the wing skin of a tiltrotor aircraft. Evaluation of specimens impacted at energy level of 500 in.-lbs indicate a minimal loss in stiffness and less than 30 percent loss in strength. Evaluation of specimens with severed center stiffener and adjacent skin indicated a strength loss in excess of percent.
Author
*Composite Structures; Aeroelasticity; Stiffness*

**20040085785** NASA Langley Research Center, Hampton, VA, USA
**Optimal Design and Damage Tolerance Verification of an Isogrid Structure for Helicopter Application**
Baker, Donald J.; Fudge, Jack; Ambur, Damodar R.; Kassapoglou, Christos; [2003]; 19 pp.; In English
Report No.(s): AIAA Paper 2003-1502; Copyright; Avail: CASI; A03, Hardcopy

A composite isogrid panel design for application to a rotorcraft fuselage is presented. An optimum panel design for the lower fuselage of the rotorcraft that is subjected to combined in-plane compression and shear loads was generated using a design tool that utilizes a smeared-stiffener theory in conjunction with a genetic algorithm. A design feature was introduced along the edges of the panel that facilitates introduction of loads into the isogrid panel without producing undesirable local bending gradients. A low-cost manufacturing method for the isogrid panel that incorporates these design details is also presented. Axial compression tests were conducted on the undamaged and low-speed impact damaged panels to demonstrate the damage tolerance of this isogrid panel. A combined loading test fixture was designed and utilized that allowed simultaneous application of compression and shear loads to the test specimen. Results from finite element analyses are presented for the isogrid panel designs and these results are compared with experimental results. This study illustrates the isogrid concept to be a viable candidate for application to the helicopter lower fuselage structure.
Author
*Aircraft Design; Composite Structures; Compression Tests; Damage*

**20040085941** Federal Aviation Administration, Washington, DC
**Bulging Factor Solutions for Cracks in Longitudinal Lap Joints of Pressurized Aircraft Fuselages**
Rahman, A.; Bakuckas, J.; Bigelow, C.; Jun. 2004; 42 pp.; In English
Report No.(s): PB2004-106633; DOT/FAA/AR-04/2; No Copyright; Avail: CASI; A03, Hardcopy
This report is a compilation of bulging factor solutions obtained at the Federal Aviation Administration William J. Hughes Technical Center for cracks in typical transport category aircraft. The solutions were obtained for longitudinal cracks in the critical rivet row of longitudinal lap splice joints. Both unstiffened and frame- and longeron-stiffened configurations were considered. The loading, crack length, skin thickness, substructure spacing, and properties were varied. Baseline solutions for cracks in an unstiffened shell were also obtained. The results from these studies are compiled in this report, and the effects of the parameters that were varied on the bulging factor are discussed.
NTIS
*Crack Propagation; Bulging; Lap Joints*

**20040085942** Federal Aviation Administration, Washington, DC
**Flight-Testing of the FAA Onboard Inert Gas Generation System on an Airbus A320**
Burns, M.; Cavage, W. M.; Hill, R.; Morrison, R.; Jun. 2004; In English
Report No.(s): PB2004-106632; DOT/FAA/AR-03/58; No Copyright; Avail: National Technical Information Service (NTIS)
Extensive development and analysis has illustrated that fuel tank inerting could potentially be cost-effective if air separation modules (ASM), based on hollow-fiber membrane technology, could be used in an efficient way. To illustrate this, the Federal Aviation Administration has developed an onboard inert gas generation system that uses aircraft bleed air to generate nitrogen-enriched air (NEA) at varying flow and purity (oxygen concentration) during a commercial airplane flight cycle. A series of ground and flight tests were performed, in conjunction with Airbus, designed to prove the simplified inerting concept. The system was mounted in the cargo bay of an A320 operated by Airbus for the purposes of research and development and used to inert the aircraft center wing fuel tank during testing. The system and center wing fuel tank were instrumented to allow for the analysis of the system performance and inerting capability. The results of the tests indicated that the concept of the simplified inerting system is valid and that the air separation module dynamic characteristics were as expected. ASM pressure had the expected effect on flow rate and purity; however, bleed air consumption was greater than expected during cruise. The fuel tank inerting results illustrated that no stratification or heterogeneous oxygen concentrations occurred in the tank. The measured average tank ullage oxygen concentration data agreed well with a simple analytical model applied to the flight test data. The measured effect of the high-flow mode was significant, allowing the single-membrane configuration to maintain an inert ullage during the entire flight cycle, even with the very high rate of descent employed for the flight tests. Fuel had virtually no effect on the resulting oxygen concentrations observed in all the tests.
NTIS
*Nitrogen; Gas Generators; Oxygen*

**20040085975** NASA Langley Research Center, Hampton, VA, USA
**Aeroelastic Deformation Measurements of Flap, Gap, and Overhang on a Semispan Model**
Burner, A. W.; Liu, Tian-Shu; Garg, Sanjay; Ghee, Terence A.; Taylor, Nigel J.; [2001]; 30 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy
Single-camera, single-view videogrammetry has been used for the first time to determine static aeroelastic deformation

of a slotted flap configuration on a semispan model at the National Transonic Facility (NTF). Deformation was determined by comparing wind-off to wind-on spatial data from targets placed on the main element, shroud, and flap of the model. Digitized video images from a camera were recorded and processed to automatically determine target image plane locations that were then corrected for sensor, lens, and frame grabber spatial errors. The videogrammetric technique used for the measurements presented here has been established at NASA facilities as the technique of choice when high-volume static aeroelastic data with minimum impact on data taking is required. However, the primary measurement at the NTF with this technique in the past has been the measurement of the static aeroelastic wing twist of the main wing element on full span models rather than for the measurement of component deformation. Considerations for using the videogrammetric technique for semispan component deformation measurements as well as representative results are presented.
Derived from text
*Aeroelasticity; Deformation; Flapping; Semispan Models*

**20040085988** NASA Langley Research Center, Hampton, VA, USA
**Development of a Dynamically Scaled Generic Transport Model Testbed for Flight Research Experiments**
Jordan, Thomas; Langford, William; Belcastro, Christine; Foster, John; Shah, Gautam; Howland, Gregory; Kidd, Reggie; [2004]; 16 pp.; In English; AUVSI's Unmanned Systems North America 2004 Symposium and Exhibition, 3-5 Aug. 2004, Anaheim, CA, USA
Contract(s)/Grant(s): 23-728-30-33; No Copyright; Avail: CASI; A03, Hardcopy

This paper details the design and development of the Airborne Subscale Transport Aircraft Research (AirSTAR) test-bed at NASA Langley Research Center (LaRC). The aircraft is a 5.5% dynamically scaled, remotely piloted, twin-turbine, swept wing, Generic Transport Model (GTM) which will be used to provide an experimental flight test capability for research experiments pertaining to dynamics modeling and control beyond the normal flight envelope. The unique design challenges arising from the dimensional, weight, dynamic (inertial), and actuator scaling requirements necessitated by the research community are described along with the specific telemetry and control issues associated with a remotely piloted subscale research aircraft. Development of the necessary operational infrastructure, including operational and safety procedures, test site identification, and research pilots is also discussed. The GTM is a unique vehicle that provides significant research capacity due to its scaling, data gathering, and control characteristics. By combining data from this testbed with full-scale flight and accident data, wind tunnel data, and simulation results, NASA will advance and validate control upset prevention and recovery technologies for transport aircraft, thereby reducing vehicle loss-of-control accidents resulting from adverse and upset conditions.
Author
*Research Aircraft; Transport Aircraft; Dynamic Models; Test Stands; Aircraft Design*

**20040086035** Dynamic Response, Inc., Sherman Oaks, CA, USA
**Investigation, Evaluation, and Application of Techniques for Correlating Rotorcraft Full-Scale Water Impact Tests Versus Analyses**
Wittlin, G.; Gamon, M.; Jun. 2004; In English
Report No.(s): PB2004-106634; No Copyright; Avail: National Technical Information Service (NTIS)

This report presents the results of applying various correlation techniques between aircraft water impact tests and analysis. Various relationships, such as between floor accelerations and panel pressures amplitudes or between time and frequency domains, were also investigated. This report describes the investigation and evaluation of several procedures considered appropriate for correlation. The investigation included frequency filtering levels, the application of modal analysis and contribution, the application of power spectral density techniques, the Huang Hilbert Spectra analysis procedure, force reconstruction techniques, and automotive industry correlation procedures. The conclusions, drawn from the results, indicate that the use of different correlation techniques provides a better understanding of water impact testing versus analysis.
NTIS
*Full Scale Tests; Spectrum Analysis; Rotary Wing Aircraft; Impact; Water*

**20040086037** Federal Aviation Administration, Washington, DC
**Flammability Assessment of Bulk-Packed, Nonrechargeable Lithium Primary Batteries in Transport Category Aircraft**
Webster, H.; Jun. 2004; In English
Report No.(s): PB2004-106637; DOT/FAA/AR-04/26; No Copyright; Avail: National Technical Information Service (NTIS)

This report documents the findings of a series of tests conducted to determine the flammability characteristics of primary

lithium batteries and the dangers associated with shipping them in bulk form on commercial transport category aircraft.
NTIS
*Flammability; Lithium Batteries; Primary Batteries*

**20040086067** Army Research Lab., Hampton, VA, USA
**Crash Simulation of a Vertical Drop Test of a B737 Fuselage Section With Auxiliary Fuel Tank**
Fasanella, Edwin L.; Jackson, Karen E.; [2004]; 14 pp.; In English
Contract(s)/Grant(s): DTFA03-98-X-90031; No Copyright; Avail: CASI; A03, Hardcopy

A 30-ft/s vertical drop test of a fuselage section of a Boeing 737 aircraft was conducted in October of 1999 at the FAA William J. Hughes Technical Center in Atlantic City, NJ. This test was performed to evaluate the structural integrity of a conformable auxiliary fuel tank mounted beneath the floor and to determine its effect on the impact response of the airframe structure. The test data were used to compare with a finite element simulation of the fuselage structure and to gain a better understanding of the impact physics through analytical/experimental correlation. To perform this simulation, a full-scale 3-dimensional finite element model of the fuselage section was developed using the explicit, nonlinear transient-dynamic finite element code, MSC.Dytran. The emphasis of the simulation was to determine the structural deformation and floor-level acceleration responses obtained from the drop test of the B737 fuselage section with the auxiliary fuel tank.
Author
*Aircraft Structures; Crashes; Drop Tests; Structural Failure; Deformation*

**20040086075** NASA Langley Research Center, Hampton, VA, USA
**The NASA Aircraft VOrtex Spacing System (AVOSS): Concept Demonstration Results and Future Direction**
Rutishauser, David K.; OConnor, Cornelius J.; [2004]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Since the late 1990s the national airspace system has been recognized as approaching a capacity crisis. In the light of this condition, industry, government, user organizations, and educational institutions have been working on procedural and technological solutions to the problem. One aspect of system operations that holds potential for improvement is the separation criteria applied to aircraft for wake vortex avoidance. These criteria, applied when operations are conducted under instrument flight rules (IFR), were designed to represent safe spacing under weather conditions conducive to the longest wake hazards. It is well understood that wake behavior is dependent on meteorological conditions as well as the physical parameters of the generating aircraft. Under many ambient conditions, such as moderate crosswinds or turbulence, wake hazard durations are substantially reduced. To realize this reduction NASA has developed a proof-of-concept Aircraft VOrtex Spacing System (AVOSS). Successfully demonstrated in a realtime field demonstration during July 2000 at the Dallas Ft. Worth International Airport (DFW), AVOSS is a novel integration of weather sensors, wake sensors, and analytical wake prediction algorithms. AVOSS provides dynamic wake separation criteria that are a function of the ambient weather conditions for a particular airport, and the predicted wake behavior under those conditions. Wake sensing subsystems provide safety checks and validation for the predictions. The AVOSS was demonstrated in shadow mode; no actual spacing changes were applied to aircraft. This paper briefly reviews the system architecture and operation, reports the latest performance results from the DFW deployment, and describes the future direction of the project.
Derived from text
*Aircraft Approach Spacing; Vortices; Aircraft Wakes; National Airspace System; Climatology*

**20040086080** NASA Langley Research Center, Hampton, VA, USA
**Projection Moire Interferometry Measurements of Micro Air Vehicle Wings**
Fleming, Gary A.; Bartram, Scott M.; Waszak, Martin R.; Jenkins, Luther N.; [2001]; 13 pp.; In English; SPIE Conference on Optical Diagnostics for Fluids, Solids and Combustion, 29 Jul. - 3 Aug. 2001, San Diego, CA, USA
Report No.(s): SPIE Paper 4448-16; No Copyright; Avail: CASI; A03, Hardcopy

Projection Moire Interferometry (PMI) has been used to measure the structural deformation of micro air vehicle (MAV) wings during a series of wind tunnel tests. The MAV wings had a highly flexible wing structure, generically reminiscent of a bat s wing, which resulted in significant changes in wing shape as a function of MAV angle-of-attack and simulated flight speed. This flow-adaptable wing deformation is thought to provide enhanced vehicle stability and wind gust alleviation compared to rigid wing designs. Investigation of the potential aerodynamic benefits of a flexible MAV wing required measurement of the wing shape under aerodynamic loads. PMI was used to quantify the aerodynamically induced changes in wing shape for three MAV wings having different structural designs and stiffness characteristics. This paper describes the PMI

technique, its application to MAV testing, and presents a portion of the PMI data acquired for the three different MAV wings tested.
Author
*Moire Interferometry; Wing Loading; Stiffness; Wings; Structural Design*

**20040086084** NASA Langley Research Center, Hampton, VA, USA
**Use of 3000 Bragg Grating Strain Sensors Distributed on Four Eight-meter Optical Fibers During Static Load Tests of a Composite Structure**
Childers, Brooks A.; Froggatt, Mark E.; Allison, Sidney G.; Moore, Thomas C., Sr.; Hare, David A.; Batten, Christopher F.; Jegley, Dawn C.; [2001]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

This paper describes the use of a fiber optic system to measure strain at thousands of locations along optical fibers where weakly reflecting Bragg gratings have been photoetched. The optical fibers were applied to an advanced composite transport wing along with conventional foil strain gages. A comparison of the fiber optic and foil gage systems used for this test will be presented including: a brief description of both strain data systems; a discussion of the process used for installation of the optical fiber; comparative data from the composite wing test; the processes used for the location and display of the high density fiber optic data. Calibration data demonstrating the potential accuracy of the fiber optic system will also be presented. The opportunities for industrial and commercial applications will be discussed. The fiber optic technique is shown to be a valuable augmentation to foil strain gages providing insight to structural behavior previously requiring reliance on modeling.
Author
*Bragg Gratings; Composite Structures; Fiber Optics; Measuring Instruments*

**20040086096** NASA Langley Research Center, Hampton, VA, USA
**Wind Tunnel Data Fusion and Immersive Visualization: A Case Study**
Severance, Kurt; Brewster, Paul; Lazos, Barry; Keefe, Daniel; [2001]; 5 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

This case study describes the process of fusing the data from several wind tunnel experiments into a single coherent visualization. Each experiment was conducted independently and was designed to explore different flow features around airplane landing gear. In the past, it would have been very difficult to correlate results from the different experiments. However, with a single 3-D visualization representing the fusion of the three experiments, significant insight into the composite flowfield was observed that would have been extremely difficult to obtain by studying its component parts. The results are even more compelling when viewed in an immersive environment.
Derived from text
*Fuel Production; Photogrammetry; Convolution Integrals; Fusion; Wind Tunnel Tests*

**20040086098** NASA Langley Research Center, Hampton, VA, USA
**Experimental Investigations of Generalized Predictive Control for Tiltrotor Stability Augmentation**
Nixon, Mark W.; Langston, Chester W.; Singleton, Jeffrey D.; Piatak, David J.; Kvaternik, Raymond G.; Bennett, Richard L.; Brown, Ross K.; [2001]; 12 pp.; In English; 2001 CEAS/AIAA/AIAE International Forum of Aeroelasticity and Structural Dynamics, 5-7 Jun. 2001, Madrid, Spain; Copyright; Avail: CASI; A03, Hardcopy

A team of researchers from the Army Research Laboratory, NASA Langley Research Center (LaRC), and Bell Helicopter-Textron, Inc. have completed hover-cell and wind-tunnel testing of a 1/5-size aeroelastically-scaled tiltrotor model using a new active control system for stability augmentation. The active system is based on a generalized predictive control (GPC) algorithm originally developed at NASA LaRC in 1997 for un-known disturbance rejection. Results of these investigations show that GPC combined with an active swashplate can significantly augment the damping and stability of tiltrotors in both hover and high-speed flight.
Author
*Active Control; Stability Augmentation; Tilt Rotor Aircraft; Control Stability*

**20040086465** NASA Langley Research Center, Hampton, VA, USA
**Finite Element Model Development For Aircraft Fuselage Structures**
Buehrle, Ralph D.; Fleming, Gary A.; Pappa, Richard S.; Grosveld, Ferdinand W.; [2000]; 7 pp.; In English; XVIII International Modal Analysis Conference, Feb. 2000, San Antonio, TX, USA; No Copyright; Avail: CASI; A02, Hardcopy

The ability to extend the valid frequency range for finite element based structural dynamic predictions using detailed

models of the structural components and attachment interfaces is examined for several stiffened aircraft fuselage structures. This extended dynamic prediction capability is needed for the integration of mid-frequency noise control technology. Beam, plate and solid element models of the stiffener components are evaluated. Attachment models between the stiffener and panel skin range from a line along the rivets of the physical structure to a constraint over the entire contact surface. The finite element models are validated using experimental modal analysis results.
Author
*Aircraft Structures; Finite Element Method; Fuselages; Mathematical Models*

**20040086484** Army Research Lab., Hampton, VA, USA
**Crash Simulation of a Vertical Drop Test of a Commuter-Class Aircraft**
Jackson, Karen E.; Fasanella, Edwin L.; [2004]; 13 pp.; In English; 2004 International Crashworthiness Conference, 14-16 Jul. 2004, San Francisco, CA, USA
Contract(s)/Grant(s): 23-728-01-06; No Copyright; Avail: CASI; A03, Hardcopy

A finite element model of an ATR42-300 commuter-class aircraft was developed and a crash simulation was executed. Analytical predictions were correlated with data obtained from a 30-ft/s (9.14-m/s) vertical drop test of the aircraft. The purpose of the test was to evaluate the structural response of the aircraft when subjected to a severe, but survivable, impact. The aircraft was configured with seats, dummies, luggage, and other ballast. The wings were filled with 8,700 lb. (3,946 kg) of water to represent the fuel. The finite element model, which consisted of 57,643 nodes and 62,979 elements, was developed from direct measurements of the airframe geometry. The seats, dummies, luggage, fuel, and other ballast were represented using concentrated masses. The model was executed in LS-DYNA, a commercial code for performing explicit transient dynamic simulations. Predictions of structural deformation and selected time-history responses were generated. The simulation was successfully validated through extensive test-analysis correlation.
Author
*Aircraft Models; Commuter Aircraft; Crashes; Deformation; Drop Tests*

**20040086521** Boeing Co., Saint Louis, MO, USA
**Boeing TacAir CFD Capabilities/Issues**
Stookesberry, Dave; Berrier, Frank; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 365-377; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

The paper discusses: 1. Tactical Aircraft (TacAir) group of Boeing's Integrated Defence Systems (IDS) division. 2. Production tactical fighter aircraft - primarily aircraft upgrade or manufacturing issues. Located in St. Louis, Missouri along with elements of Boeing Phantom works R&D unit (Advanced Military Aircraft). 3. WIND flow solver (Steady-state, Navier-Stokes). Two-equation turbulence model. Primarily structured/overlapped grids, some unstructured grids. CFD solutions run on LINUX PC clusters.
CASI
*Computational Fluid Dynamics; Mathematical Models; Structured Grids (Mathematics); Turbulence Models*

## 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*.

**20040085692** NASA Langley Research Center, Hampton, VA, USA
**Real-Time Integrity Monitoring of Stored Geo-Spatial Data Using Forward-Looking Remote Sensing Technology**
Young, Steven D.; Harrah, Steven D.; deHaag, Maarten Uijt; [2002]; 10 pp.; In English; 21st Digital Avionics Systems Conference, 28-31 Oct. 2002, Irvine, CA, USA; Original contains color and black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

Terrain Awareness and Warning Systems (TAWS) and Synthetic Vision Systems (SVS) provide pilots with displays of stored geo-spatial data (e.g. terrain, obstacles, and/or features). As comprehensive validation is impractical, these databases typically have no quantifiable level of integrity. This lack of a quantifiable integrity level is one of the constraints that has limited certification and operational approval of TAWS/SVS to ″advisory-only″ systems for civil aviation. Previous work demonstrated the feasibility of using a real-time monitor to bound database integrity by using downward-looking remote

sensing technology (i.e. radar altimeters). This paper describes an extension of the integrity monitor concept to include a forward-looking sensor to cover additional classes of terrain database faults and to reduce the exposure time associated with integrity threats. An operational concept is presented that combines established feature extraction techniques with a statistical assessment of similarity measures between the sensed and stored features using principles from classical detection theory. Finally, an implementation is presented that uses existing commercial-off-the-shelf weather radar sensor technology.
Author
*Real Time Operation; Civil Aviation; Display Devices; Enhanced Vision; Warning Systems*

**20040085995** NASA Langley Research Center, Hampton, VA, USA
**Two Aircraft Head-Up Traffic Surveillance Symbology Issues: Range Filter and Inboard Field-of-View Symbology**
Wong, Douglas T.; Kramer, Lynda J.; Norman, R. Michael; [2004]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The purpose of the eXternal Visibility System (XVS) effort for NASA s High-Speed Research Program was to determine and to provide required pilot visual information for a High Speed Civil Transport vehicle concept to allow safe and efficient operation in the absence of forward windows. The objective of this preliminary experiment conducted at NASA Langley Research Center was to investigate two head-up surveillance symbology (HUSS) display issues. The first issue was concerned with the benefits of adding a range filter to the current HUSS concept. A range filter limits the amount of traffic symbols displayed head-up by setting a range boundary (e.g. 7-nmi) around the ownship. The second issue was concerned with the need to incorporate HUSS in the inboard field-of-view (IFOV) display of the XVS concept. The hypothesis tested was that adding a range filter to the XVS display and HUSS to the IFOV display would enhance the pilot s effectiveness of traffic surveillance tasks. Using a high-resolution graphics flight simulator, each of three pilots flew departure and arrival scenarios under visual meteorological conditions. The pilots main tasks, while managing flight path, were to detect and assess potential airborne traffic hazards and to maintain overall situation awareness. Upon completing all the runs, each pilot completed a subjective questionnaire. Results showed that having both the HUSS on the IFOV and the range filter on each of the XVS displays enhanced the effectiveness of the XVS surveillance display concept. This configuration had the least head down time and the lowest mental workload. Combining both features gave the best target detection, the earliest threat recognition, and enabled the pilots to create a better strategy for evasive action when it became necessary.
Author
*Detection; Display Devices; Field of View; Flight Paths; Head-Up Displays; High Resolution; Mental Performance*

**20040085996** NASA Langley Research Center, Hampton, VA, USA
**Can Effective Synthetic Vision System Displays be Implemented on Limited Size Display Spaces?**
Comstock, J. Raymond, Jr.; Glaab, Lou J.; Prinzel, Lance J.; Elliott, Dawn M.; [2004]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The Synthetic Vision Systems (SVS) element of the NASA Aviation Safety Program is striving to eliminate poor visibility as a causal factor in aircraft accidents, and to enhance operational capabilities of all types or aircraft. To accomplish these safety and situation awareness improvements, the SVS concepts are designed to provide a clear view of the world ahead through the display of computer generated imagery derived from an onboard database of terrain, obstacle and airport information. An important issue for the SVS concept is whether useful and effective Synthetic Vision System (SVS) displays can be implemented on limited size display spaces as would be required to implement this technology on older aircraft with physically smaller instrument spaces. In this study, prototype SVS displays were put on the following display sizes: (a) size ″A' (e.g. 757 EADI), (b) form factor ″D″ (e.g. 777 PFD), and (c) new size ″X″ (Rectangular flat-panel, approximately 20 x 25 cm). Testing was conducted in a high-resolution graphics simulation facility at NASA Langley Research Center. Specific issues under test included the display size as noted above, the field-of-view (FOV) to be shown on the display and directly related to FOV is the degree of minification of the displayed image or picture. Using simulated approaches with display size and FOV conditions held constant no significant differences by these factors were found. Preferred FOV based on performance was determined by using approaches during which pilots could select FOV. Mean preference ratings for FOV were in the following order: (1) 30 deg., (2) Unity, (3) 60 deg., and (4) 90 deg., and held true for all display sizes tested. Limitations of the present study and future research directions are discussed.
Author
*Display Devices; Field of View; Flight Safety; Simulation; Computer Graphics*

**20040085999** NASA Langley Research Center, Hampton, VA, USA
**Decision-Making in Flight with Different Convective Weather Information Sources: Preliminary Results**
Latorella, Kara A.; Chamberlain, James P.; [2004]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This paper reports preliminary and partial results of a flight experiment to address how General Aviation (GA) pilots use weather cues to make flight decisions. This research presents pilots with weather cue conditions typically available to GA pilots in visual meteorological conditions (VMC) and instrument meteorological conditions (IMC) today, as well as in IMC with a Graphical Weather Information System (GWIS). These preliminary data indicate that both VMC and GWIS-augmented IMC conditions result in better confidence, information sufficiency and perceived performance than the current IMC condition. For all these measures, the VMC and GWIS-augmented conditions seemed to provide similar pilot support. These preliminary results are interpreted for their implications on GWIS display design, training, and operational use guidelines. Final experimental results will compare these subjective data with objective data of situation awareness and decision quality.
Author
*Flight Conditions; General Aviation Aircraft; Weather; Cues*

**20040086062** NASA Langley Research Center, Hampton, VA, USA
**Flight Test Results of a Synthetic Vision Elevation Database Integrity Monitor**
deHaag, Maarten Uijt; Sayre, Jonathon; Campbell, Jacob; Young, Steve; Gray, Robert; [2001]; 10 pp.; In English; SPIE's 15th Annual International Symposium on Aerospace/Defense Sensing Simulation and Controls, 16-20 Apr. 2001, Orlando, FL, USA
Contract(s)/Grant(s): NCC1-351; Copyright; Avail: CASI; A02, Hardcopy

This paper discusses the flight test results of a real-time Digital Elevation Model (DEM) integrity monitor for Civil Aviation applications. Providing pilots with Synthetic Vision (SV) displays containing terrain information has the potential to improve flight safety by improving situational awareness and thereby reducing the likelihood of Controlled Flight Into Terrain (CFIT). Utilization of DEMs, such as the digital terrain elevation data (DTED), requires a DEM integrity check and timely integrity alerts to the pilots when used for flight-critical terrain-displays, otherwise the DEM may provide hazardous misleading terrain information. The discussed integrity monitor checks the consistency between a terrain elevation profile synthesized from sensor information, and the profile given in the DEM. The synthesized profile is derived from DGPS and radar altimeter measurements. DEMs of various spatial resolutions are used to illustrate the dependency of the integrity monitor s performance on the DEMs spatial resolution. The paper will give a description of proposed integrity algorithms, the flight test setup, and the results of a flight test performed at the Ohio University airport and in the vicinity of Asheville, NC.
Author
*Data Bases; Digital Elevation Models; Enhanced Vision; Flight Tests; Monitors; Civil Aviation*

## 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*.

**20040085894** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Integrated Testing of a 4-Bed Molecular Sieve and a Temperature-Swing Adsorption Compressor for Closed-Loop Air Revitalization**
Knox, James C.; Mulloth, Lila M.; Affleck, David L.; [2004]; 10 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA
Report No.(s): Rept-041CES-299; Copyright; Avail: CASI; A02, Hardcopy

Accumulation and subsequent compression of carbon dioxide that is removed from space cabin are two important processes involved in a closed-loop air revitalization scheme of the International Space Station (ISS). The 4-Bed Molecular Sieve (4BMS) of ISS currently operates in an open loop mode without a compressor. This paper reports the integrated 4BMS and liquid-cooled TSAC testing conducted during the period of March 3 to April 18, 2003. The TSAC prototype was developed at NASA Ames Research Center (ARC). The 4BMS was modified to a functionally flight-like condition at NASA Marshall Space Flight Center (MSFC). Testing was conducted at MSFC. The paper provides details of the TSAC operation at various CO2 loadings and corresponding performance of CDRA.
Author
*Adsorption; Compressors; Sieves; Feedback Control; Air Purification; Temperature Profiles*

**20040086086** Old Dominion Univ., Norfolk, VA, USA

**Modeling and Simulation of the Apache Rotor System in CAMRAD II**

Kunz, Donald L.; Jones, Henry E.; [2001]; 9 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The unique capabilities of CAMRAD II are used to develop two enhanced models of the AH-64 Apache rotor system. Based on existing sources of structural and dynamic blade properties, common characteristics of both models are first validated. Then, a single-load path, kinematic joint model, which includes the exact kinematics of the blade retention system, is developed and validated. A multiple-load-path model, which incorporates an accurate representation of the strap pack into the kinematic joint model, is also created. Pitch link loads are calculated and compared to flight test data.

Derived from text

*Ah-64 Helicopter; Dynamic Characteristics; Simulation; Structural Design; Rotors*

## 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*.

**20040085723** NASA Langley Research Center, Hampton, VA, USA

**Regaining Lost Separation in a Piloted Simulation of Autonomous Aircraft Operations**

Barhydt, Richard; Eischeid, Todd M.; Palmer, Michael T.; Wing, David J.; [2002]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

NASA is currently investigating a new concept of operations for the National Airspace System, designed to improve capacity while maintaining or improving current levels of safety. This concept, known as Distributed Air/Ground Traffic Management (DAG-TM), allows appropriately equipped autonomous aircraft to maneuver freely for flight optimization while resolving conflicts with other traffic and staying out of special use airspace and hazardous weather. While Airborne Separation Assurance System (ASAS) tools would normally allow pilots to resolve conflicts before they become hazardous, evaluation of system performance in sudden, near-term conflicts is needed in order to determine concept feasibility. If an acceptable safety level can be demonstrated in these situations, then operations may be conducted with lower separation minimums. An experiment was conducted in NASA Langley s Air Traffic Operations Lab to address issues associated with resolving near-term conflicts and the potential use of lower separation minimums. Sixteen commercial airline pilots flew a total of 32 traffic scenarios that required them to use prototype ASAS tools to resolve close range pop-up conflicts. Required separation standards were set at either 3 or 5 NM lateral spacing, with 1000 ft vertical separation being used for both cases. Reducing the lateral separation from 5 to 3 NM did not appear to increase operational risk, as indicated by the proximity to the intruder aircraft. Pilots performed better when they followed tactical guidance cues provided by ASAS than when they didn't follow the guidance. As air-air separation concepts are evolved, further studies will consider integration issues between ASAS and existing Airborne Collision Avoidance Systems (ACAS).These types of non-normal events will require the ASAS to provide effective alerts and resolutions prior to the time that an Airborne Collision Avoidance System (ACAS) would give a Resolution Advisory (RA). When an RA is issued, a pilot must take immediate action in order to avoid a potential near miss. The Traffic Alert and Collision Avoidance System (TCAS) II currently functions as an ACAS aboard commercial aircraft. Depending on the own aircraft s altitude, TCAS only issues RA s 15-35 seconds prior to the Closest Point of Approach (CPA). Prior to an RA, DAG-TM pilots operating autonomous aircraft must rely solely on ASAS for resolution guidance. An additional area of DAG-TM concept feasibility relates to a potential reduction in separation standards. Lower separation standards are likely needed in order to improve NAS efficiency and capacity. Current separation minimums are based in large part on the capabilities of older radar systems. Safety assessments are needed to determine the feasibility of reduced separation minimums. They will give strong consideration to surveillance system performance, including accuracy, integrity, and availability. Candidate surveillance systems include Automatic Dependent Surveillance-Broadcast (ADS-B) and multi-lateration systems. Considering studies done for Reduced Vertical Separation Minimums (RVSM) operations, it is likely that flight technical errors will also be considered. In addition to a thorough evaluation of surveillance system performance, a potential decision to lower the separation standards should also take operational considerations into account. An ASAS Safety Assessment study identified improper maneuvering in response to a conflict (due to ambiguous or improper resolution commands or a pilot s failure to comply with the resolution) as a potential safety risk. If near-term conflicts with lower separation minimums were determined to be more challenging for pilots, the severity of these risks could be even greater.

Author

*Autonomy; Flight Operations; Aircraft Pilots; Commercial Aircraft; Computerized Simulation; Separation*

**20040085767** Army Research Lab., Hampton, VA, USA
**A Review of Recent Rotorcraft Investigations in the Langley Transonic Dynamics Tunnel**
Yeager, William T., Jr.; Wilbur, Matthew L.; Nixon, Mark W.; [2003]; 14 pp.; In English
Report No.(s): AIAA Paper 2003-1963; No Copyright; Avail: CASI; A03, Hardcopy

A review of recent rotorcraft investigations conducted in the NASA Langley Transonic Dynamics Tunnel (TDT) is presented. The paper begins with a brief description of the TDT and the rotorcraft testbeds used at the facility. A unique characteristic of the TDT is the use of a heavy gas test medium, so a brief discussion of the beneficial effects of this test medium for model-scale rotorcraft testing is presented. The paper concludes with a discussion of results obtained during recent TDT tests of an active twist helicopter rotor, and stiff- and soft-inplane tiltrotor configurations.
Author
*Rotary Wing Aircraft; Tilt Rotor Aircraft*

**20040085775** NASA Langley Research Center, Hampton, VA, USA
**An Overview of the NASA Test Platform Research**
Lim, K. B.; Shin, J.-Y.; Cooper, E. G.; Moerder, D. D.; Khong, T. H.; Smith, M. F.; [2003]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A methodology for improving attitude stability and control for low-speed and hovering air vehicle is under development. In addition to aerodynamically induced control forces such as vector thrusting, the new approach exploits the use of bias momenta and torque actuators, similar to a class of spacecraft system, for its guidance and control needs. This approach will be validated on a free-flying research platform under development at NASA Langley Research Center. More broadly, this platform also serves as an in-house testbed for research in new technologies aimed at improving guidance and control of a Vertical Take-Off and Landing (VTOL) vehicle.
Author
*Attitude Stability; Flying Platforms; Flight Control; Test Stands*

**20040085786** NASA Langley Research Center, Hampton, VA, USA
**Nonlinear Flutter Aspects of the Flexible HSCT Semispan Model**
Hajj, Muhammad R.; Silva, Walter A.; [2003]; 9 pp.; In English; 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 7-10 Apr. 2003, Norfolk, VA, USA
Report No.(s): AIAA Paper 2003-1515; Copyright; Avail: CASI; A02, Hardcopy

The nonlinear aspects that lead to the flutter of an High-Speed Civil Transport (HSCT) Flexible Semispan Model are analyzed. A hierarchy of spectral moments was used to determine the characteristics of the aerodynamic loading and structural strains and motions. The results show that the frequency of the bending motion of the wing varied significantly as the Mach number was increased between 0.90 and 0.97. Examination of the pressure coefficients in terms of mean value and fluctuations showed that the flow characteristics over the wing changed significantly around a Mach number of 0.97. A strong shock was identified near the trailing edge. Nonlinear analysis of the pressure fluctuations, under these conditions, showed nonlinear coupling involving low-frequency components at pressure locations where the mean value was at a local minimum. This shows that the aerodynamic forces acting on the model had nonlinearly coupled frequency components. The results presented here show how nonlinear analysis tools can be used to identify nonlinear aspects of the flutter phenomenon which are needed in the validation of nonlinear computational methodologies. Keywords: Nonlinear aeroelasticity, Flutter, Bispectrum.
Author
*Nonlinearity; Aerodynamic Forces; Aeroelasticity; Structural Strain; Flutter*

**20040085795** NASA Langley Research Center, Hampton, VA, USA
**Next Generation Active Buffet Suppression System**
Galea, Stephen C.; Ryall, Thomas G.; Henderson, Douglas A.; Moses, Robert W.; White, Edward V.; Zimcik, David G.; [2003]; 10 pp.; In English
Report No.(s): AIAA Paper 2003-2905; Copyright; Avail: CASI; A02, Hardcopy

Buffeting is an aeroelastic phenomenon that is common to high performance aircraft, especially those with twin vertical tails like the F/A-18, at high angles of attack. These loads result in significant random stresses, which may cause fatigue damage leading to restricted capabilities and availability of the aircraft. This paper describes an international collaborative research activity among Australia, Canada and the USA involving the use of active structural control to alleviate the damaging structural response to these loads. The research program is being co-ordinated by the Air Force Research Laboratory (AFRL)

and is being conducted under the auspices of The Technical Cooperative Program (TTCP). This truly unique collaborative program has been developed to enable each participating country to contribute resources toward a program that coalesces a broad range of technical knowledge and expertise into a single investigation. This collaborative program is directed toward a full-scale test of an F/A-18 empennage, which is an extension of an earlier initial test. The current program aims at applying advanced directional piezoactuators, the aircraft rudder, switch mode amplifiers and advanced control strategies on a full-scale structure to demonstrate the enhanced performance and capability of the advanced active BLA control system in preparation for a flight test demonstration.
Author
*Buffeting; Aeroelasticity; Loads (Forces); Structural Stability; Stabilizers (Fluid Dynamics); Damage*

**20040085796** NASA Langley Research Center, Hampton, VA, USA
**LPV Antiwindup Compensation for Enhanced Flight Control Performance**
Lu, Bei; Wu, Fen; Kim, Sung-Wan; [2003]; 12 pp.; In English; AIAA Guidance, Navigation and Control Conference, 11-14 Aug. 2003, Austin, TX, USA
Contract(s)/Grant(s): NAG1-01119
Report No.(s): AIAA Paper 2003-5495; Copyright; Avail: CASI; A03, Hardcopy

In this paper, we propose a saturation control scheme for linear parameter-varying (LPV) systems from an antiwindup control perspective. The proposed control approach is advantageous because it can be thought of as an augmented control algorithm from the existing control system. Moreover, the synthesis condition for an antiwindup compensator is formulated as a linear matrix inequality (LMI) optimization problem and can be solved efficiently. We have applied the LPV antiwindup controller to an F-16 longitudinal autopilot control system design to enhance aircraft safety and improve flight quality in a high angle of attack region.
Author
*Flight Control; Control Systems Design; F-16 Aircraft; Linear Parameter-Varying Control*

**20040086059** National Academy of Sciences - National Research Council, Hampton, VA, USA
**Effect of Assumed Damage and Location on the Delamination Onset Predictions for Skin-Stiffener Debonding**
Paris, Isabelle L.; Krueger, Ronald; OBrien, T. Kevin; January 2004; 17 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The difference in delamination onset predictions based on the type and location of the assumed initial damage are compared in a specimen consisting of a tapered flange laminate bonded to a skin laminate. From previous experimental work, the damage was identified to consist of a matrix crack in the top skin layer followed by a delamination between the top and second skin layer (+45 deg./-45 deg. interface). Two-dimensional finite elements analyses were performed for three different assumed flaws and the results show a considerable reduction in critical load if an initial delamination is assumed to be present, both under tension and bending loads. For a crack length corresponding to the peak in the strain energy release rate, the delamination onset load for an assumed initial flaw in the bondline is slightly higher than the critical load for delamination onset from an assumed skin matrix crack, both under tension and bending loads. As a result, assuming an initial flaw in the bondline is simpler while providing a critical load relatively close to the real case. For the configuration studied, a small delamination might form at a lower tension load than the critical load calculated for a 12.7 mm (0.5″) delamination, but it would grow in a stable manner. For the bending case, assuming an initial flaw of 12.7 mm (0.5″) is conservative, the crack would grow unstably.
Author
*Bonded Joints; Crack Propagation; Critical Loading*

**20040086083** NASA Langley Research Center, Hampton, VA, USA
**Real-Time Adaptive Control Allocation Applied to a High Performance Aircraft**
Davidson, John B.; Lallman, Frederick J.; Bundick, W. Thomas; [2001]; 11 pp.; In English; 2001 5th SIAM Conference on Control and its Applications, 2001; Copyright; Avail: CASI; A03, Hardcopy

Abstract This paper presents the development and application of one approach to the control of aircraft with large numbers of control effectors. This approach, referred to as real-time adaptive control allocation, combines a nonlinear method for control allocation with actuator failure detection and isolation. The control allocator maps moment (or angular acceleration) commands into physical control effector commands as functions of individual control effectiveness and availability. The actuator failure detection and isolation algorithm is a model-based approach that uses models of the actuators to predict

actuator behavior and an adaptive decision threshold to achieve acceptable false alarm/missed detection rates. This integrated approach provides control reconfiguration when an aircraft is subjected to actuator failure, thereby improving maneuverability and survivability of the degraded aircraft. This method is demonstrated on a next generation military aircraft Lockheed-Martin Innovative Control Effector) simulation that has been modified to include a novel nonlinear fluid flow control control effector based on passive porosity. Desktop and real-time piloted simulation results demonstrate the performance of this integrated adaptive control allocation approach.
Author
*Real Time Operation; Adaptive Control; Aircraft Control; Maneuverability; Controllability; Control Simulation*

**20040086515** NASA Langley Research Center, Hampton, VA, USA
**COMSAC: Computational Methods for Stability and Control, Part 2**
Fremaux, C. Michael, Compiler; Hall, Robert M., Compiler; April 2004; 389 pp.; In English; COMSAC: Computational Methods for Stability and Control, 23-25 Sep. 2003, Hampton, VA, USA; See also 20040086516 - 20040086532
Contract(s)/Grant(s): WU 23-762-45-AF
Report No.(s): NASA/CP-2004-213028/PT2; L-18378B/PT2; No Copyright; Avail: CASI; A17, Hardcopy

The unprecedented advances being made in computational fluid dynamic (CFD) technology have demonstrated the powerful capabilities of codes in applications to civil and military aircraft. Used in conjunction with wind-tunnel and flight investigations, many codes are now routinely used by designers in diverse applications such as aerodynamic performance predictions and propulsion integration. Typically, these codes are most reliable for attached, steady, and predominantly turbulent flows. As a result of increasing reliability and confidence in CFD, wind-tunnel testing for some new configurations has been substantially reduced in key areas, such as wing trade studies for mission performance guarantees. Interest is now growing in the application of computational methods to other critical design challenges. One of the most important disciplinary elements for civil and military aircraft is prediction of stability and control characteristics. CFD offers the potential for significantly increasing the basic understanding, prediction, and control of flow phenomena associated with requirements for satisfactory aircraft handling characteristics.
Author
*Computational Fluid Dynamics; Aircraft Stability; Aircraft Control; Computerized Simulation*

**20040086529** NASA Langley Research Center, Hampton, VA, USA
**COMSAC: Visions and Potential Program Content**
Hall, Robert M.; Fremaux, C. Michael; Chambers, Joseph R.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 692-717; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

The intent of this talk is to present the stability and control (S and C) priorities as seen by the Langley team. No roadmaps or 5 year plans will be presented. We are actively soliciting your feedback, your ideas, and your help in building and executing this program. The outline of this viewgraph presentation includes: 1) Background; 2) NASA Constraints and Priorities; 3) Potential Program Content (high priority issues, approach); 4) Prepared Critiques; 5) Comments by Attendees; 6) Closing Comments.
Author (revised)
*Aircraft Stability; Aircraft Control; Priorities*

**20040086530** Lockheed Martin Aeronautics Co., Marietta, GA, USA
**COMSAC Feedback**
Raj, Pradeep; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 718-721; In English; See also 20040086515; No Copyright; Avail: CASI; A01, Hardcopy

There is an overarching need for a streamlined Computational Fluid Dynamics (CFD) process that is automated, user friendly, and robust. This viewgraph presentation lists priorities in stability and control research, and encourages the simultaneous enhancement of CFD quality and acceptance.
Derived from text
*Aircraft Stability; Aircraft Control; Computational Fluid Dynamics*

**20040086531** Naval Air Systems Command, Patuxent River, MD, USA
**COMSAC Plan: NAVAIR Comments**
Clark, John; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 722-729; In English; See also 20040086515; No Copyright; Avail: CASI; A02, Hardcopy

The Computational Methods for Stability and Control (COMSAC) plan along with Naval Air Systems Command (NAVAIR) comments are presented. The topics include: 1) COMSAC objectives; 2) COMSAC Strategy; 3) NAVAIR Priorities; 4) Observations; and 5) Issues.
CASI
*Control Stability; Computational Fluid Dynamics; Navy; Air Navigation*

**20040086539** NASA Langley Research Center, Hampton, VA, USA
**CFIT Prevention Using Synthetic Vision**
Arthur, Jarvis J., III; Prinzel, Lawrence J., III; Kramer, Lynda J.; Bailey, Randall E.; Parrish, Russell V.; [2003]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

In commercial aviation, over 30-percent of all fatal accidents worldwide are categorized as Controlled Flight Into Terrain (CFIT) accidents where a fully functioning airplane is inadvertently flown into the ground, water, or an obstacle. An experiment was conducted at NASA Langley Research Center investigating the presentation of a synthetic terrain database scene to the pilot on a Primary Flight Display (PFD). The major hypothesis for the experiment is that a synthetic vision system (SVS) will improve the pilot s ability to detect and avoid a potential CFIT compared to conventional flight instrumentation. All display conditions, including the baseline, contained a Terrain Awareness and Warning System (TAWS) and Vertical Situation Display (VSD) enhanced Navigation Display (ND). Sixteen pilots each flew 22 approach - departure maneuvers in Instrument Meteorological Conditions (IMC) to the terrain challenged Eagle County Regional Airport (EGE) in Colorado. For the final run, the flight guidance cues were altered such that the departure path went into the terrain. All pilots with a SVS enhanced PFD (12 of 16 pilots) noticed and avoided the potential CFIT situation. All of the pilots who flew the anomaly with the baseline display configuration (which included a TAWS and VSD enhanced ND) had a CFIT event.
Author
*Flight Control; Terrain; Navigation Aids; Enhanced Vision; Flight Instruments*

## 09
## RESEARCH AND SUPPORT FACILITIES (AIR)

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

**20040085565** Los Alamos National Lab., NM, USA
**Seasonal Advance and Retreat of Mars' South Polar Cap as Measured by the Mars Odyssey Neutron Spectrometer**
Prettyman, T. H.; Feldman, W. C.; Murphy, J. R.; Funsten, H. O.; Lawrence, D. J.; Linn, R. R.; Maurice, S.; Tokar, R. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Martian seasonal polar caps consist of CO2 frost deposits that advance towards lower latitudes during fall and winter and retreat toward the poles during spring and early summer in response to seasonal changes in insolation. Because a large portion of the atmosphere is cycled in and out of the seasonal caps during the year, the frost deposits play a significant role in regional and global atmospheric circulation. Surface thermal properties as well as local atmospheric temperature and pressure influence the onset of frost deposition. The presence of dust in the atmosphere affects the polar energy balance, and can influence the rate of deposition and sublimation of frost. During southern summer, the south polar cap is covered by residual CO2 frost.
Derived from text
*Annual Variations; Atmospheric Circulation; Mars Surface; Surface Properties*

**20040086073** NASA Langley Research Center, Hampton, VA, USA
**Experience and Grouping Effects when Handling Non-Normal Situations**
Trujillo, Anna C.; [2004]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Currently, most of the displays in control rooms can be categorized as status, alerts/procedures, or control screens. With the advent and use of CRTs and the associated computing power available to compute and display information, it is now possible to combine these different elements of information and control onto a single display. An experiment was conducted to determine which, if any, of these functions should be collocated in order to better handle simple anticipated non-normal

system events. The results indicated that there are performance benefits and subject preferences to combining all the information onto one screen or combining the status and alert/procedure information onto one screen and placing the controls in another area. The results indicated that operators quickly modify their display preferences to the display configuration most recently used.
Author
*Display Devices; Ground Based Control*

**20040086088** NASA Langley Research Center, Hampton, VA, USA
**Accuracy of Pressure Sensitive Paint**
Liu, Tianshu; Guille, M.; Sullivan, J. P.; AIAA Journal; January 2001; Volume 39, No. 1; 42 pp.; In English; Copyright; Avail: Other Sources

Uncertainty in pressure sensitive paint (PSP) measurement is investigated from a standpoint of system modeling. A functional relation between the imaging system output and luminescent emission from PSP is obtained based on studies of radiative energy transports in PSP and photodetector response to luminescence. This relation provides insights into physical origins of various elemental error sources and allows estimate of the total PSP measurement uncertainty contributed by the elemental errors. The elemental errors and their sensitivity coefficients in the error propagation equation are evaluated. Useful formulas are given for the minimum pressure uncertainty that PSP can possibly achieve and the upper bounds of the elemental errors to meet required pressure accuracy. An instructive example of a Joukowsky airfoil in subsonic flows is given to illustrate uncertainty estimates in PSP measurements.
Author
*Pressure Sensitive Paints; Error Analysis; Sensitivity*

**20040086542** Massachusetts Inst. of Tech., Cambridge, MA, USA
**Supporting the Future Air Traffic Control Projection Process**
Davison, Hayley J.; Hansman, R. John, Jr.; [2002]; 7 pp.; In English
Contract(s)/Grant(s): FAA-02-C-MIT-07; NAG2-1299; No Copyright; Avail: CASI; A02, Hardcopy

In air traffic control, projecting what the air traffic situation will be over the next 30 seconds to 30 minutes is a key process in identifying conflicts that may arise so that evasive action can be taken upon discovery of these conflicts. A series of field visits in the Boston and New York terminal radar approach control (TRACON) facilities and in the oceanic air traffic control facilities in New York and Reykjavik, Iceland were conducted to investigate the projection process in two different ATC domains. The results from the site visits suggest that two types of projection are currently used in ATC tasks, depending on the type of separation minima and/or traffic restriction and information display used by the controller. As technologies improve and procedures change, care should be taken by designers to support projection through displays, automation, and procedures. It is critical to prevent time/space mismatches between interfaces and restrictions. Existing structure in traffic dynamics could be utilized to provide controllers with useful behavioral models on which to build projections. Subtle structure that the controllers are unable to internalize could be incorporated into an ATC projection aid.
Author
*Air Traffic Control; Information Systems; Evasive Actions; Display Devices*

## 12
## ASTRONAUTICS (GENERAL)

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

**20040085944** National Inst. of Standards and Technology, Gaithersburg, MD
**Terminology for Specifying the Autonomy Levels for Unmanned Systems: Version 1.0**
Huang, H. M.; 2004; 38 pp.; In English
Report No.(s): PB2004-106573; NIST SP-1011; No Copyright; Avail: CASI; A03, Hardcopy

Unmanned systems have been fielded in several domains in the recent past, ranging from battlefields to Mars and mostly sponsored by the Government. As the number of programs for developing unmanned systems accelerates, there is a growing need for characterizing these systems. Individual government agencies have begun these efforts. The Department of Defense

Joint Program Office, the Air Force Research Laboratory, the U.S. Army Science Board, the Army Maneuver Support Center, and National Institute of Standards and Technology have described levels of autonomy for various programs. NASA has embarked upon a project on defining levels of autonomy for a human space flight vehicle. It is beneficial that these and other agencies leverage each others efforts and aim at a consistent approach.
NTIS
*Autonomy; Control Systems Design*

**20040086076** NASA Langley Research Center, Hampton, VA, USA
**Fabrication and Testing of Habitat Components Using In-Situ Materials for Martian Exploration**
Kim, M.-H. Y.; Thibeault, S. A.; Kiefer, R. L.; Wilson, J. W.; Singleterry, R. C.; Moore, J.; Huff, H.; Wilkins, R.; [2004]; 12 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The development of Mars for human activity will require the utilization of Martian materials in building habitats and working structures. One approach is to use polymer binders with regolith to form structural elements. Not only can useful composite materials be produced in this way but the radiation protection properties are also increased. This is important since only modest protection from space radiation is provided by the Martian atmosphere. We have studied composites fabricated using Martian regolith simulant and polymers which can be synthesized from local Martian materials for their potential use as radiation shields for manned Mars missions. To validate shielding effectiveness, composites are irradiated with a 55 MeV proton beam and neutron beams up to 800 MeV. Shielding effects on microelectronic devices are measured by placing them behind samples of the composites during irradiation. To measure structural properties of the composites, preliminary characterization and mechanical testing are made for the composites.
Author
*Binders (Materials); Extraterrestrial Radiation; Fabrication; Habitats; Performance Tests*

## 15
## LAUNCH VEHICLES AND LAUNCH OPERATIONS

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

**20040086439** Air Force Inst. of Tech., Wright-Patterson AFB, OH
**Characterization and Ground Test of an Inflatable Rigidizable Space Experiment**
Lindemuth, Steven N.; Mar. 2004; 123 pp.; In English; Original contains color illustrations
Report No.(s): AD-A424403; AFIT/GSS/ENY/04-M05; No Copyright; Avail: CASI; A06, Hardcopy

As greater capability is demanded of space-based assets, their size and complexity are growing. Inflatable, rigidizable structures offer significant improvements in the areas of weight, size, and complexity over traditional mechanically deployed systems. These structures are not well understood and little testing of them has been done in the space environment. Widespread acceptance of these technologies will not be achieved without significant reduction in the risk of using inflatable, rigidizable structures in space. The goal of this experiment is to verify and validate ground testing of small tubular truss structures for use in space. This experiment builds on previous research done in this area to reduce the risks involved in testing inflatable, rigidizable structures in space. The Rigidizable Inflatable Get-Away- Special Experiment (RIGEX) is designed to launch as a self- contained experiment on the Space Shuttle. It will inflate and rigidize three redundant experiments in the open space environment. Once these structures are deployed and rigidized, the experiment will vibrationally excite the deployed structures and record the vibrational response. This thesis produced test equipment that would meet the RIGEX Concept of Operations and conducted testing to gain an understanding of the heating, pressurization, and inflation systems of the RIGEX experiment to avoid mission failure. Appendixes contain the following: system weight tabulations, heating test results, inflation test results, success criteria, DoD SERB briefing slides, system architecture, updated NASA payload accommodations requirements, and inflation system calculations. The accommodation plan defines the technical agreement between NASA/Goddard Space Flight Center (GSFC) and the Getaway Special Canister (GAS) customer concerning the unique information needed for the preparation, flight, and disposition of the GAS payload. (12 tables, 32 figures, 32 refs.)
DTIC
*Aerospace Engineering; Ground Tests; Heating; Inflatable Structures; Inflating; Spaceborne Experiments; Trusses*

**20040086455** Air Force Academy, CO, USA
**Arms Control Implications for Military Operations in Space**
Billick, Thomas W.; May 2001; 69 pp.; In English; Original contains color illustrations
Report No.(s): AD-A424741; No Copyright; Avail: CASI; A04, Hardcopy

International treaties and agreements frequently have a limiting effect on U.S. military flexibility. The constraints imposed by arms control agreements are often misunderstood and subject to interpretation, particularly in connection with military operations in space. There is a prevailing misconception, even with the defense community, that existing agreements and international law prohibit the U. S. from fully exercising its ability to control and exploit the space medium. Current and future limitations on U.S. military operations in space are of particular concern because the capability to defend national interests, deter acquisition, and shape the behavior of state and non-state actors will increasingly be dependent upon this country's preeminent position as a global space power. The purpose of this paper is twofold: first, to identify specific U.S. obligations and opportunities for military operations in space, within the framework of international law and current arms control agreements; second, to propose rationale supporting maximum flexibility for military operations in space, to be considered by U.S. policy makers before engaging in any new space arms control negotiations. The research includes relevant background information on the nature of arms control, space law and policy, military activities in space, the geopolitical environment, and the status of space arms control discussions in the United Nations. The U.S. is far more dependent on its capabilities in space than any other country and therefore, has the most to lose from international restrictions on space activities. Generally, there are few existing arms control or other legal prohibitions on military operations in space. However, challenges to U.S. military dominance in space will continue to grow from states and organizations seeking to level the playing field.″
DTIC
*Military Operations*

**20040086460** National Defense Univ., Washington, DC
**Defense Horizons. Responsive Space and Strategic Information. April 2004, Number 40**
Worden, Simon P.; Correll, Randall R.; Apr. 2004; 9 pp.; In English; Original contains color illustrations
Report No.(s): AD-A424473; No Copyright; Avail: CASI; A02, Hardcopy

American strategists face a daunting challenge. They must assure and defend American and allied interests; induce and encourage international security cooperation; and deter, dissuade, and defeat a diverse range of potential adversaries. This challenge has been addressed by senior political leadership in recent policy statements, such as the Nuclear Posture Review of 2002, and in the formation of an expanded U.S. Strategic Command, but this vision has not yet taken root in the Department of Defense components responsible for providing operational capability. The authors propose a new strategic posture based upon a war-prevention focus. The central element of this proposal is a transformational space and information sortie capability. American space capabilities now depend on a fixed infrastructure of large, expensive satellites. The authors argue for a complementary capability to launch small, inexpensive payloads in time of crisis to augment and reconstitute existing capabilities and perform entirely new special operation missions and global conventional strikes through space. These assets also would expand information operations beyond network defense and network attack to create effects in the minds of U.S. adversaries and those who would support them. An enabler for these new capabilities will be the technology to deliver effects in and through space rapidly and affordably. A similar capability will be needed to deliver effects through cyber space. Space-based nodes would be critical components of an integrated physical, cyber, and psychological application of military force and strategic influence. These technologies exist today both in the USA and elsewhere. But a focused and funded program to develop them for military purposes is not yet in place. This new strategic posture will arguably require the formation of a new space and information military service to organize, train, and equip the space and information force structure of the future.
DTIC
*Aerospace Systems; Horizon; Internets; Military Operations; Security; Strategy; Warfare*

**20040086536** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Hot Structure Control Surface Progress for X-37 Technology Development Program**
Valentine, P. G.; Meyer, David L., Editor; Snow, Holly, Editor; July 23, 2004; 3 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The NASA Marshall Space Flight Center (MSFC) has been leading the development of technologies that will enable the development, fabrication, and flight of the automated X-37 Orbital Vehicle (OV). With the Administration s recent announcement of the Vision for Space Exploration, NASA placed the X-37 OV design on hold while developing detailed requirements for a Crew Exploration Vehicle, but has continued funding the development of high-risk, critical technologies

for potential future space exploration vehicle applications. Hot Structure Control Surfaces (HSCS) technology development is one of the high-priority areas being funded at this time. The goal of HSCS research is to mitigate risk by qualifying the lightest possible components that meet the stringent X-37 OV weight and performance requirements, including Shuttle-type reen- try environments with peak temperatures of 2800 OF. The small size of the X-37 OV (25.7-feet long and 14.9-foot wingspan) drives the need for advanced HSCS because the vehicle's two primary aerodynamic surfaces, the flaperons and ruddervators, have thicknesses ranging from approximately 5 in. down to 1 in. Traditional metallic or polymer-matrix composites covered with tile or blanket thermal protection system (TPS) materials cannot be used as there is insufficient volume to fabricate such multi-component structures. Therefore, carbon-carbon (C-C) and carbodsilicon-carbide (C-SiC) composite HSCS structures are being developed in parallel by two teams supporting the X-37 prime contractor (The Boeing Company). The Science Applications International Coy. (SAIC) and Carbon-Carbon Advanced Technologies, Inc. (C-CAT) team is developing the C-C HSCS, while the General Electric Energy Power Systems Composites (GE-PSC) and Materials Research and Design (MRD) team is developing the C-SiC HSCS. These two teams were selected to reduce the high level of risk associated with developing advanced control surface components. They have continued HSCS development work as part of the X-37 critical technology development contract. The SAIC/C-CAT team is using Advanced Carbon-Carbon (ACC) because its fabrication is very similar to the process used for Space Shuttle Reinforced Carbon-Carbon fabrication, including the Sic-based pack cementation conversion coating systems using with both materials. ACC was selected over RCC because it has much higher tension and compressions strengths, and because T-300 fiber is readily available, whereas RCC rayon fiber is no longer manufactured. The GE-PSC/MRD team is using a T-300 fiber-reinforced Sic matrix composite material densified by chemical vapor infiltration. The C-Sic material has an Sic-based environmental barrier coating. Major accomplishments have been made over the past year by both HSCS teams. C-C and C- SiC flaperon subcomponents, which are truncated full-scale versions of flight hardware, have been fabricated and are undergoing testing at the NASA Dryden Flight Research Center, NASA Langley Research Center, and U.S. Air Force Research Laboratory. By the end of 2004, ruddervator subcomponents also will be delivered and tested. As NASA moves forward in realizing the Vision for Space Exploration, it will continue to invest in advanced research and development aimed at making new generations of spacecraft safer, more reliable, and more affordable. The X-37 HSCS effort ultimately will benefit the Agency's vision and mission.
Author
*Control Surfaces; X-37 Vehicle; Technology Utilization; Fabrication; Aircraft Design; Hot Surfaces*

## 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*.

**20040085739** NASA Langley Research Center, Hampton, VA, USA
**Structural Health Monitoring Sensor Development at NASA Langley Research Center**
Prosser, W. H.; Wu, M. C.; Allison, S. G.; DeHaven, S. L.; Ghoshal, A.; [2002]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

NASA is applying considerable effort on the development of sensor technology for structural health monitoring (SHM). This research is targeted toward increasing the safety and reliability of aerospace vehicles, while reducing operating and maintenance costs. Research programs are focused on applications to both aircraft and space vehicles. Sensor technologies under development span a wide range including fiber-optic sensing, active and passive acoustic sensors, electromagnetic sensors, wireless sensing systems, MEMS, and nanosensors. Because of their numerous advantages for aerospace applications, fiber-optic sensors are one of the leading candidates and are the major focus of this presentation. In addition, recent advances in active and passive acoustic sensing will also be discussed.
Author
*Health; Aerospace Vehicles; Safety; Reliability; Microelectromechanical Systems; Signal Detectors*

**20040085998** NASA Marshall Space Flight Center, Huntsville, AL, USA, Boeing Co., Canoga Park, CA, USA
**Advanced Health Management System for the Space Shuttle Main Engine**
Davidson, Matt; Stephens, John; [2004]; 11 pp.; In English; AIAA Conference, 12 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-01140; NAS8-45000; No Copyright; Avail: CASI; A03, Hardcopy

Boeing-Canoga Park (BCP) and NASA-Marshall Space Flight Center (NASA-MSFC) are developing an Advanced

Health Management System (AHMS) for use on the Space Shuttle Main Engine (SSME) that will improve Shuttle safety by reducing the probability of catastrophic engine failures during the powered ascent phase of a Shuttle mission. This is a phased approach that consists of an upgrade to the current Space Shuttle Main Engine Controller (SSMEC) to add turbomachinery synchronous vibration protection and addition of a separate Health Management Computer (HMC) that will utilize advanced algorithms to detect and mitigate predefined engine anomalies. The purpose of the Shuttle AHMS is twofold; one is to increase the probability of successfully placing the Orbiter into the intended orbit, and the other is to increase the probability of being able to safely execute an abort of a Space Transportation System (STS) launch. Both objectives are achieved by increasing the useful work envelope of a Space Shuttle Main Engine after it has developed anomalous performance during launch and the ascent phase of the mission. This increase in work envelope will be the result of two new anomaly mitigation options, in addition to existing engine shutdown, that were previously unavailable. The added anomaly mitigation options include engine throttle-down and performance correction (adjustment of engine oxidizer to fuel ratio), as well as enhanced sensor disqualification capability. The HMC is intended to provide the computing power necessary to diagnose selected anomalous engine behaviors and for making recommendations to the engine controller for anomaly mitigation. Independent auditors have assessed the reduction in Shuttle ascent risk to be on the order of 40% with the combined system and a three times improvement in mission success.
Author
*Space Shuttle Main Engine; Systems Health Monitoring; Space Transportation System; Aerospace Safety; NASA Space Programs*

## 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*.

**20040085510** Qualtech Systems, Inc., Wethersfield, CT, USA
**Real-time Onboard and Remote Vehicle Health Management**
Deb, Somnath; March 23, 2003; 56 pp.; In English
Contract(s)/Grant(s): NAS2-02061; STTR-00.00-0000
Report No.(s): QSI-SBIR-REP-02061-8; No Copyright; Avail: CASI; A04, Hardcopy

This is the final technical report submitted by Qualtech Systems, Inc. (QSI) on the NASA-ARC Phase II STTR ″Real-time Onboard and Remote Vehicle Health Management″. The period of performance for this report is March 13,2002 to March 12,2004. We have enhanced the TEAMS-RT algorithms to better support real-time monitoring functions for the ISS. This includes development of algorithms to diagnose multiple simultaneous failures, provide minimal fault diagnosis, and prioritize the diagnosis based on criticality and Failure rates. Moreover, we have made our reasoning algorithms more robust by adding capabilities to reason in the presence of uncertainties in tests (missed detection and false alarms), and latencies in the detection processes resulting from fault-to-failure progression and test-reporting intervals. A particularly novel feature resulting from this research is the ability to detect degradations and predict hard failures based on the progression of error rate resulting from decreasing performance margins. The resultant algorithms were demonstrated to NASA-ARC and are incorporated in QSI's toolset - TEAMS-RT and TEAMS-RDS. The resulting toolset will be applied to the International Space Station and the Crew Expeditionary Vehicle in partnership with Honeywell.
Author
*Real Time Operation; Systems Health Monitoring; Onboard Equipment; International Space Station*

**20040085693** NASA Langley Research Center, Hampton, VA, USA
**ISS Radiation Shielding and Acoustic Simulation Using an Immersive Environment**
Verhage, Joshua E.; Sandridge, Chris A.; Qualls, Garry D.; Rizzi, Stephen A.; [2002]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The International Space Station Environment Simulator (ISSES) is a virtual reality application that uses high-performance computing, graphics, and audio rendering to simulate the radiation and acoustic environments of the International Space Station (ISS). This CAVE application allows the user to maneuver to different locations inside or outside of the ISS and interactively compute and display the radiation dose at a point. The directional dose data is displayed as a color-mapped sphere

that indicates the relative levels of radiation from all directions about the center of the sphere. The noise environment is rendered in real time over headphones or speakers and includes non-spatial background noise, such as air-handling equipment, and spatial sounds associated with specific equipment racks, such as compressors or fans. Changes can be made to equipment rack locations that produce changes in both the radiation shielding and system noise. The ISSES application allows for interactive investigation and collaborative trade studies between radiation shielding and noise for crew safety and comfort.
Author
*Acoustic Simulation; International Space Station; Radiation Shielding; Environment Simulators; Technology Utilization*

**20040085696** NASA Langley Research Center, Hampton, VA, USA
**Shield Optimization in Simple Geometry for the Gateway Concept**
Tripathi, R. K.; Simonsen, L. C.; Nealy, J. E.; Troutman, P. A.; Wilson, J. W.; [2002]; 15 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The great cost of added radiation shielding is a potential limiting factor in many deep space missions. For this enabling technology, we are developing tools for optimized shield design over multi-segmented missions involving multiple work and living areas in the transport and duty phase of various space missions. The total shield mass over all pieces of equipment and habitats is optimized subject to career dose and dose rate constraints. Preliminary studies of deep space missions indicate that for long duration space missions, improved shield materials will be required. The details of this new method and its impact on space missions and other technologies will be discussed. This study will provide a vital tool for evaluating Gateway designs in their usage context. Providing protection against the hazards of space radiation is one of the challenges to the Gateway infrastructure designs. We will use the mission optimization software to scope the impact of Gateway operations on human exposures and the effectiveness of alternate shielding materials on Gateway infrastructure designs. This study will provide a guide to the effectiveness of multifunctional materials in preparation to more detailed geometry studies in progress.
Author
*Design Analysis; Radiation Shielding; Protection*

**20040085708** NASA Langley Research Center, Hampton, VA, USA
**Aeroheating Thermal Analysis Methods for Aerobraking Mars Missions**
Amundsen, Ruth M.; Dec, John A.; George, Benjamin E.; [2002]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Mars missions often employ aerobraking upon arrival at Mars as a low-mass method to gradually reduce the orbit period from a high-altitude, highly elliptical insertion orbit to the final science orbit. Two recent missions that made use of aerobraking were Mars Global Surveyor (MGS) and Mars Odyssey. Both spacecraft had solar arrays as the main aerobraking surface area. Aerobraking produces a high heat load on the solar arrays, which have a large surface area exposed to the airflow and relatively low mass. To accurately model the complex behavior during aerobraking, the thermal analysis must be tightly coupled to the flight mechanics, aerodynamics, and atmospheric modeling efforts being performed during operations. To properly represent the temperatures prior to and during the drag pass, the model must include the orbital solar and planetary heat fluxes. The correlation of the thermal model to flight data allows a validation of the modeling process, as well as information on what processes dominate the thermal behavior. This paper describes the thermal modeling method that was developed for this purpose, as well as correlation for two flight missions, and a discussion of improvements to the methodology.
Author
*Aerobraking; Mars Missions; Elliptical Orbits; Thermal Analysis; Aerodynamic Heating*

**20040085770** NASA Langley Research Center, Hampton, VA, USA
**Using Bond Graphs for Articulated, Flexible Multi-bodies, Sensors, Actuators, and Controllers with Application to the International Space Station**
Montgomery, Raymond C.; Granda, Jose J.; [2003]; 8 pp.; In English; 2003 Western NultiConference on Computer Simulation, 19-23 Jan. 2003, Orlando, FL, USA; Copyright; Avail: CASI; A02, Hardcopy

Conceptually, modeling of flexible, multi-body systems involves a formulation as a set of time-dependent partial differential equations. However, for practical, engineering purposes, this modeling is usually done using the method of Finite Elements, which approximates the set of partial differential equations, thus generalizing the approach to all continuous media. This research investigates the links between the Bond Graph method and the classical methods used to develop system models and advocates the Bond Graph Methodology and current bond graph tools as alternate approaches that will lead to a quick

and precise understanding of a flexible multi-body system under automatic control. For long endurance, complex spacecraft, because of articulation and mission evolution the model of the physical system may change frequently. So a method of automatic generation and regeneration of system models that does not lead to implicit equations, as does the Lagrange equation approach, is desirable. The bond graph method has been shown to be amenable to automatic generation of equations with appropriate consideration of causality. Indeed human-interactive software now exists that automatically generates both symbolic and numeric system models and evaluates causality as the user develops the model, e.g. the CAMP-G software package. In this paper the CAMP-G package is used to generate a bond graph model of the International Space Station (ISS) at an early stage in its assembly, Zvezda. The ISS is an ideal example because it is a collection of bodies that are articulated, many of which are highly flexible. Also many reaction jets are used to control translation and attitude, and many electric motors are used to articulate appendages, which consist of photovoltaic arrays and composite assemblies. The Zvezda bond graph model is compared to an existing model, which was generated by the NASA Johnson Space Center during the Verification and Analysis Cycle of Zvezda.
Author
*Actuators; Bond Graphs; Flexible Bodies; International Space Station; Sensors*

**20040085793** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA, NASA Langley Research Center, Hampton, VA, USA
**The Mars Exploration Rovers Entry Descent and Landing and the Use of Aerodynamic Decelerators**
Steltzner, Adam; Desai, Prasun; Lee, Wayne; Bruno, Robin; [2003]; 8 pp.; In English; AIAA ADS Conference, 20-22 May 2003, Monterey, CA, USA
Report No.(s): AIAA Paper 2003-2125; No Copyright; Avail: CASI; A02, Hardcopy
The Mars Exploration Rovers (MER) project, the next USA mission to the surface of Mars, uses aerodynamic decelerators in during its entry, descent and landing (EDL) phase. These two identical missions (MER-A and MER-B), which deliver NASA s largest mobile science suite to date to the surface of Mars, employ hypersonic entry with an ablative energy dissipating aeroshell, a supersonic/subsonic disk-gap-band parachute and an airbag landing system within EDL. This paper gives an overview of the MER EDL system and speaks to some of the challenges faced by the various aerodynamic decelerators.
Author
*Aerodynamic Brakes; Air Bag Restraint Devices; Mars Exploration; Roving Vehicles*

**20040085794** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Flight Reconstruction of the Mars Pathfinder Disk-Gap-Band Parachute Drag Coefficient**
Desai, Prasun; Schofield, John T.; Lisano, Michael E.; [2003]; 7 pp.; In English; 17th AIAA Aerodynamic Decelerator Systems Technology Conference and Seminar, 19-22 May 2003, Monterey, CA, USA
Report No.(s): AIAA Paper 2003-2126; No Copyright; Avail: CASI; A02, Hardcopy
On July 4, 1997, the Mars Pathfinder (MPF) mission successfully landed on Mars. The entry, descent, and landing (EDL) scenario employed the use of a Disk-Gap-Band parachute design to decelerate the Lander. Flight reconstruction of the entry using MPF flight accelerometer data revealed that the MPF parachute decelerated faster than predicted. In the summer of 2003, the Mars Exploration Rover (MER) mission will send two Landers to the surface of Mars arriving in January 2004. The MER mission utilizes a similar EDL scenario and parachute design as that employed by MPF. As a result, characterizing the degree of underperformance of the MPF parachute system is critical for the MER EDL trajectory design. This paper provides an overview of the methodology utilized to estimate the MPF parachute drag coefficient as experienced on Mars.
Author
*Aerodynamic Coefficients; Aerodynamic Drag; Mars Pathfinder; Mars Surface*

**20040085888** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**Properties of a Formal Method to Model Emergence in Swarm-Based Systems**
Rouff, Christopher; Vanderbilt, Amy; Truszkowski, Walt; Rash, James; Hinchey, Mike; [2004]; 21 pp.; In English; Third NASA-Goddard/IEEE Workshop on Formal Approaches to Agent-Based Systems, 26-27 Apr. 2004, Greenbelt, MD, USA; No Copyright; Avail: CASI; A03, Hardcopy
Future space missions will require cooperation between multiple satellites and/or rovers. Developers are proposing intelligent autonomous swarms for these missions, but swarm-based systems are difficult or impossible to test with current techniques. This viewgraph presentation examines the use of formal methods in testing swarm-based systems. The potential

usefulness of formal methods in modeling the ANTS asteroid encounter mission is also examined.
Derived from text
*Autonomy; Space Missions; Formalism*

**20040085893** ATK-Thiokol Propulsion, Brigham City, UT, USA
**Verification of RSRM Nozzle Thermal Models With ETM-3 Aft Exit Cone In-depth Temperature Measurements**
Maw, Joel F.; Lui, Robbie C.; Totman, Peter D.; [2004]; 15 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2004-3897; Copyright; Avail: CASI; A03, Hardcopy

One of the goals of the Engineering Test Motor (ETM-3) static test was to verify analytical models through the use of instrumentation that provide real-time transient temperature response of ablating phenolic liners. Accurate measurement of in-depth temperature is critical for validating the analytical models and assessing design safety margins for nozzle insulation materials. Recent developments of in-depth thermocouple plugs have been made to more accurately measure temperature response of nozzle Liners. Thermocouple plugs were installed at two axial stations (four plugs circumferentially at each station) near the end of the ETM-3 nozzle aft exit cone to gather temperature histories during and after motor operation. The thermocouple plugs were placed at depths that bounded the reusable solid rocket motor nominal measured char depth in order to portray the carbon phenolic temperature response during the charring process. The data were used to verify the analytical models during motor operation and to better define char penetration during heat soak after motor burn out.
Author
*Static Tests; Real Time Operation; Mathematical Models; Solid Propellant Rocket Engines; Linings; Ablation; Temperature Measurement*

**20040085896** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Results of the Vapor Compression Distillation Flight Experiment (VCD-FE)**
Hutchens, Cindy; Graves, Rex; [2004]; 1 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA; Copyright; Avail: Other Sources; Abstract Only

Vapor Compression Distillation (VCD) is the chosen technology for urine processing aboard the International Space Station (ISS). Key aspects of the VCD design have been verified and significant improvements made throughout the ground;based development history. However, an important element lacking from previous subsystem development efforts was flight-testing. Consequently, the demonstration and validation of the VCD technology and the investigation of subsystem performance in micro-gravity were the primary goals of the VCD-FE. The Vapor Compression Distillation Flight Experiment (VCD-E) was a flight experiment aboard the Space Shuttle Columbia during the STS-107 mission. The VCD-FE was a full-scale developmental version of the Space Station Urine Processor Assembly (UPA) and was designed to test some of the potential micro-gravity issues with the design. This paper summarizes the experiment results.
Author
*Vapors; Distillation; Flight Tests; Space Transportation System; Microgravity*

**20040085901** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Test Results for Entry Guidance Methods for Space Vehicles**
Hanson, John M.; Jones, Robert E.; [2004]; 29 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

There are a number of approaches to advanced guidance and control that have the potential for achieving the goals of significantly increasing reusable launch vehicle (or any space vehicle that enters an atmosphere) safety and reliability, and reducing the cost. This paper examines some approaches to entry guidance. An effort called Integration and Testing of Advanced Guidance and Control Technologies has recently completed a rigorous testing phase where these algorithms faced high-fidelity vehicle models and were required to perform a variety of representative tests. The algorithm developers spent substantial effort improving the algorithm performance in the testing. This paper lists the test cases used to demonstrate that the desired results are achieved, shows an automated test scoring method that greatly reduces the evaluation effort required, and displays results of the tests. Results show a significant improvement over previous guidance approaches. The two best-scoring algorithm approaches show roughly equivalent results and are ready to be applied to future vehicle concepts.
Author
*Guidance (Motion); Aerospace Vehicles; Performance Tests; Display Devices*

**20040085932** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Status of the Node 3 Regenerative ECLSS Water Recovery and Oxygen Generation Systems**

Carrasquillo, Robyn L.; Cloud, Dale; Bedard, Jake; [2004]; 1 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

NASA's Marshall Space Flight Center is providing three racks containing regenerative water recovery and oxygen generation systems (WRS and OGS) for flight on the International Space Station's (ISS) Node 3 element. The major assemblies included in these racks are the Water Processor Assembly (WPA), Urine Processor Assembly (UPA), Oxygen Generation Assembly (OGA), and the Power Supply Module (PSM) supporting the OGA. The WPA and OGA are provided by Hamilton Sundstrand Space Systems International (HSSSI), while the UPA and PSM are being designed and manufactured in-house by MSFC. The assemblies are completing the manufacturing phase and are in various stages of ORU and system level testing, to be followed by integration into the flight racks. This paper gives a current status, along with technical challenges encountered and lessons learned.

Author

*Life Support Systems; Oxygen Production; Water Reclamation; Aerospace Systems; International Space Station*

**20040085957** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Guidelines for Developing Spacecraft Structural Requirements: A Thermal and Environmental Perspective**

Holladay, Jon; Day, Greg; Gill, Larry; [2004]; 8 pp.; In English; 34th International Conference on Environmental Systems (ICES), 19-22 Jul. 2004, Colorado Springs, CO, USA

Report No.(s): SAE Paper 2004-01-2284; Copyright; Avail: CASI; A02, Hardcopy

Spacecraft are typically designed with a primary focus on weight in order to meet launch vehicle performance parameters. However, for pressurized and/or man-rated spacecraft, it is also necessary to have an understanding of the vehicle operating environments to properly size the pressure vessel. Proper sizing of the pressure vessel requires an understanding of the space vehicle's life cycle and compares the physical design optimization (weight and launch ″cost″) to downstream operational complexity and total life cycle cost. This paper will provide an overview of some major environmental design drivers and provide examples for calculating the optimal design pressure versus a selected set of design parameters related to thermal and environmental perspectives. In addition, this paper will provide a generic set of cracking pressures for both positive and negative pressure relief valves that encompasses worst case environmental effects for a variety of launch / landing sites. Finally, several examples are included to highlight pressure relief set points and vehicle weight impacts for a selected set of orbital missions.

Author

*Design Analysis; Environment Effects; Life Cycle Costs; Service Life; Structural Analysis; Thermal Analysis*

**20040085974** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Recent Operational Experience with the Internal Thermal Control System Dual-Membrane Gas Trap**

Leimkuehler, Thomas O.; Lukens, Clark; Reeves, Daniel R.; Holt, James M.; [2004]; 4 pp.; In English; 2004 International Conference on Environmental Systems 34th Annual Meeting, 19-22 Jul. 2004, Colorado Springs, CO, USA

Report No.(s): SAE-04ICES-201; Copyright; Avail: Other Sources

A dual-membrane gas trap is currently used to remove gas bubbles from the Internal Thermal Control System (ITCS) coolant on board the International Space Station. The gas trap consists of concentric tube membrane pairs, comprised of outer hydrophilic tubes and inner hydrophobic fibers. Liquid coolant passes through the outer hydrophilic membrane, which traps the gas bubbles. The inner hydrophobic fiber allows the trapped gas bubbles to pass through and vent to the ambient atmosphere in the cabin. The gas removal performance and operational lifetime of the gas trap have been affected by contamination in the ITCS coolant. However, the gas trap has performed flawlessly with regard to its purpose of preventing gas bubbles from causing depriming, overspeed, and shutdown of the ITCS pump. This paper discusses on-orbit events over the course of the last year related to the performance and functioning of the gas trap.

Author

*Temperature Control; International Space Station; Vapor Traps; Cooling Systems*

**20040085978** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Effects of Surfactant Contamination on the Next Generation Gas Trap for the ISS Internal Thermal Control System**

Leimkuehler, Thomas O.; Lukens, Clark; Reeves, Daniel R.; Holt, James M.; [2004]; 5 pp.; In English; 2004 International Conference on Environmental Systems 34th Annual Meeting, 19-22 Jul. 2004, Colorado Springs, CO, USA

Report No.(s): SAE-04ICES-203; Copyright; Avail: Other Sources; Abstract Only

The current dual-membrane gas trap is designed to remove non-condensed gas bubbles from the Internal Thermal Control System (ITCS) coolant on board the International Space Station (ISS). To date it has successfully served its purpose of preventing gas bubbles from causing depriming, overspeed, and shutdown of the ITCS pump. However, contamination in the ITCS coolant has adversely affected the gas venting rate and lifetime of the gas trap, warranting a development effort for a next-generation gas trap. Previous testing has shown that a hydrophobic-only design is capable of performing even better than the current dual-membrane design for both steady-state gas removal and gas slug removal in clean deionized water. This paper presents results of testing to evaluate the effects of surfactant contamination on the steady-state performance of the hydrophobic-only design.
Author
*Contamination; Surfactants; Vapor Traps; International Space Station; Temperature Control*

**20040085980** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Review of the ProSEDS Electrodynamic Tether Mission Development**
Vaughn, Jason A.; Curtis, Leslie; Gilchrist, Brian E.; Bilen, Sven; Lorenzini, Enrico; [2004]; 1 pp.; In English; AIAA/ASME/SAE/ASEE 40th Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

The Propulsive Small Expendable Deployer System (ProSEDS) space experiment was ready to fly as a secondary payload on a Delta-II expendable launch vehicle in late March 2003. Concerns raised in February 2003 by the International Space Station resulted in the delay of the launch of ProSEDS. Issues associated with the delayed launch date and a change in starting altitude resulted in the cancellation of the mission. ProSEDS was intended to deploy a tether (5 km bare wire plus 10 km non-conducting Dyneema) from a Delta I1 second stage to achieve adequate drag thrust that would lower the orbit of the system over days as opposed to months due to atmospheric drag. It was also designed to utilize the tether-generated current to provide limited spacecraft power. Considerable effort and testing went in to developing the ProSEDS system by a dedicated team. Through this effort, important technological issues were identified and addressed and this presentation will discuss some of the important technical issues and hurdles that had to be addressed to successfully prepare for flight. It is intended that this information will be of use for future tether mission and experiment designers.
Author
*Tethering; Electrodynamics; Expendable Stages (Spacecraft); Space Missions; Systems Engineering*

**20040086047** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Acoustic Modeling and Analysis for the Space Shuttle Main Propulsion System Liner Crack Investigation**
Casiano, Matthew J.; Zoladz, Tom F.; [2004]; 1 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

Cracks were found on bellows flow liners in the liquid hydrogen feedlines of several space shuttle orbiters in 2002. An effort to characterize the fluid environment upstream of the space shuttle main engine low-pressure fuel pump was undertaken to help identify the cause of the cracks and also provide quantitative environments and loads of the region. Part of this effort was to determine the duct acoustics several inches upstream of the low-pressure fuel pump in the region of a bellows joint. A finite element model of the complicated geometry was made using three-dimensional fluid elements. The model was used to describe acoustics in the complex geometry and played an important role in the investigation. Acoustic mode shapes and natural frequencies of the liquid hydrogen in the duct and in the cavity behind the flow liner were determined. Forced response results were generated also by applying an edgetone-like forcing to the liner slots. Studies were conducted for state conditions and also conditions assuming two-phase entrapment in the backing cavity. Highly instrumented single-engine hot fire data confirms the presence of some of the predicted acoustic modes.
Author
*Space Shuttle Main Engine; Linings; Cracks; Acoustic Properties*

**20040086435** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Spacecraft Cabin Atmospheric Major Constituent Monitoring Using Off-the-Shelf Techniques**
Perry, Jay L.; Tatara, James D.; [2004]; 14 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA
Report No.(s): SAE-20004-01-2541; Copyright; Avail: Other Sources

Since the beginning of the crewed space exploration program, the National Aeronautics and Space Administration (NASA) recognized the need to monitor the composition of a spacecraft cabin atmosphere. Typically, major constituent

monitoring has been limited to nitrogen, oxygen, carbon dioxide, and water vapor. For the International Space Station, mass spectroscopy was selected as the baseline technology for this task. Recently, new techniques for monitoring major atmospheric constituents have matured commercially making them viable for crewed spacecraft applications. These techniques have advantages over the mass spectroscopy and electrochemically-based instruments used on board the /SS and Shuttle. Fast laser diode oxygen analysis, solid-state infrared carbon dioxide detection, and thin-film capacitive humidity detection are among the emerging techniques. Representative instruments employing these techniques have been selected and tested to demonstrate their potential for crewed spacecraft applications. A summary of testing results is provided.
Author
*Spacecraft Cabin Atmospheres; Mass Spectroscopy; Atmospheric Composition*

**20040086476** NASA Langley Research Center, Hampton, VA, USA
**Integrated Orbit, Attitude, and Structural Control System Design for Space Solar Power Satellites**
Woods-Vedeler, Jessica, Technical Monitor; Moore, Chris, Technical Monitor; Wie, Bong; Roithmayr, Carlos; [2001]; 11 pp.; In English
Contract(s)/Grant(s): NAS1-00122
Report No.(s): AIAA Paper 2001-4273; Copyright; Avail: CASI; A03, Hardcopy

The major objective of this study is to develop an integrated orbit, attitude, and structural control system architecture for very large Space Solar Power Satellites (SSPS) in geosynchronous orbit. This study focuses on the 1.2-GW Abacus SSPS concept characterized by a 3.2 x 3.2 km solar-array platform, a 500-m diameter microwave beam transmitting antenna, and a 500 700 m earth-tracking reflector. For this baseline Abacus SSPS configuration, we derive and analyze a complete set of mathematical models, including external disturbances such as solar radiation pressure, microwave radiation, gravity-gradient torque, and other orbit perturbation effects. The proposed control system architecture utilizes a minimum of 500 1-N electric thrusters to counter, simultaneously, the cyclic pitch gravity-gradient torque, the secular roll torque caused by an o.set of the center-of-mass and center-of-pressure, the cyclic roll/yaw microwave radiation torque, and the solar radiation pressure force whose average value is about 60 N.
Author
*Attitude Control; Control Systems Design; Geosynchronous Orbits; Solar Power Satellites; Satellite Configurations; Mathematical Models*

**20040086485** NASA Marshall Space Flight Center, Huntsville, AL, USA, Honeywell Engines, Systems and Services, Torrance, CA, USA
**A Selected Operational History of the Internal Thermal Control System (ITCS) for International Space Station (ISS)**
Patel, Vipul P.; Winton, Dale; Ibarra, Thomas H.; [2004]; 11 pp.; In English; 2004 International Conference on Environmental Systems (ICES), 19-22 Jul. 2004, Colorado Springs, CO, USA
Contract(s)/Grant(s): NAS15-10000; HX2200
Report No.(s): Paper-2004-01-2470; No Copyright; Avail: CASI; A03, Hardcopy

The Internal Thermal Control System (ITCS) has been developed jointly by Boeing Corporation, Huntsville, Alabama and Honeywell Engines & Systems, Torrance, California to meet the internal thermal control needs for the International Space Station (ISS). The ITCS provides heat removal for the critical life support systems and thermal conditioning for numerous experiment racks. The ITCS will be fitted on a number of modules on the ISS. The first US Element containing the ITCS, Node 1, was launched in December 1998. Since Node 1 does not contain a pump to circulate the fluid it was not filled with ITCS fluid until after the US Laboratory Module was installed. The second US Element module, US Laboratory Module, which contains the pumps and all the major ITCS control hardware, was launched in February 2001. The third US Element containing the ITCS, the US Airlock, was launched in July 2001. The dual loop system of the ITCS is comprised of a lowtemperature loop (LTL) and a moderate-temperature loop (MTL). Each loop has a pump package assembly (PPA), a system flow control assembly (SFCA), a threeway mixing valve (TWMV), several rack flow control assemblies (RFCA), cold plates, pressure sensors, temperature sensors, pump bypass assembly (PBA) and a heat exchanger. In addition, the MTL has an additional TWMV, a payload regeneration heat exchanger (P/RHE) and a manual flow control valve (MFCV). The LTL has a service performance and checkout unit (SPCU) heat exchanger. The two loops are linked via one loop crossover assembly (LCA) providing cross loop capabilities and a single PPA, two-loop functionality. One important parameter monitored by the ground stations and on-orbit is the amount of fluid leakage from the ITCS. ISS fluid leakage is of importance since ITCS fluid is costly to re-supply, may be difficult to clean up in zero-g, and if uncontained could lead to equipment failures and potential hazards. This paper examines the nominal leakage observed over period of a year of on-orbit operation and compares this with

analysis predictions. This paper also addresses the off-nominal leakage and a fluid transfer event causing significant changes in accumulator quantity.
Author
*International Space Station; Temperature Control; Control Systems Design; Heat Exchangers*

**20040086498** NASA Langley Research Center, Hampton, VA, USA
**Importance of Nuclear Physics to NASA's Space Missions**
Tripathi, R. K.; Wilson, J. W.; Cucinotta, F. A.; [2001]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

We show that nuclear physics is extremely important for accurate risk assessments for space missions. Due to paucity of experimental input radiation interaction information it is imperative to develop reliable accurate models for the interaction of radiation with matter. State-of-the-art nuclear cross sections models have been developed at the NASA Langley Research center and are discussed.
Author
*Nuclear Physics; Mathematical Models; Nuclear Models*

**20040086499** NASA Langley Research Center, Hampton, VA, USA
**A Passive Earth-Entry Capsule for Mars Sample Return**
Mitcheltree, Robert A.; Kellas, Sotiris; [1999]; 11 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A combination of aerodynamic analysis and testing, aerothermodynamic analysis, structural analysis and testing, impact analysis and testing, thermal analysis, ground characterization tests, configuration packaging, and trajectory simulation are employed to determine the feasibility of an entirely passive Earth entry capsule for the Mars Sample Return mission. The design circumvents the potential failure modes of a parachute terminal descent system by replacing that system with passive energy absorbing material to cushion the Mars samples during ground impact. The suggested design utilizes a spherically blunted 45-degree half-angle cone forebody with an ablative heat shield. The primary structure is a hemispherical, composite sandwich enclosing carbon foam energy absorbing material. Though no demonstration test of the entire system is included, results of the tests and analysis presented indicate that the design is a viable option for the Mars Sample Return Mission.
Author
*Reentry; Mars Sample Return Missions; Aerodynamic Characteristics; Aerothermodynamics; Atmospheric Entry; Design Analysis; Impact Tests*

**20040086541** NASA Langley Research Center, Hampton, VA, USA
**Reliability Methods for Shield Design Process**
Tripathi, R. K.; Wilson, J. W.; [2002]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Providing protection against the hazards of space radiation is a major challenge to the exploration and development of space. The great cost of added radiation shielding is a potential limiting factor in deep space operations. In this enabling technology, we have developed methods for optimized shield design over multi-segmented missions involving multiple work and living areas in the transport and duty phase of space missions. The total shield mass over all pieces of equipment and habitats is optimized subject to career dose and dose rate constraints. An important component of this technology is the estimation of two most commonly identified uncertainties in radiation shield design, the shielding properties of materials used and the understanding of the biological response of the astronaut to the radiation leaking through the materials into the living space. The largest uncertainty, of course, is in the biological response to especially high charge and energy (HZE) ions of the galactic cosmic rays. These uncertainties are blended with the optimization design procedure to formulate reliability-based methods for shield design processes. The details of the methods will be discussed.
Author
*Extraterrestrial Radiation; Protection; Radiation Shielding; Reliability*

## 19
## SPACECRAFT INSTRUMENTATION AND ASTRIONICS

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

**20040085963** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Solid-state Distributed Temperature Control for International Space Station**
Holladay, Jon B.; Reagan, Shawn E.; Day, Greg; [2004]; 5 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA
Report No.(s): SAE-2004-01-2430; Copyright; Avail: CASI; A01, Hardcopy

A newly developed solid-state temperature controller will offer greater flexibility in the thermal control of aerospace vehicle structures. A status of the hardware development along with its implementation on the Multi- Purpose Logistics Module will be provided. Numerous advantages of the device will also be discussed with regards to current and future flight vehicle implementations.
Author
*Temperature Control; Solid State*

**20040086048** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Performance Assessment of ISS Water Processor Assembly Reactor**
Carter, Layne; Tatara, James; Mason, Rich; OConner, Ed; Bedard, John; [2004]; 1 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA; Copyright; Avail: Other Sources; Abstract Only

Due to modifications to the ISS waste water composition, the concentration of volatile organics has significantly increased in the feed to the Water Processor Assembly (WPA). In parallel, the oxygen supply pressure increased, resulting in a higher flow rate of oxygen to the WPA. Preliminary testing at Hamilton Sund strand indicated that the higher oxygen flow rate would increase the WPA capacity for volatile organics. Following an analysis of the expected waste water composition, personnel at NASA MSFC and Hamilton Sundstrand conducted a test of a flight-like reactor to assess its capacity for the higher organic loads. The results of this test indicate the WPA can accommodate the expected organic load in the ISS waste water with margin.
Author
*Waste Water; International Space Station; Reactors; Technology Assessment*

## 20
## SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 15 Launch Vehicles and Launch Operations*, and *44 Energy Production and Conversion*.

**20040085473** Alabama Univ., Huntsville, AL, USA
**Building a Propulsion Experiment Project Management Environment**
Keiser, Ken; Tanner, Steve; Hatcher, Danny; Graves, Sara; [2004]; 9 pp.; In English; 52nd JANNAF Joint Propulsion Meeting, 10-14 May 2004, Las Vegas, NV, USA
Contract(s)/Grant(s): NCC8-200; No Copyright; Avail: CASI; A02, Hardcopy

What do you get when you cross rocket scientists with computer geeks? It is an interactive, distributed computing web of tools and services providing a more productive environment for propulsion research and development. The Rocket Engine Advancement Program 2 (REAP2) project involves researchers at several institutions collaborating on propulsion experiments and modeling. In an effort to facilitate these collaborations among researchers at different locations and with different specializations, researchers at the Information Technology and Systems Center,' University of Alabama in Huntsville, are creating a prototype web-based interactive information system in support of propulsion research. This system, to be based on experience gained in creating similar systems for NASA Earth science field experiment campaigns such as the Convection and Moisture Experiments (CAMEX), will assist in the planning and analysis of model and experiment results across REAP2 participants. The initial version of the Propulsion Experiment Project Management Environment (PExPM) consists of a

controlled-access web portal facilitating the drafting and sharing of working documents and publications. Interactive tools for building and searching an annotated bibliography of publications related to REAP2 research topics have been created to help organize and maintain the results of literature searches. Also work is underway, with some initial prototypes in place, for interactive project management tools allowing project managers to schedule experiment activities, track status and report on results. This paper describes current successes, plans, and expected challenges for this project.
Author
*Project Management; Propulsion; Rocket Engines; Information Systems; Earth Sciences*

**20040085525** Science Applications International Corp., USA, Gray Research, Inc., Huntsville, AL, USA
**In-Space Chemical Propulsion System Model**
Byers, David C.; Woodcock, Gordon; Benfield, M. P. J.; [2004]; 6 pp.; In English; Space Propulsion 2004, 2-9 Jun. 2004, Chia Laguna, Italy; No Copyright; Avail: CASI; A02, Hardcopy

Multiple, new technologies for chemical systems are becoming available and include high temperature rockets, very light propellant tanks and structures, new bipropellant and monopropellant options, lower mass propellant control components, and zero boil off subsystems. Such technologies offer promise of increasing the performance of in-space chemical propulsion for energetic space missions. A mass model for pressure-fed, Earth and space-storable, advanced chemical propulsion systems (ACPS) was developed in support of the NASA MSFC In-Space Propulsion Program. Data from flight systems and studies defined baseline system architectures and subsystems and analyses were formulated for parametric scaling relationships for all ACPS subsystems. The paper will first provide summary descriptions of the approaches used for the systems and the subsystems and then present selected analyses to illustrate use of the model for missions with characteristics of current interest.
Author
*Chemical Propulsion; Propulsion System Performance; Technology Utilization; Systems Engineering; Models*

**20040085768** Boeing Phantom Works, Huntsville, AL, USA
**Chemical and Solar Electric Propulsion Systems Analyses for Mars Sample Return Missions**
Donahue, Benjamin B.; Green, Shaun E.; Coverstone, Victoria L.; Woo, Byoungsam; June 15, 2004; 12 pp.; In English; AIAA/ASME Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Report No.(s): AIAA Paper 2004-3807; No Copyright; Avail: CASI; A03, Hardcopy

Conceptual in-space transfer stages, including those utilizing solar electric propulsion, chemical propulsion, and chemical propulsion with aerobraking or aerocapture assist at Mars, were evaluated. Roundtrip Mars sample return mission vehicles were analyzed to determine how specific system technology selections influence payload delivery capability. Results show how specific engine, thruster, propellant, capture mode, trip time and launch vehicle technology choices would contribute to increasing payload or decreasing the size of the required launch vehicles. Heliocentric low-thrust trajectory analyses for Solar Electric Transfer were generated with the SEPTOP code.
Author
*Chemical Propulsion; Solar Electric Propulsion; Propulsion System Performance; Mars Sample Return Missions*

**20040085797** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Development of Solar Sail Propulsion for Inner Solar System NASA Science Missions**
Montgomery, Edward E., IV; Johnson, Les; June 22, 2004; 8 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdal, FL, USA; No Copyright; Avail: CASI; A02, Hardcopy

This paper examines recent assessments of the technology challenges facing solar sails, identifies the systems and technologies needing development, and the approach employed by NASA's In-Space Propulsion program in NASA to achieve near-term products that move this important technology from low technology readiness level toward the goal of application to science missions in near-Earth space and beyond.
Author
*NASA Programs; Solar Sails; Solar System; Spacecraft Propulsion*

**20040085892** ATK-Thiokol Propulsion, Brigham City, UT, USA
**Real-Time Measurements of Aft Dome Insulation Erosion on Space Shuttle Reusable Solid Rocket Motor**
McWhorter, Bruce; Ewing, Mark; Albrechtsen, Kevin; Noble, Todd; Longaker, Matt; [2004]; 9 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2004-3896; No Copyright; Avail: CASI; A02, Hardcopy

Real-time erosion of aft dome internal insulation was measured with internal instrumentation on a static test of a lengthened version of the Space Shuffle Reusable Solid Rocket Motor (RSRM). This effort marks the first time that real-time aft dome insulation erosion (Le., erosion due to the combined effects of thermochemical ablation and mechanical abrasion) was measured in this kind of large motor static test [designated as Engineering Test Motor number 3 (ETM3)I. This paper presents data plots of the erosion depth versus time. The data indicates general erosion versus time behavior that is in contrast to what would be expected from earlier analyses. Engineers have long known that the thermal environment in the aft dome is severe and that the resulting aft dome insulation erosion is significant. Models of aft dome erosion involve a two-step process of computational fluid dynamics (CFD) modeling and material ablation modeling. This modeling effort is complex. The time- dependent effects are difficult to verify with only prefire and postfire insulation measurements. Nozzle vectoring, slag accumulation, and changing boundary conditions will affect the time dependence of aft dome erosion. Further study of this data and continued measurements on future motors will increase our understanding of the aft dome flow and erosion environment.
Author
*Insulation; Solid Propellant Rocket Engines; Space Shuttle Boosters; Real Time Operation; Ablation; Abrasion; Erosion*

**20040085899** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Advanced Chemical Propulsion Study**
Woodcock, Gordon; Byers, Dave; Alexander, Leslie A.; Krebsbach, Al; [2004]; 13 pp.; In English; 2004 JPC Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; Copyright; Avail: CASI; A03, Hardcopy

A study was performed of advanced chemical propulsion technology application to space science (Code S) missions. The purpose was to begin the process of selecting chemical propulsion technology advancement activities that would provide greatest benefits to Code S missions. Several missions were selected from Code S planning data, and a range of advanced chemical propulsion options was analyzed to assess capabilities and benefits re these missions. Selected beneficial applications were found for higher-performing bipropellants, gelled propellants, and cryogenic propellants. Technology advancement recommendations included cryocoolers and small turbopump engines for cryogenic propellants; space storable propellants such as LOX-hydrazine; and advanced monopropellants. It was noted that fluorine-bearing oxidizers offer performance gains over more benign oxidizers. Potential benefits were observed for gelled propellants that could be allowed to freeze, then thawed for use.
Author
*Chemical Propulsion; Space Missions; Gelled Propellants; Liquid Rocket Propellants; Cryogenic Rocket Propellants; Cryogenic Cooling; Storable Propellants*

**20040085908** Science Applications International Corp., Huntsville, AL, USA, Illinois Univ. at Urbana-Champaign, Urbana, IL, USA
**Application of Solar Electric Propulsion to a Comet Surface Sample Return Mission**
Cupples, Mike; Coverstone, Victoria; Woo, Byoungsam; [2004]; 15 pp.; In English; AIAA/ASME Joint Propulsion Conference, 12 Jul. 2004, Fort Lauderdale, FL, USA
Report No.(s): AIAA Paper 2004-3804; No Copyright; Avail: CASI; A03, Hardcopy

Current NSTAR (planned for the Discovery Mission: Dawn) and NASA's Evolutionary Xenon Thruster based propulsion systems were compared for a comet surface sample return mission to Tempe1 1. Mission and systems analyses were conducted over a range of array power for each propulsion system with an array of 12 kW EOL at 1 AU chosen for a baseline. Engine configurations investigated for NSTAR included 4 operational engines with 1 spare and 5 operational engines with 1 spare. The NEXT configuration investigated included 2 operational engines plus 1 spare, with performance estimated for high thrust and high Isp throttling modes. Figures of merit for this comparison include Solar Electric Propulsion dry mass, average engine throughput, and net non-propulsion payload returned to Earth flyby.
Author
*Solar Electric Propulsion; Comets; Sample Return Missions; Propulsion System Configurations; Propulsion System Performance; Systems Analysis*

**20040085915** Tennessee Univ. Space Inst., Tullahoma, TN, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA

**On Nonlinear Combustion Instability in Liquid Propellant Rocket Motors**

Sims, J. D., Technical Monitor; Flandro, Gary A.; Majdalani, Joseph; Sims, Joseph D.; July 11, 2004; 13 pp.; In English; AIAA/ASME/SAE/ASEE 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA

Contract(s)/Grant(s): NNM04AA30G

Report No.(s): AIAA Paper 2004-3516; Copyright; Avail: CASI; A03, Hardcopy

All liquid propellant rocket instability calculations in current use have limited value in the predictive sense and serve mainly as a correlating framework for the available data sets. The well-known n-t model first introduced by Crocco and Cheng in 1956 is still used as the primary analytical tool of this type. A multitude of attempts to establish practical analytical methods have achieved only limited success. These methods usually produce only stability boundary maps that are of little use in making critical design decisions in new motor development programs. Recent progress in understanding the mechanisms of combustion instability in solid propellant rockets″' provides a firm foundation for a new approach to prediction, diagnosis, and correction of the closely related problems in liquid motor instability. For predictive tools to be useful in the motor design process, they must have the capability to accurately determine: 1) time evolution of the pressure oscillations and limit amplitude, 2) critical triggering pulse amplitude, and 3) unsteady heat transfer rates at injector surfaces and chamber walls. The method described in this paper relates these critical motor characteristics directly to system design parameters. Inclusion of mechanisms such as wave steepening, vorticity production and transport, and unsteady detonation wave phenomena greatly enhance the representation of key features of motor chamber oscillatory behavior. The basic theoretical model is described and preliminary computations are compared to experimental data. A plan to develop the new predictive method into a comprehensive analysis tool is also described.

Author

*Liquid Propellant Rocket Engines; Combustion Stability; Nonlinearity; Design Analysis; Mathematical Models*

**20040085937** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Asymmetrical Capacitors for Propulsion and the ISR Asymmetrical Capacitator Thruster, Experimental Results and Improved Designs**

Canning, Francis; Winet, Ed; Ice, Bob; Melcher, Cory; Pesavento, Phil; Holmes, Alan; Butler, Carey; Cole, John; Campbell, Jonathan; [2004]; 46 pp.; In English; IEEE Upper Monongalia Subsection of Pittsburgh Section of IEEE, 23 Feb. 2004, Morgan Town, WV, USA

Contract(s)/Grant(s): NCC8-225; No Copyright; Avail: CASI; A03, Hardcopy

The outline of this viewgraph presentation on asymmetrical capacitor thruster development includes: 1) Test apparatus; 2) Devices tested; 3) Circuits used; 4) Data collected (Time averaged, Time resolved); 5) Patterns observed; 6) Force calculation; 7) Electrostatic modeling; 8) Understand it all.

CASI

*Capacitors; Electrostatic Propulsion*

**20040085982** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Nonlinear Longitudinal Mode Instability in Liquid Propellant Rocket Engine Preburners**

Sims, J. D., Technical Monitor; Flandro, Gary A.; Majdalani, Joseph; Sims, Joseph D.; July 11, 2004; 16 pp.; In English; AIAA/ASME/SAE/ASEE 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA

Contract(s)/Grant(s): NNM04AA30G

Report No.(s): AIAA Paper 2004-4162; Copyright; Avail: CASI; A03, Hardcopy

Nonlinear pressure oscillations have been observed in liquid propellant rocket instability preburner devices. Unlike the familiar transverse mode instabilities that characterize primary combustion chambers, these oscillations appear as longitudinal gas motions with frequencies that are typical of the chamber axial acoustic modes. In several respects, the phenomenon is similar to longitudinal mode combustion instability appearing in low-smoke solid propellant motors. An important feature is evidence of steep-fronted wave motions with very high amplitude. Clearly, gas motions of this type threaten the mechanical integrity of associated engine components and create unacceptably high vibration levels. This paper focuses on development of the analytical tools needed to predict, diagnose, and correct instabilities of this type. For this purpose, mechanisms that lead to steep-fronted, high-amplitude pressure waves are described in detail. It is shown that such gas motions are the outcome of the natural steepening process in which initially low amplitude standing acoustic waves grow into shock-like disturbances. The energy source that promotes this behavior is a combination of unsteady combustion energy release and interactions with the quasi-steady mean chamber flow. Since shock waves characterize the gas motions, detonation-like mechanisms may well

control the unsteady combustion processes. When the energy gains exceed the losses (represented mainly by nozzle and viscous damping), the waves can rapidly grow to a finite amplitude limit cycle. Analytical tools are described that allow the prediction of the limit cycle amplitude and show the dependence of this wave amplitude on the system geometry and other design parameters. This information can be used to guide corrective procedures that mitigate or eliminate the oscillations.
Author
*Liquid Propellant Rocket Engines; Nonlinearity; Preburners; Combustion Stability; Axial Modes; Longitudinal Waves*

**20040085985** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Controllability of Large SEP for Earth Orbit Raising**
Woodcock, Gordon; [2004]; 10 pp.; In English; 2004 Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: CASI; A02, Hardcopy

A six-degree-of-freedom (6DOF) simulation was constructed and exercised for a large solar electric propulsion (SEP) vehicle operating in low Earth orbit Nominal power was 500 kWe, with the large array sizes implied. Controllability issues, including gravity gradient, roll maneuvering for Sun tracking, and flexible arrays, and flight control methods, were investigated. Initial findings are that a SEP vehicle of this size is controllable and could be used for orbit raising of heavy payloads.
Author
*Controllability; Earth Orbits; Simulation; Solar Electric Propulsion*

**20040086051** NASA Marshall Space Flight Center, Huntsville, AL, USA
**A 100 kW-Class Technology Demonstrator for Space Solar Power**
Carrington, Connie; Howell, Joe; Day, Greg; [2004]; 2 pp.; In English; Fourth International Conference on Solar Power from Space, 30 Jun. - 2 Jul. 2004, Granada, Spain; No Copyright; Avail: CASI; A01, Hardcopy

A first step in the development of solar power from space is the flight demonstration of critical technologies. These fundamental technologies include efficient solar power collection and generation, power management and distribution, and thermal management. In addition, the integration and utilization of these technologies into a viable satellite bus could provide an energy-rich platform for a portfolio of payload experiments such as wireless power transmission (WPT). This paper presents the preliminary design of a concept for a 100 kW-class fiee-flying platform suitable for flight demonstration of technology experiments. Recent space solar power (SSP) studies by NASA have taken a stepping stones approach that lead to the gigawatt systems necessary to cost-effectively deliver power from space. These steps start with a 100 kW-class satellite, leading to a 500 kW and then a 1 MW-class platform. Later steps develop a 100 M W bus that could eventually lead to a 1-2 GW pilot plant for SSP. Our studies have shown that a modular approach is cost effective. Modular designs include individual laser-power-beaming satellites that fly in constellations or that are autonomously assembled into larger structures at geosynchronous orbit (GEO). Microwave power-beamed approaches are also modularized into large numbers of identical units of solar arrays, power converters, or supporting structures for arrays and microwave transmitting antennas. A cost-effective approach to launching these modular units is to use existing Earth-to-orbit (ETO) launch systems, in which the modules are dropped into low Earth orbit (LEO) and then the modules perform their own orbit transfer to GEO using expendable solar arrays to power solar electric thrusters. At GEO, the modules either rendezvous and are assembled robotically into larger platforms, or are deployed into constellations of identical laser power-beaming satellites. Since solar electric propulsion by the modules is cost-effective for both self-transport of the modules from LEO to GEO, and for on-orbit stationkeeping and repositioning capability during the satellite's lifetime, this technology is also critical in technology development for SSP. The 100 kW-class technology demonstrator will utilize advanced solar power collection and generation technologies, power management and distribution, advanced thermal management, and solar electric propulsion. State-of-the-art solar concentrators, highly efficient multi-junction solar cells, integrated thermal management on the arrays, and innovative deployable structure design and packaging make the 100 kW satellite feasible for launch on one existing launch vehicle. Early SSP studies showed that a major percentage of the on-orbit mass for power-beaming satellites was from massive power converters at the solar arrays, at the bus, at the power transmitter, or at combinations of these locations. Higher voltage mays and power management and distribution (PMAD) systems reduce or eliminate the need for many of these massive power converters, and could enable direct-drive of high-voltage solar electric thrusters. Lightweight, highly efficient thermal management systems are a critical technology that must be developed and flown for SSP feasibility. Large amounts of power on satellites imply that large amounts of waste heat will need to be managed. In addition, several of the more innovative lightweight configurations proposed for SSP satellites take advantage of solar concentrators that are intractable without advanced thermal management technologies for the solar arrays. These thermal management systems include efficient interfaces with the WPT systems or other high-power technology experiments, lightweight deployable radiators that can be

easily integrated into satellite buses, and efficient reliable thermal distribution systems that can pipe heat from the technology experiments to the radiators. In addition to demonstrating the integration and use of these mission-ctical technologies, the 100 kw-class satellite will provide a large experiment deck for a portfolio of technology experiments. Current plans for this technology demonstrator allow 2000 kg of payload capability and up to 100 kW of power. The technology experiments could include one or more wireless power transmission demonstrations, either to the Earth s surface or to a suitable space-based receiver. Technology experiments to quantify the on-orbit performance of critical technologies for SSP or space exploration are welcomed. In addition, the technology experiments provide an opportunity for international cooperation, to advance technology readiness levels of SSP technologies that require flight demonstration. This paper will present the preliminary design for a 100 kW solar-powered satellite and a variety of technology experiments that may be suitable for flight demonstration. In addition, a space-to-Earth-surface WPT experiment will be discussed.
Author
*Technology Assessment; Wireless Communication; Solar Power Satellites; Space Exploration*

**20040086053** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Development and Demonstration of a Device to Determine Thrust by Measuring the Force on a Target Plate in the Exhaust of a Plasma Thruster**
Chavers, Greg; Chang-Diaz, Franklin; [2004]; 1 pp.; In English; 40th AIAA Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

A device has been developed to measure the force on a target plate by an impacting beam of charged and neutral particles. This device, an impact thrust stand, was developed to allow thrusters at low TRL, levels to be easily tested without the expense of developing a flight prototype of the thruster to be placed on a conventional thrust stand. The impact thrust stand was developed for the Variable Specific Impulse Magnetoplasma Rocket (VASIMR) but has been tested and calibrated using several devices including Hall thrusters. The calibration and comparison of the impact thrust stand against conventional thrust stands will be discussed in this paper.
Author
*Targets; Exhaust Systems; Fabrication; Mechanical Engineering; Plasmas (Physics); Rocket Thrust*

**20040086436** NASA Marshall Space Flight Center, Huntsville, AL, USA
**MSFC Propulsion Research Center Overview**
Schafer, Charles; [2004]; 1 pp.; In English; DIA Applied Technology Conference, 26-30 Jul. 2004, Huntsville, AL, USA; No Copyright; Avail: Other Sources; Abstract Only

The MSFC Propulsion Research Center (PRC) is housed in a new research laboratory and provides research and technology development capabilities in several areas related to space propulsion. These areas include advanced chemical propulsion and high power propulsion for in-space applications. The research directions and capabilities, including a description of the facilities, of the PRC will be discussed.
Author
*Chemical Propulsion; Propulsion; Research and Development*

**20040086483** ATK-Thiokol Propulsion, Brigham City, UT, USA
**A Review of ETM-03 (A Five Segment Shuttle RSRM Configuration) Ballistic Performance**
McMillin, J. E.; Furfaro, J. A.; March 15, 2004; 11 pp.; In English; 40th AIAA Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2004-3895; Copyright; Avail: CASI; A03, Hardcopy

Marshall Space Flight Center and ATK Thiokol Propulsion worked together on the engineering design of a five-segment Engineering Test Motor (ETM-03), the world's largest segmented solid rocket motor. The data from ETM-03's static test have helped to provide a better understanding of the Reusable Solid Rocket Motor's (RSRM's) margins and the techniques and models used to simulate solid rocket motor performance. The enhanced performance of ETM-03 was achieved primarily by the addition of a RSRM center segment. Added motor performance was also achieved with a nozzle throat diameter increase and the incorporation of an Extended Aft Exit Cone (EAEC). Performance parameters such as web time, action time, head-end pressure, web time average pressure, maximum thrust, mass flow rate, centerline Mach number, pressure and thrust integrals

were all increased over RSRM. In some cases, the performance increases were substantial. Overall, the measured data were exceptionally close to the pretest predictions.
Author
*Propulsion; Propulsion System Performance; Reusable Rocket Engines; Solid Propellant Rocket Engines; Rocket Engine Design*

**20040086487** NASA Marshall Space Flight Center, Huntsville, AL, USA
**NASA's In-Space Propulsion Technology Program: Overview and Update**
Johnson, Les; Alexander, Leslie; Baggett, Randy M.; Bonometti, Joseph A.; Herrmann, Melody; James, Bonnie F.; Montgomery, Sandy E.; [2004]; 7 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: CASI; A02, Hardcopy

NASA's In-Space Propulsion Technology Program is investing in technologies that have the potential to revolutionize the robotic exploration of deep space. For robotic exploration and science missions, increased efficiencies of future propulsion systems are critical to reduce overall life-cycle costs and, in some cases, enable missions previously considered impossible. Continued reliance on conventional chemical propulsion alone will not enable the robust exploration of deep space - the maximum theoretical efficiencies have almost been reached and they are insufficient to meet needs for many ambitious science missions currently being considered. The In-Space Propulsion Technology Program s technology portfolio includes many advanced propulsion systems. From the next-generation ion propulsion system operating in the 5- to 10-kW range to aerocapture and solar sails, substantial advances in spacecraft propulsion performance are anticipated. Some of the most promising technologies for achieving these goals ase the environment of space itself for energy and propulsion and are generically called 'propellantless' because they do not require onboard fuel to achieve thrust. Propellantless propulsion technologies include scientific innovations such as solar sails, electrodynamic and momentum transfer tethers, aeroassist, and aerocapture. This paper will provide an overview of both propellantless and propellant-based advanced propulsion technologies, as well as NASA s plans for advancing them as part of the In-Space Propulsion Technology Program.
Author
*NASA Programs; Spacecraft Propulsion; Technology Assessment*

**20040086489** Science Applications International Corp., Huntsville, AL, USA
**Modeling of Spacecraft Advanced Chemical Propulsion Systems**
Benfield, Michael P. J.; Belcher, Jeremy A.; [2004]; 10 pp.; In English; JPC 2004 Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; Copyright; Avail: CASI; A02, Hardcopy

This paper outlines the development of the Advanced Chemical Propulsion System (ACPS) model for Earth and Space Storable propellants. This model was developed by the System Technology Operation of SAIC-Huntsville for the NASA MSFC In-Space Propulsion Project Office. Each subsystem of the model is described. Selected model results will also be shown to demonstrate the model's ability to evaluate technology changes in chemical propulsion systems.
Author
*Chemical Propulsion; Spacecraft Propulsion; Propulsion System Configurations; Models*

**20040086537** NASA Marshall Space Flight Center, Huntsville, AL, USA
**NEXIS Reservoir Cathode 2000 Hour Life Test**
Vaughn, Jason; Schneider, Todd; Polk, Jay; Goebel, Dan; Ohlinger, Wayne; Hill, D. Norm; [2004]; 1 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; Copyright; Avail: Other Sources; Abstract Only

The current design of the Nuclear Electric Xenon Ion System (NEXIS) employs a reservoir cathode as both the discharge and neutralizer cathode to meet the 10 yr thruster design life. The main difference between a reservoir cathode and a conventional discharge cathode is the source material (barium-containing compound) is contained within a reservoir instead of in an impregnated insert in the hollow tube. However, reservoir cathodes do not have much life test history associated with them. In order to demonstrate the feasibility of using a reservoir cathode as an integral part of the NEXIS ion thruster, a 2000 hr life test was performed. Several proof-of-concept (POC) reservoir cathodes were built early in the NEXIS program to conduct performance testing as well as life tests. One of the POC cathodes was sent to Marshall Space Flight Center (MSFC) where it was tested for 2000 hrs in a vacuum chamber. The cathode was operated at the NEXIS design point of 25 A discharge current and a xenon flow rate of 5.5 sccm during the 2000 hr test. The cathode performance parameters, including discharge current, discharge voltage, keeper current; keeper voltage, and flow rate were monitored throughout test. Also, the temperature

upstream of cathode heater, the temperature downstream of the cathode heater, and the temperature of the orifice plate were monitored throughout the life of the test. The results of the 2000 hr test will be described in this paper. Included in the results will be time history of discharge current, discharge voltage, and flow rate. Also, a time history of the cathode temperature will be provided.
Author
*Cathodes; Xenon; Life (Durability); Nuclear Electric Propulsion; Systems Engineering*

## 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*.

**20040085483** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Investigation to Characterise Bacteria by Means of Analysis by Gas Chromatography-Mass Spectrometry (GC-MS) of Methylated Fatty Acids (FAME: ″Fatty Acid Methyl Esters″**
Rosbergen, C.; vanBaar, B. L. M.; Wils, E. R. J.; January 2004; 48 pp.; In Dutch
Contract(s)/Grant(s): B01/CO/431; TNO Proj. 014.12825.01.01
Report No.(s): PML-2003-A74; TD-2003-0248; Copyright; Avail: Other Sources

An initial study was undertaken to characterise bacteria by means of analysis by gas chromatography-mass spectrometry (GC-MS) of methylated fatty acids (FAME: ″Fatty Acids Methyl Esters″). A procedure was elaborated to isolate lipids from bacteria, to saponify them to free fatty acids and to esterify the fatty acids before GC-MS analysis. In total 31 bacteria strains were investigated divided into Gram-positive and Gram-negative cocci and bacilli. Each bacteria strain produced a more or less characteristic pattern of GC peaks originated from methylated fatty acids. The distinction within each of the groups of Gram-positive cocci and bacilli and Gram-negative bacilli was mainly due to quantitative differences of the GC peaks. A principal component analysis was carried out in order to visualize the differences and similarities of the GC-profiles. The patterns obtained were stored in a self designed database. The results of the method are limited so far and much work needs to be done still to arrive at a universal applicable identification method for bacteria.
Author
*Bacillus; Gas Chromatography; Lipids; Fatty Acids*

**20040085531** Iowa State Univ. of Science and Technology, Ames, IA
**Organogermanium Chemistry: Germacyclobutanes and Digermane Additions to Acetylenes**
Chubb, A. M.; 2003; 136 pp.; In English
Report No.(s): DE2004-822062; No Copyright; Avail: Department of Energy Information Bridge

This dissertation comprises two main research projects. The first project, presented in Chapter 1, involves the synthesis and thermochemistry of germacyclobutanes (germetanes). Four new germetanes (spirodigermetane, diallylgermetane, dichlorogermetane, and germacyclobutane) have been synthesized using a modified di-Grignard synthesis. Diallylgermetane is shown to be a useful starting material for obtaining other germetanes, particularly the parent germetane, germacyclobutane. The gas-phase thermochemistries of spirodigermetane, diallylgermetane and germacyclobutane have been explored via pulsed stirred-flow reactor (SFR) studies, showing remarkable differences in decomposition, depending on the substitution at the germanium atom. The second project investigates the thermochemical, photochemical, and catalytic additions of several digermanes to acetylenes. The first examples of thermo- and photochemical additions of Ge-Ge bonds to C(triple(underline)bond)C are demonstrated. Mechanistic investigations are described and comparisons are made to analogous disilane addition reactions, previously studied in their group.
NTIS
*Acetylene; Germanium; Organic Chemistry; Cyclobutane*

**20040085548** Oak Ridge National Lab., TN
**Treatment of Mercury Contaminated Oil From Sandia National Laboratory**
Klasson, K. T.; 2003; In English
Report No.(s): DE2003-814646; No Copyright; Avail: National Technical Information Service (NTIS)

First Article Tests of a stabilization method for greater than 260 mg mercury/kg oil were performed under a treatability

study. This alternative treatment technology will address treatment of U.S. Department of Energy (DOE) organics (mainly used pump oil) contaminated with mercury and other heavy metals. Some of the oil is also co-contaminated with tritium, other radionuclides, and hazardous materials. The technology is based on contacting the oil with a sorbent powder (Self-Assembled Mercaptan on Mesoporous Support, SAMMS), proven to adsorb heavy metals, followed by stabilization of the oil/powder mixture using a stabilization agent (Nochar N990). Two variations of the treatment technology were included in the treatability study.
NTIS
*Contamination; Tritium; Mercury (Metal)*

**20040085945** National Inst. of Standards and Technology, Gaithersburg, MD, USA
**Effect of Refrigerant Oil Additive on R134a and R123 Boiling Heat Transfer Performance and Related Issues for GSA**
Kedzierski, M. A.; Jun. 2004; In English
Report No.(s): PB2004-106572; NISTIR-7132; No Copyright; Avail: National Technical Information Service (NTIS)
The paper investigates the effect that an additive had on the boiling performance of an R134a/polyolester lubricant (POE) mixture and an R123/naphthenic mineral oil mixture on a roughened, horizontal flat surface. Both pool boiling heat transfer data and lubricant excess surface density data are given for the R134a/POE (98% mass fraction/2% mass fraction) mixture for before and after use of the additive. A spectrofluorometer was used to measure the lubricant excess density that was established by the boiling of the R134a/POE lubricant mixture before and after use of the additive.
NTIS
*Heat Transfer; Refrigerants; Boiling; Oil Additives*

**20040086028** Argonne National Lab., IL, USA
**Supporting Evaluation for the Proposed Plan for Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of Weldon Spring Site, Weldon Spring, Missouri**
Aug. 2003; In English
Report No.(s): DE2003-815670; DOE/GJ/79491-934; No Copyright; Avail: National Technical Information Service (NTIS)
This report presents the technical information developed since the interim record of decision (IROD) was issued in September 2000 (U.S. Department of Energy 2000). The information was incorporated into the evaluation that was performed in selecting the preferred alternative for the Chemical Plant groundwater operable unit (GWOU) of the Weldon Spring site. The contaminants of concern (COCs) in groundwater and springs are trichloroethylene (TCE), nitrate, uranium, and nitroaromatic compounds. The preferred alternative of monitored natural attenuation (MNA) coupled with institutional controls (ICs) and contingency activities is described in the Proposed Plan (PP) for Final Remedial Action for the Groundwater Operable Unit at the Chemical Plant Area of the Weldon Spring Site, Weldon Spring, Missouri (DOE 2003b).
NTIS
*Ground Water; Contaminants*

## 24
## COMPOSITE MATERIALS

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

**20040085505** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA, USA
**Residual Stress Effects in Anisotropic Composite Laminates**
Hyer, M. W.; July 2004; 2 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG1-2298; No Copyright; Avail: CASI; A01, Hardcopy
This final report consists of reprints of one journal paper and three conference papers: The reprints are as follows: Warpage of Large Curved Composite Panels due to Manufacturing Anomalies. Manufacturing Distortions of Curved Composite. Deformation Response of Unsymmetrically Laminated Plates subjected to Inplane Loading. Deformations of Flat Unsymmetric Laminates subjected to Inplane Loads.
Derived from text
*Composite Structures; Curved Panels; Deformation; Residual Stress; Anisotropy*

**20040085553** Oak Ridge National Lab., TN
**Interfacial Properties of Electron Beam Cured Composites**
2003; In English
Report No.(s): DE2003-816161; No Copyright; Avail: National Technical Information Service (NTIS)

The objectives of the CRADA are to: Confirm that fiber-resin adhesion is responsible for the observed poor shear properties; Determine the mechanism(s) responsible for poor adhesion between carbon fibers and epoxy resins after e-beam curing; Develop and evaluate resin systems and fiber treatments to improve the properties of e-beam cured, carbon-fiber-reinforced composites; and Develop refined methods for processing e-beam cured, carbon-fiber-reinforced composites.
NTIS
*Fiber Composites; Electron Beams*

**20040085700** NASA Langley Research Center, Hampton, VA, USA
**Constitutive Modeling of Nanotube/Polymer Composites with Various Nanotube Orientations**
Odegard, Gregory M.; Gates, Thomas S.; [2002]; 4 pp.; In English; 2002 SEM Annual Conference and Exposition on Experimental and Applied Mechanics, 10-12 Jun. 2002, Milwaukee, MN, USA; No Copyright; Avail: CASI; A01, Hardcopy

In this study, a technique has been proposed for developing constitutive models for polymer composite systems reinforced with single-walled carbon nanotubes (SWNT) with various orientations with respect to the bulk material coordinates. A nanotube, the local polymer adjacent to the nanotube, and the nanotube/polymer interface have been modeled as an equivalent-continuum fiber by using an equivalent-continuum modeling method. The equivalent-continuum fiber accounts for the local molecular structure and bonding information and serves as a means for incorporating micromechanical analyses for the prediction of bulk mechanical properties of SWNT/polymer composite. As an example, the proposed approach is used for the constitutive modeling of a SWNT/LaRC-SI (with a PmPV interface) composite system, with aligned nanotubes, three-dimensionally randomly oriented nanotubes, and nanotubes oriented with varying degrees of axisymmetry. It is shown that the Young s modulus is highly dependent on the SWNT orientation distribution.
Author
*Carbon Nanotubes; Mathematical Models; Continuum Modeling; Mechanical Properties; Molecular Structure*

**20040085706** Army Research Lab., Hampton, VA, USA
**Fatigue Life Analysis of Tapered Hybrid Composite Flexbeams**
Murri, Gretchen B.; Schaff, Jeffery R.; Dobyns, Alan L.; [2002]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Nonlinear-tapered flexbeam laminates from a full-size composite helicopter rotor hub flexbeam were tested under combined constant axial tension and cyclic bending loads. The two different graphite/glass hybrid configurations tested under cyclic loading failed by delamination in the tapered region. A 2-D finite element model was developed which closely approximated the flexbeam geometry, boundary conditions, and loading. The analysis results from two geometrically nonlinear finite element codes, ANSYS and ABAQUS, are presented and compared. Strain energy release rates (G) obtained from the above codes using the virtual crack closure technique (VCCT) at a resin crack location in the flexbeams are presented for both hybrid material types. These results compare well with each other and suggest that the initial delamination growth from the resin crack toward the thick region of the flexbeam is strongly mode II. The peak calculated G values were used with material characterization data to calculate fatigue life curves and compared with test data. A curve relating maximum surface strain to number of loading cycles at delamination onset compared reasonably well with the test results.
Author
*Hybrid Composites; Fatigue Life; Boundary Conditions; Rotary Wings; Laminates*

**20040085718** NASA Langley Research Center, Hampton, VA, USA
**Synthesis of Nano-Crystalline Gamma-TiAl Materials**
Hales, Stephen J.; Vasquez, Peter; [2003]; 8 pp.; In English; Gamma Titanium Aluminides 2003, 2003; No Copyright; Avail: CASI; A02, Hardcopy

One of the principal problems with nano-crystalline materials is producing them in quantities and sizes large enough for valid mechanical property evaluation. The purpose of this study was to explore an innovative method for producing nano-crystalline gamma-TiAl bulk materials using high energy ball milling and brief secondary processes. Nano-crystalline powder feedstock was produced using a Fritsch P4(TM) vario-planetary ball mill recently installed at NASA-LaRC. The high energy ball milling process employed tungsten carbide tooling (vials and balls) and no process control agents to minimize contamination. In a collaborative effort, two approaches were investigated, namely mechanical alloying of elemental powders

and attrition milling of pre-alloyed powders. The objective was to subsequently use RF plasma spray deposition and short cycle vacuum hot pressing in order to effect consolidation while retaining nano-crystalline structure in bulk material. Results and discussion of the work performed to date are presented.
Author
*Crystallinity; Deposition; Mechanical Properties*

**20040085784** NASA Langley Research Center, Hampton, VA, USA
**Analysis of the Effects of Residual Strains and Defects on Skin/Stiffener Debonding using Decohesion Elements**
Davila, Carlos G.; Camanho, Pedro P.; [2003]; 9 pp.; In English
Report No.(s): AIAA Paper 2003-1465; Copyright; Avail: CASI; A02, Hardcopy

Delamination is one of the predominant forms of failure in laminated composites especially when there is no reinforcement in the thickness direction. To develop composite structures that are more damage tolerant, it is necessary to understand how delamination develops and how it can affect the residual performance. A number of factors such as residual thermal strains, matrix curing shrinkage, and manufacturing defects affect how damage will grow in a composite structure. It is important to develop analysis methods that are computationally efficient that can account for all such factors. The objective of the current work is to apply a newly developed decohesion element to investigate the debond strength of skin/stiffener composite specimens. The process of initiation of delaminations and the propagation of delamination fronts is investigated. The numerical predictions are compared with published experimental results.
Author
*Strain Measurement; Numerical Analysis; Durability; Composite Structures*

**20040085787** NASA Langley Research Center, Hampton, VA, USA
**Thermal/Mechanical Durability of Polymer-Matrix Composites in Cryogenic Environments**
Gates, Thomas S.; Whitley, Karen S.; Grenoble, Ray W.; Bandorawalla, Tozer; [2003]; 12 pp.; In English; 44th Annual AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 7-10 Apr. 2003, Norfolk, VA, USA
Report No.(s): AIAA Paper 2003-7408; No Copyright; Avail: CASI; A03, Hardcopy

In order to increase the reliability of the next generation of space transportation systems, the mechanical behavior of polymeric-matrix composite (PMC) materials at cryogenic temperatures must be investigated. This paper presents experimental data on the residual mechanical properties of a carbon fiber polymeric composite, IM7/PETI-5 as a function of temperature and aging. Tension modulus and strength were measured at room temperature, -196 C, and -269 C on five different specimens ply lay-ups. Specimens were preconditioned with one set of coupons being isothermally aged for 576 hours at -184 C, in an unloaded state. Another set of corresponding coupons were mounted in constant strain fixtures such that a constant uniaxial strain was applied to the specimens for 576 hours at -184 C. A third set was mechanically cycled in tension at -184 C. The measured properties indicated that temperature, aging, and loading mode can all have significant influence on performance. Moreover, this influence is a strong function of laminate stacking sequence. Thermal-stress calculations based on lamination theory predicted that the transverse tensile ply stresses could be quite high for cryogenic test temperatures. Microscopic examination of the surface morphology showed evidence of degradation along the exposed edges of the material because of aging at cryogenic temperatures.
Author
*Polymer Matrix Composites; Mechanical Properties; Thermal Fatigue; Stress Analysis; Cryogenic Temperature*

**20040085792** NASA Langley Research Center, Hampton, VA, USA
**Failure Criteria for FRP Laminates in Plane Stress**
Davila, Carlos G.; Jaunky, Navin; Goswami, Sanjib; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-1991; Copyright; Avail: CASI; A03, Hardcopy

A new set of failure criteria for fiber reinforced polymer laminates that are being developed at NASA Langley Research Center is described. Derived from Hashin's criteria for unidirectional laminates and Puck's action plane concept, the physically based LaRC02 criteria 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. The 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 predictions are compared to the

predictions of other available failure criteria and with experimental results. Predictions with LaRC02 correlate well with the experimental results.
Author
*Failure Modes; Fiber Composites; Fracturing*

**20040085965** NASA Langley Research Center, Hampton, VA, USA
**Thermal Effects on the Compressive Behavior of IM7/PET15 Laminates**
Walker, Sandra Polesky; [2003]; 11 pp.; In English; Fourteenth International Conference on Composite Materials, 14-18 Jul. 2003, San Diego, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy

The effect of changing operating temperature on the compressive response of IM7/PETI5 composite laminates is investigated within this paper. The three temperatures evaluated for this study were 129 C, 21 C, and 177 C, a spectrum from cryogenic to an elevated operating temperature. Laminate compressive strength property testing was conducted using the Wyoming Combined Load Compression fixture to generate strength data at the three operating temperatures of interest for several lay-ups. A three-dimensional finite element analysis model of a [90/0]8s composite laminate subject to compressive loading is developed. The model is used to study the key attributes of the laminate that significantly influence the state of stress in the laminate. Both the resin rich layer located between lamina and the thermal residual stresses present in the laminate due to curing are included in the analysis model. For the laminate modeled, the effect of modeling temperature dependent material properties was determined to be insignificant for the operating temperatures studied. Simply using the material properties measured at the operating temperature of interest was sufficient for predicting stresses accurately in a linear analysis for the current problem. The three-dimensional analysis results revealed that the application of an applied compressive axial load in the 0-degree direction decreased the interlaminar stresses present in the laminate initially due to curing. Therefore, failure was concluded not be attributable to the interlaminar stresses in the composite laminate being studied when a compressive load is applied. The magnitude of the measured laminate compressive strength change with a change in temperature is concluded to be dominated by the change in the lamina compressive axial strength with a change in temperature.
Author
*Laminates; Temperature Effects; Compressive Strength; Compression Loads; Interlaminar Stress; Thermal Stresses*

**20040085968** NASA Langley Research Center, Hampton, VA, USA
**FaceSheet Push-off Tests to Determine Composite Sandwich Toughness at Cryogenic Temperatures**
Gates, Thomas S.; Herring, Helen M.; [2001]; 11 pp.; In English; 42nd AIAA/ASME/AHS/ASC Structures, Structural Dynamics and Materials Conference and Exhibit, 16-19 Apr. 2001, Seattle, WA, USA; Original contains color and black and white illustrations
Report No.(s): AIAA Paper 2001-1219; Copyright; Avail: CASI; A03, Hardcopy

A new novel test method, associated analysis, and experimental procedures are developed to investigate the toughness of the facesheet-to-core interface of a sandwich material at cryogenic temperatures. The test method is designed to simulate the failure mode associated with facesheet debonding from high levels of gas pressure in the sandwich core. The effects of specimen orientation are considered, and the results of toughness measurements are presented. Comparisons are made between room and liquid nitrogen (-196 C) test temperatures. It was determined that the test method is insensitive to specimen facesheet orientation and strain energy release rate increases with a decrease in the test temperature.
Author
*Cryogenic Temperature; Sandwich Structures; Mechanical Properties; Composite Structures; Fracture Strength*

**20040085973** National Academy of Sciences - National Research Council, Hampton, VA, USA
**Fatigue Life Methodology for Bonded Composite Skin/Stringer Configurations**
Krueger, Ronald; Paris, Isabelle L.; OBrien, T. Kevin; Proceedings of the American Society for Composites, Fifteenth Technical Conference; 2000, pp. 729-736; In English; Fifteenth Technical Conference, 2000; No Copyright; Avail: CASI; A02, Hardcopy

A methodology is presented for determining the fatigue life of bonded composite skin/stringer structures based on delamination fatigue characterization data and geometric nonlinear finite element analyses. Results were compared to fatigue tests on stringer flange/skin specimens to verify the approach.
Author
*Fatigue Life; Composite Structures; Finite Element Method*

**20040085990** Army Research Lab., Hampton, VA, USA
**Characterization, Analysis and Prediction Delamination in Composites using Fracture Mechanics**
OBrien, T. Kevin; [2004]; 6 pp.; In English
Report No.(s): ICF100942OR; No Copyright; Avail: CASI; A02, Hardcopy

The state-of-the-art for characterizing, analyzing, and predicting delamination growth in composite materials and structures using a fracture mechanics approach will be reviewed. Techniques for measuring delamination fracture toughness and fatigue delamination onset data will be highlighted. The use of these data in finite element analyses utilizing fracture mechanics will be examined. The virtual crack closure technique for calculating strain energy release rates will be highlighted. The importance of capturing the physics of damage formation, accumulation, and growth will be emphasized. Application of this approach to delamination onset and life predictions for stiffener pull-off behavior in skin-stiffened regions and fatigue failure of composite rotor hub flexbeams will be highlighted.
Author
*Characterization; Composite Materials; Delaminating; Fracture Mechanics*

**20040085992** NASA Langley Research Center, Hampton, VA, USA
**Comparison of 2D Finite Element Modeling Assumptions with Results From 3D Analysis for Composite Skin-Stiffener Debonding**
Krueger, Ronald; Paris, Isbelle L.; OBrien, T. Kevin; Minguet, Pierre J.; [2004]; 19 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The influence of two-dimensional finite element modeling assumptions on the debonding prediction for skin-stiffener specimens was investigated. Geometrically nonlinear finite element analyses using two-dimensional plane-stress and plane-strain elements as well as three different generalized plane strain type approaches were performed. The computed skin and flange strains, transverse tensile stresses and energy release rates were compared to results obtained from three-dimensional simulations. The study showed that for strains and energy release rate computations the generalized plane strain assumptions yielded results closest to the full three-dimensional analysis. For computed transverse tensile stresses the plane stress assumption gave the best agreement. Based on this study it is recommended that results from plane stress and plane strain models be used as upper and lower bounds. The results from generalized plane strain models fall between the results obtained from plane stress and plane strain models. Two-dimensional models may also be used to qualitatively evaluate the stress distribution in a ply and the variation of energy release rates and mixed mode ratios with delamination length. For more accurate predictions, however, a three-dimensional analysis is required.
Author
*Debonding (Materials); Finite Element Method; Mathematical Models; Three Dimensional Models; Composite Materials; Skin (Structural Member)*

**20040086002** NASA Langley Research Center, Hampton, VA, USA
**Progressive Damage Analyses of Skin/Stringer Debonding**
Daville, Carlos G.; Camanho, Pedro P.; deMoura, Marcelo F.; [2004]; 14 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The debonding of skin/stringer constructions is analyzed using a step-by-step simulation of material degradation based on strain softening decohesion elements and a ply degradation procedure. Decohesion elements with mixed-mode capability are placed at the interface between the skin and the flange to simulate the initiation and propagation of the delamination. In addition, the initiation and accumulation of fiber failure and matrix damage is modeled using Hashin-type failure criteria and their corresponding material degradation schedules. The debonding predictions using simplified three-dimensional models correlate well with test results.
Author
*Damage Assessment; Debonding (Materials); Degradation; Delaminating*

**20040086011** NASA Langley Research Center, Hampton, VA, USA
**A Curved, Elastostatic Boundary Element for Plane Anisotropic Structures**
Smeltzer, Stanley S.; Klang, Eric C.; [2001]; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The plane-stress equations of linear elasticity are used in conjunction with those of the boundary element method to develop a novel curved, quadratic boundary element applicable to structures composed of anisotropic materials in a state of plane stress or plane strain. The curved boundary element is developed to solve two-dimensional, elastostatic problems of

arbitrary shape, connectivity, and material type. As a result of the anisotropy, complex variables are employed in the fundamental solution derivations for a concentrated unit-magnitude force in an infinite elastic anisotropic medium. Once known, the fundamental solutions are evaluated numerically by using the known displacement and traction boundary values in an integral formulation with Gaussian quadrature. All the integral equations of the boundary element method are evaluated using one of two methods: either regular Gaussian quadrature or a combination of regular and logarithmic Gaussian quadrature. The regular Gaussian quadrature is used to evaluate most of the integrals along the boundary, and the combined scheme is employed for integrals that are singular. Individual element contributions are assembled into the global matrices of the standard boundary element method, manipulated to form a system of linear equations, and the resulting system is solved. The interior displacements and stresses are found through a separate set of auxiliary equations that are derived using an Airy-type stress function in terms of complex variables. The capabilities and accuracy of this method are demonstrated for a laminated-composite plate with a central, elliptical cutout that is subjected to uniform tension along one of the straight edges of the plate. Comparison of the boundary element results for this problem with corresponding results from an analytical model show a difference of less than 1%.
Author
*Anisotropic Media; Boundary Element Method; Mathematical Models; Elastostatics; Plane Stress; Mechanical Properties*

**20040086019** NASA Langley Research Center, Hampton, VA, USA
**Hybrid Composites for LH2 Fuel Tank Structure**
Grimsley, Brian W.; Cano, Roberto J.; Johnston, Norman J.; Loos, Alfred C.; McMahon, William M.; [2001]; 12 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The application of lightweight carbon fiber reinforced plastics (CFRP) as structure for cryogenic fuel tanks is critical to the success of the next generation of Reusable Launch Vehicles (RLV). The recent failure of the X-33 composite fuel tank occurred in part due to microcracking of the polymer matrix, which allowed cryogen to permeate through the inner skin to the honeycomb core. As part of an approach to solve these problems, NASA Langley Research Center (LaRC) and Marshall Space Flight Center (MSFC) are working to develop and investigate polymer films that will act as a barrier to the permeation of LH2 through the composite laminate. In this study two commercially available films and eleven novel LaRC films were tested in an existing cryogenics laboratory at MSFC to determine the permeance of argon at room temperature. Several of these films were introduced as a layer in the composite to form an interleaved, or hybrid, composite to determine the effects on permeability. In addition, the effects of the interleaved layer thickness, number, and location on the mechanical properties of the composite laminate were investigated. In this initial screening process, several of the films were found to exhibit lower permeability to argon than the composite panels tested.
Author
*Carbon Fiber Reinforced Plastics; Composite Structures; Failure; Microcracks; Mechanical Properties*

**20040086087** NASA Langley Research Center, Hampton, VA, USA
**Studies on Automated Manufacturing of High Performance Composites**
Cano, R. J.; Belvin, H. L.; Hulcher, A. B.; Grenoble, R. W.; [2001]; 10 pp.; In English; Structure Specialist Meeting, 30 Oct. - 1 Nov. 2001, Williamsburg, VA, USA; Copyright; Avail: CASI; A02, Hardcopy

The NASA Langley Research Center fiber placement facility has proven to be a valuable asset for obtaining data, experience, and insights into the automated fabrication of high performance composites. The facility consists of two automated devices: an Asea Brown Boveri (ABB) robotic arm with a modified heated head capable of hot gas and focused infrared heating and a 7' x 17' gantry containing a feeder head, rotating platform, focused infrared lamp and e-beam gun. While uncured thermoset tow and tape, e.g., epoxy and cyanate prepreg, can be placed with a robot, the placement facility s most powerful attribute is the ability to place thermoplastic and e-beam curable material to net shape. In recent years, ribbonizing techniques have been developed to make high quality thermoplastic and thermoset dry material forms to the standards required for robotic placement. A variety of composites have been fabricated from these ribbons by heated head tow and tape placement including both flat plates and cylinders. Composite mechanical property values of the former were between 85 and 100 percent of those obtained by hand lay-up/autoclave processing.
Author
*Fabrication; Thermoplasticity; Mechanical Properties; Manufacturing; Epoxy Resins; Automatic Control; Composite Materials*

**20040086496** NASA Langley Research Center, Hampton, VA, USA
**Temporal Treatment of a Thermal Response for Defect Depth Estimation**
Plotnikov, Y. A.; Winfree, W. P.; [2004]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Transient thermography, which employs pulse surface heating of an inspected component followed by acquisition of the thermal decay stage, is gaining wider acceptance as a result of its remoteness and rapidness. Flaws in the component s material may induce a thermal contrast in surface thermograms. An important issue in transient thermography is estimating the depth of a subsurface flaw from the thermal response. This improves the quantitative ability of the thermal evaluation: from one scan it is possible to locate regions of anomalies in thickness (caused by corrosion) and estimate the implications of the flaw on the integrity of the structure. Our research focuses on thick composite aircraft components. A long square heating pulse and several minutes observation period are required to receive an adequate thermal response from such a component. Application of various time-related informative parameters of the thermal response for depth estimation is discussed. A three-dimensional finite difference model of heat propagation in solids in Cartesian coordinates is used to simulate the thermographic process. Typical physical properties of polymer graphite composites are assumed for the model.
Derived from text
*Defects; Depth; Temperature Effects; Thermography; Three Dimensional Models; Algorithms*

## 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*.

**20040085537** Savannah River Ecology Lab., Aiken, SC, USA
**Production of Plutonium Metal from Aqueous Solutions**
Orth, D. A.; Field, E. L.; Radke, J. H.; Jul. 1960; 52 pp.; In English
Report No.(s): DE2004-808279; DPSPU 60-11-22; No Copyright; Avail: Department of Energy Information Bridge

The primary separation of plutonium from irradiated uranium by the Purex solvent extraction process at the Savannah River Plant produces a dilute plutonium solution containing residual fission products and uranium. A cation exchange process is used for concentration and further decontamination of the plutonium, as the first step in the final preparation of metal. This paper discusses the production of plutonium metal from the aqueous solutions.
NTIS
*Production; Plutonium; Aqueous Solutions*

**20040085934** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Intricate Crystal Structure of Dihydrolipoamide Dehydrogenase (E3) with its Binding Protein: Multiple Copies, Dynamic and Static Disorders**
Makal, A.; Hong, Y. S.; Potter, R.; Vettaikkorumakankauv, A. K.; Korotchkina, L. G.; Patel, M. S.; Ciszak, E.; [2004]; 1 pp.; In English; American Crystallographic Association, 17-22 Jul. 2004, Chicago, IL, USA; No Copyright; Avail: Other Sources; Abstract Only

Human E3 and binding protein E3BP are two components of the pyruvate dehydrogenase complex. Crystallization of E3 with 221-amino acid fragment of E3BP (E3BPdd) led to crystals that diffracted to a resolution of 2.6 Angstroms. Structure determination involved molecular replacement using a dimer of E3 homolog as a search model and de novo building of the E3BPdd peptide. Solution was achieved by inclusion of one E3 dimer at a time, followed by refinement until five E3 dimers were located. This complete content of E3 provided electron density maps suitable for tracing nine peptide chains of E3BPdd, eight of them being identified with partial occupancies. Final content of the asymmetric unit consists of five E3 dimers, each binding one E3BPdd molecule. In four of these molecular complexes, E3BPdd is in static disorder resulting in E3BPdd binding to either one or the other monomer of the E3 dimer. However, E3BPdd of the fifth E3 dimer forms specific contacts that lock it at one monomer. In addition to this static disorder, E3BPdd reveals high mobility in the limited space of the crystal lattice. Support from NIH and NASA.
Author
*Crystal Structure; Dehydrogenases; Proteins; Amides; Peptides*

**20040085953** Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA
**Thermodynamic Modeling of the SRS Evaporators, Part 4, Incorporation of High Caustic Aluminosilicate Solubility Data**
Jantzen, C. M.; Pareizs, J. M.; Edwards, T. B.; Mar. 2003; In English
Report No.(s): DE2004-809738; WSRC-RP-2002-00330-REV-0-Pt-4; No Copyright; Avail: National Technical Information Service (NTIS)

Accumulations of two solid phases (a nitrated aluminosilicate) and sodium diuranate, in the form of scale, caused the SRS 2H Evaporator pot to become completely inoperable in October 1999. The accumulation of the sodium diuranate phase, which selectively precipitated with the aluminosilicate phase, caused criticality concerns in the 2H Evaporator. In order to understand the role of steady state saturation on the scale formation, solutions processed from the SRS 2H, 2F, and 3H Evaporators were evaluated with a commercially available thermodynamic equilibrium code known as Geochemist's Workbench.
NTIS
*Thermodynamics; Evaporators; Thermodynamic Equilibrium*

**20040085962** Ohio Aerospace Inst., Cleveland, OH, USA
**Enhanced Boiling on Micro-Configured Composite Surfaces Under Microgravity Conditions**
[2004]; 5 pp.; In English
Contract(s)/Grant(s): NCC3-620; No Copyright; Avail: CASI; A01, Hardcopy
Both experimental and mechanism analysis studies about the enhanced pool boiling on the micro-configured composite surfaces have been conducted. The major study activities and results are summarized.
Author (revised)
*Nucleate Boiling; Microgravity; Bubbles*

**20040086025** Arizona State Univ., Tempe, AZ, USA
**Enhancing the Atomic-Level Understanding of CO2 Mineral Sequestration Mechanisms via Advanced Computational Modeling**
Chizmeshya, A. V. G.; McKelvy, M. J.; Sankey, O. F.; Dec. 2002; In English
Report No.(s): DE2003-815770; No Copyright; Avail: National Technical Information Service (NTIS)
Fossil fuels currently provide 85% of the world's energy needs, with the majority coming from coal, due to its low cost, wide availability, and high energy content. The extensive use of coal fired power assumes that the resulting CO(sub 2) emissions can be vented to the atmosphere. However, exponentially increasing atmospheric CO(sub 2) levels have brought this assumption under critical review. Over the last decade, this discussion has evolved from whether exponentially increasing anthropogenic CO(sub 2) emissions will adversely affect the global environment, to the timing and magnitude of their impact. A variety of sequestration technologies are being explored to mitigate CO(sub 2)emissions. These technologies must be both environmentally benign and economically viable. Mineral carbonation is an attractive candidate technology as it disposes of CO(sub 2) as geologically stable, environmentally benign mineral carbonates, clearly satisfying the first criteria. The primary challenge for mineral carbonation is cost-competitive process development. CO(sub 2) mineral sequestration--the conversion of stationary-source CO(sub 2) emissions into mineral carbonates, e.g., magnesium and calcium carbonate, MgCO(sub 3) and CaCO(sub 3)--has recently emerged as one of the most promising sequestration options, providing permanent CO(sub 2) disposal, rather than storage. In this approach a magnesium-bearing feedstock mineral (typically serpentine or olivine; available in vast quantities globally) is specially processed and allowed to react with CO(sub 2) under controlled conditions. This produces a mineral carbonate which (1) is environmentally benign, (2) already exists in nature in quantities far exceeding those that could result from carbonating the world's known fossil fuel reserves, and (3) is stable on a geological time scale.
NTIS
*Calcium Carbonates; Fossil Fuels; Coal*

## 26
## METALS AND METALLIC MATERIALS

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

**20040085539** Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA
**Air-Melt Recovery of Lithium-Aluminum Scrap**
Selby, C. L.; Jul. 1959; 16 pp.; In English
Report No.(s): DE2004-810369; DPSP 59-25-15; No Copyright; Avail: Department of Energy Information Bridge
This report describes results obtained in evaluation of three different production processes for recovery of scrap by induction melting in air.
NTIS
*Materials Recovery; Melting; Scrap*

**20040085554** Ohio State Univ., Columbus, OH, USA
**Effects of Externally Solidified Product on Wave Celerity and Quality of Die Cast Products**
Sep. 05, 2003; In English
Report No.(s): DE2003-816408; No Copyright; Avail: National Technical Information Service (NTIS)

The cold chamber die casting process is used to produce essentially all the die cast aluminum products and about 50% of the die cast magnesium products made today. Modeling of the cold chamber die casting process and metallographic observations of cold chamber die cast products indicate that typically 5 to 20% of the shot weight is solidified in the shot sleeve before or during cavity filling. The portion of the resulting die casting which is solidified in the shot sleeve is referred to as externally solidified product, or, when identified as a casting defect, as cold flakes. This project was directed to extending the understanding of the effects of externally solidified product on the cold chamber die casting process and products to enable the production of defect-free die castings and reduce the energy associated with these products. The projected energy savings from controlling the fraction of externally solidified product in die cast components is 40 x 10 Btu through the year 2025.
NTIS
*Casting; Dies*

**20040085719** NASA Langley Research Center, Hampton, VA, USA
**An Innovative Method for Manufacturing Gamma-TiAl Foil**
Hales, Stephen J.; Saqib, Mohammad; Alexa, Joel A.; [2003]; 10 pp.; In English; Gamma Titanium Aluminides 2003, 2003; Copyright; Avail: CASI; A02, Hardcopy

The manufacture and entrance into service of thin gage gamma-TiAl product has been hampered by the inherent low room temperature ductility of the material. In the present study a new approach was explored for the efficient manufacture of gamma-TiAl foil with improved ductility. The objective was to produce a very clean material (low interstitial content) with a highly refined, homogeneous microstructure placed in a fully lamellar condition. The processing route involved the use of RF plasma spray deposition of pre-alloyed powders, followed by consolidation via vacuum hot pressing and heat treatment. The approach took advantage of a deposition process which included no electrodes, no binders and high cooling rates. Results and discussion of the work performed to date are presented.
Author
*Titanium Aluminides; Microstructure; Manufacturing; Alloying*

**20040085740** NASA Langley Research Center, Hampton, VA, USA
**Fabrication and Electromagnetic Characterization of Novel Self-Metallized Thin Films**
Mackenzie, Anne I.; Cravey, Robin L.; Dudley, Kenneth L.; Fralick, Dion T.; Miner, Gilda A.; Stoakley, Diane M.; [2002]; 15 pp.; In English
Report No.(s): IEEEAC Paper-1278; No Copyright; Avail: CASI; A03, Hardcopy

Unique, self-metallized films were investigated for deployable reflector antenna applications at L-band. Polyamic acid resins or soluble polyimides were doped with metal complexes, cast into films, and thermally cured. Each resulting film had a metallic layer on one side, adhering unfailingly to the polymer. Metallization was successful for silver or palladium in 3,3',4,4'-benzophenonetetracarboxylic acid dianhydride (BTDA) and 4,4'- oxydianiline and for gold in BTDA and 2,2-bis[4-(4- aminophenoxy)phenyl]hexafluoropropane (4-BDAF) or the space durable polyimide, 2,2-bis(3,4-dicarboxyphenyl)- hexafluoropropane dianhydride and 4-BDAF (LaRCCP1). Reflectivity, transmissivity, and emissivity were determined, using an HP 8510 Vector Network Analyzer, to within 0.001 precision and accuracy. A custom-made test fixture/positioner, a thru-reflect-line calibration, and calculated reflection coefficients were used. The Ag film proved most suitable for further study, with 0.9957 reflectivity and 0.0042 emissivity. The Pd films were 0.89 reflective and 0.11 emissive; both Au films tested entirely transmissive. Transmission and scanning electron micrographs, S-parameters, and power coefficients are shown.
Author
*Fabrication; Metal Films; Metallizing; Thin Films; Characterization; Electromagnetism*

**20040085791** Alpha STAR Corp., Long Beach, CA, USA
**Wrinkling Analysis of a Kapton Square Membrane under Tensile Loading**
Su, Xiao-Feng; Abdi, Frank; Taleghani, Barmac; Blandino, Joseph R.; [2003]; 7 pp.; In English; 44th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics, and Materials Conference, 7-10 Apr. 2003, Norfolk, VA, USA
Report No.(s): AIAA Paper 2003-1985; Copyright; Avail: CASI; A02, Hardcopy

A buckling solution and a non-linear post buckling solution were employed for the wrinkling analysis of a tensioned Kapton square membrane. The buckling solution with significantly reduced bending stiffness creates localized buckling modes accounting for the wrinkle formation in the membrane. The non-linear post buckling solution with an updated Lagrangian scheme describes the detailed wrinkle evolution during the loading process. Simulations show wrinkle amplitudes decrease as the tension load increases. The wrinkle number and distribution remain stable until loads exceed a certain level, then new wrinkles occur usually by splitting from existing wrinkles. The evolution of existing wrinkles and formation of new wrinkles in simulations are consistent with experimental observations.
Author
*Wrinkling; Membrane Structures; Kapton (Trademark)*

**20040086023** Bethlehem Steel Co., PA, USA, Oak Ridge National Lab., TN
**Large-Scale Evaluation of Nickel Aluminide Rolls in a Heat-Treat Furnace at Bethlehem Steel's (Now ISG) Burns Harbor Plate Mill**
Mengel, J.; Martocci, A.; Fabina, L.; Petrusha, R.; Chango, R.; Sep. 2003; In English
Report No.(s): DE2003-815993; No Copyright; Avail: National Technical Information Service (NTIS)

At Bethlehem Steel Burns Harbor Plate Division (now ISG Burns Harbor Plate Inc.)'s annealing furnace, new nickel aluminide intermetallic alloy rolls provide greater high-temperature strength and wear resistance compared to the conventional H series cast austenitic alloys currently used in the industry, Oak Ridge National Laboratory and Bethlehem (ISG) partnered under a U.S. Department of Energy, Office of Industrial Technology's Emerging Technology Deployment Program to demonstrate and evaluate the nickel aluminide intermetallic alloy rolls as part of an updated energy efficient large commercial annealing furnace system.
NTIS
*Steels; Furnaces; Metal Plates*

**20040086471** NASA Langley Research Center, Hampton, VA, USA
**Creep Strain and Strain Rate Response of 2219 Al Alloy at High Stress Levels**
Taminger, Karen M. B.; Wagner, John A.; Lisagor, W. Barry; [1998]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

As a result of high localized plastic deformation experienced during proof testing in an International Space Station connecting module, a study was undertaken to determine the deformation response of a 2219-T851 roll forging. After prestraining 2219-T851 Al specimens to simulate strains observed during the proof testing, creep tests were conducted in the temperature range from ambient temperature to 107 C (225 F) at stress levels approaching the ultimate tensile strength of 2219-T851 Al. Strain-time histories and strain rate responses were examined. The strain rate response was extremely high initially, but decayed rapidly, spanning as much as five orders of magnitude during primary creep. Select specimens were subjected to incremental step loading and exhibited initial creep rates of similar magnitude for each load step. Although the creep rates decreased quickly at all loads, the creep rates dropped faster and reached lower strain rate levels for lower applied loads. The initial creep rate and creep rate decay associated with primary creep were similar for specimens with and without prestrain; however, prestraining (strain hardening) the specimens, as in the aforementioned proof test, resulted in significantly longer creep life.
Author
*Aluminum Alloys; Creep Properties; Strain Rate; International Space Station; Stresses*

**20040086495** NASA Langley Research Center, Hampton, VA, USA
**Characteristics of Electromagnetic Pulse Propagation in Metal**
Namkung, M.; Wincheski, B.; Nath, S.; Fulton, J. P.; [2004]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

It is well known that the solution of the diffusion equation for an electromagnetic field with a time harmonic term, e(sup iwt), is in the form of a traveling wave whose amplitude attenuates over distance into a conducting medium. As the attenuation is an increasing function of frequency, the high frequency components attenuate more rapidly than those of low ones upon entering a well conducting object. At the same time, the phase velocity of an individual component is also an increasing function of frequency causing a broadening of the pulse traveling inside a conductor. In the results of our previous study of numerical simulations, the problem of using a gaussian input pulse was immediately clear. First, having the dominant frequency components distributed around zero, the movement of the peak was not well defined. Second, with the amplitude of fourier components varying slowly over a wide range, the dispersion-induced blurring of the peak position was seen to be

severe. For the present study, we have used a gaussian modulated single frequency sinusoidal wave, i. e., the carrier, as an input pulse in an effort to improve the issues related to the unclear movement of peak and dispersion as described above. This was based on the following two anticipated advantages: First, the packet moves in a conductor at the group velocity calculated at the carrier frequency, which means it is well controllable. Second, the amplitude of frequency components other than that of the carrier can be almost negligible, such that the effect of dispersion can be significantly reduced. A series of experiments of transmitting electromagnetic pulses through aluminum plates of various thickness was performed to test the validity of the above points. The results of numerical simulation based on wave propagation are discussed with respect to the experimental results. Finally, a simple simulation was performed based on diffusion of a continuous sine wave input and the results are compared with those of a single frequency sinusoidal wave observed over time at difference locations inside a conductor.
Derived from text
*Electromagnetic Fields; Electromagnetic Pulses; Wave Propagation; Metal Plates; Aluminum*

**20040086507** NASA Langley Research Center, Hampton, VA, USA
**Nonlinear Acoustical Assessment of Precipitate Nucleation**
Cantrell, John H.; Yost, William T.; [2004]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The purpose of the present work is to show that measurements of the acoustic nonlinearity parameter in heat treatable alloys as a function of heat treatment time can provide quantitative information about the kinetics of precipitate nucleation and growth in such alloys. Generally, information on the kinetics of phase transformations is obtained from time-sequenced electron microscopical examination and differential scanning microcalorimetry. The present nonlinear acoustical assessment of precipitation kinetics is based on the development of a multiparameter analytical model of the effects on the nonlinearity parameter of precipitate nucleation and growth in the alloy system. A nonlinear curve fit of the model equation to the experimental data is then used to extract the kinetic parameters related to the nucleation and growth of the targeted precipitate. The analytical model and curve fit is applied to the assessment of S' precipitation in aluminum alloy 2024 during artificial aging from the T4 to the T6 temper.
Derived from text
*Nonlinearity; Nucleation; Acoustics; Aluminum Alloys; Precipitates*

## 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*.

**20040085484** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Procedure for Diagnosis of Exposure to Phosgene Applicable in a Field Laboratory**
Fidder, A.; Noort, D.; November 2003; 24 pp.; In Dutch
Contract(s)/Grant(s): A01/C04/CX; TNO Proj. 014.12901
Report No.(s): PML-2003-A88; TD-2002-0262; Copyright; Avail: Other Sources

A standard operating procedure has been described for diagnosis of exposure to phosgene. This method consists of isolation of albumin from plasma, followed by reduction of disulfide bridges and subsequent carboxymethylation, tryptic digestion and LC tandem MS analysis of a modified tryptic fragment. Using this method an in vitro exposure level of human blood of 1 micron phosgene can still be detected. This method can probably be used in a well-equipped field laboratory.
Author
*Diagnosis; Exposure; Phosgene; In Vitro Methods and Tests*

**20040085528** Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA
**Aluminum-Oxide Temperatures of the Mark VB, VE, VR, 15, and Mark 25 Assemblies**
Aleman, S. E.; Nov. 1984; 24 pp.; In English
Report No.(s): DE2004-810372; No Copyright; Avail: Department of Energy Information Bridge

The task was to compute the maximum aluminum-oxide and oxide-coolant temperatures of assemblies cladded in 99 plus percent aluminum. The assemblies considered were the Mark VB, VE, V5, 15 and 25. These assemblies consist of nested slug columns with individual uranium slugs cladded in aluminum cans. The CREDIT code was modified to calculate the oxide film

thickness and the aluminum-oxide temperature at each axial increment. The information in this report will be used to evaluate the potential for cladding corrosion of the Mark 25 assembly.
NTIS
*Temperature Measurement; Coolants; Aluminum Oxides; Fuel Systems*

**20040085540** Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA
**Plastic Ball and Socket Joints and Connecting Lines**
Searle, R. H.; Jan. 1959; 20 pp.; In English
Report No.(s): DE2004-810371; DPST-59-136; No Copyright; Avail: Department of Energy Information Bridge
This report describes the fabrication and evaluation of polyethylene plastic joints and connecting tubes used in the assembly of contained and shielded radiochemical apparatus.
NTIS
*Plastics; Polyethylenes*

**20040085541** Virginia Transportation Research Council, Charlottesville, VA
**Appliques for the Maintenance of Lead-Based Painted Bridges: A Laboratory Assessment of Field-Performance Characteristics**
Taylor, S. R.; Standridge, C. R.; Sprinkel, M. M.; Jul. 2004; 24 pp.; In English
Report No.(s): PB2004-106555; VTRC 05-R4; No Copyright; Avail: CASI; A03, Hardcopy
Approximately 3,500 bridges in Virginia having steel superstructures are coated with lead-based paints. Many of these bridges are in need of paint maintenance. This research evaluated applique technology, an alternative to the conventional paradigm of bridge paint maintenance in which the lead-based paint is removed and the structure repainted. The results indicate that the barrier properties, self-cleaning characteristics, chemical stability, and thermal stability of the 3M 5004 Paint Replacement System are superior to those of conventional industrial maintenance paints.
NTIS
*Bridges (Structures); Paints*

**20040085789** NASA Langley Research Center, Hampton, VA, USA
**The Effect of Chemical Functionalization on Mechanical Properties of Nanotube/Polymer Composites**
Odegard, G. M.; Frankland, S. J. V.; Gates, T. S.; [2003]; 14 pp.; In English; 44th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics, and Materials Conference, 7-10 Apt. 2003, Norfolk, VA, USA
Contract(s)/Grant(s): NAS1-97046
Report No.(s): AIAA Paper 2003-1701; Copyright; Avail: CASI; A03, Hardcopy
The effects of the chemical functionalization of a carbon nanotube embedded in a nanotube/polyethylene composite on the bulk elastic properties are presented. Constitutive equations are established for both functionalized and non-functionalized nanotube composites systems by using an equivalent-continuum modeling technique. The elastic properties of both composites systems are predicted for various nanotube lengths, volume fractions, and orientations. The results indicate that for the specific composite material considered in this study, most of the elastic stiffness constants of the functionalized composite are either less than or equal to those of the non-functionalized composite.
Author
*Mechanical Properties; Chemical Properties; Carbon Nanotubes; Composite Materials*

**20040085790** NASA Langley Research Center, Hampton, VA, USA
**Electrospun Electroactive Polymers for Aerospace Applications**
Pawlowski, Kristin J.; St.Clair, Tyler L.; McReynolds, Amber C.; Park, Cheol; Ounaies, Zoubeida; Siochi, Emilie J.; Harrison, Joycelyn S.; [2003]; 5 pp.; In English
Report No.(s): AIAA Paper 2003-1768; No Copyright; Avail: CASI; A01, Hardcopy
Electrospun piezoelectric polymers are being developed for use as a component on lightweight wings for micro-air vehicles (MAV). The goal is to incorporate fibers with tailored properties to permit dynamic control and maneuverability during flight. In particular, electrospun fiber mats of two piezoelectric polymers were investigated to ascertain their potential for the MAV application. In the work reported here, the typical experimental set-up for electrospinning was modified to induce fiber orientation in the spun mats. The morphologies of the resulting fibers and fiber mats were evaluated for various

experimental conditions, and a comparison between oriented and unoriented fiber mats was carried out.
Author
*Aerospace Engineering; Dynamic Control; Fiber Orientation*

**20040085955** Missouri Univ., Rolla, MO, USA, Oak Ridge National Lab., TN
**Characterization and Structural Modeling of Magnesia-Alumina Spinel Glass Tank Refractories**
Headrick, W. L.; Moore, R. E.; Karakus, M.; Liang, X.; Oct. 2003; In English
Report No.(s): DE2003-817048; No Copyright; Avail: National Technical Information Service (NTIS)

Furnace designers and furnace/refractories engineers recognize that improved optimization of furnace superstructure design and the use of appropriate refractories are needed as glass production furnaces are continually driven toward greater output and energy efficiencies (and concomitant harsher operating conditions). The conversion to oxy-fuel from traditional air-fuel-firing is a means to meet these objectives. Refractories for both oxy- and air-fuel-fired furnace superstructures are subjected to high temperatures during service and may appreciably creep or subside if the refractory material is not creep resistant or if it is subjected to high stress. Furnace designers can ensure that superstructure structural integrity is maintained or predicted if the creep behavior of the refractory material they are using is well-understood and well-represented by appropriate engineering creep models.
NTIS
*Magnesium Oxides; Aluminates*

**20040085956** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Differential Sputtering Behavior of Pyrolytic Graphite and Carbon-Carbon Composite Under Xenon Bombardment**
Williams, John D.; Johnson, Mark L.; Williams, Desiree D.; July 14, 2003; 21 pp.; In English; Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Report No.(s): Boeing-819415; No Copyright; Avail: CASI; A03, Hardcopy

A differential sputter yield measurement technique is described, which consists of a quartz crystal monitor that is swept at constant radial distance from a small target region where a high current density xenon ion beam is aimed. This apparatus has been used to characterize the sputtering behavior of various forms of carbon including polycrystalline graphite, pyrolytic graphite, and PVD-infiltrated and pyrolized carbon-carbon composites. Sputter yield data are presented for pyrolytic graphite and carbon-carbon composite over a range of xenon ion energies from 200 eV to 1 keV and angles of incidence from 0 deg (normal incidence) to 60 deg .
Author
*Pyrolytic Graphite; Carbon-Carbon Composites; Xenon; Bombardment*

**20040086000** NASA Langley Research Center, Hampton, VA, USA
**Accelerated Testing of Polymeric Composites Using the Dynamic Mechanical Analyzer**
Abdel-Magid, Becky M.; Gates, Thomas S.; [2000]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Creep properties of IM7/K3B composite material were obtained using three accelerated test methods at elevated temperatures. Results of flexural creep tests using the dynamic mechanical analyzer (DMA) were compared with results of conventional tensile and compression creep tests. The procedures of the three test methods are described and the results are presented. Despite minor differences in the time shift factor of the creep compliance curves, the DMA results compared favorably with the results from the tensile and compressive creep tests. Some insight is given into establishing correlations between creep compliance in flexure and creep compliance in tension and compression. It is shown that with careful consideration of the limitations of flexure creep, a viable and reliable accelerated test procedure can be developed using the DMA to obtain the viscoelastic properties of composites in extreme environments.
Author
*Accelerated Life Tests; Polymer Matrix Composites; Dynamic Characteristics; Creep Tests*

**20040086004** NASA Langley Research Center, Hampton, VA, USA
**Constitutive Modeling of Nanotube-Reinforced Polymer Composite Systems**
Odegard, Gregory M.; Harik, Vasyl M.; Wise, Kristopher E.; Gates, Thomas S.; [2004]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

In this study, a technique has been proposed for developing constitutive models for polymer composite systems reinforced with single-walled carbon nanotubes (SWNT). Since the polymer molecules are on the same size scale as the nanotubes, the

interaction at the polymer/nanotube interface is highly dependent on the local molecular structure and bonding. At these small length scales, the lattice structures of the nanotube and polymer chains cannot be considered continuous, and the bulk mechanical properties of the SWNT/polymer composites can no longer be determined through traditional micromechanical approaches that are formulated using continuum mechanics. It is proposed herein that the nanotube, the local polymer near the nanotube, and the nanotube/polymer interface can be modeled as an effective continuum fiber using an equivalent-continuum modeling method. The effective fiber retains the local molecular structure and bonding information and serves as a means for incorporating micromechanical analyses for the prediction of bulk mechanical properties of SWNT/polymer composites with various nanotube sizes and orientations. As an example, the proposed approach is used for the constitutive modeling of two SWNT/polyethylene composite systems, one with continuous and aligned SWNT and the other with discontinuous and randomly aligned nanotubes.
Author
*Carbon Nanotubes; Mathematical Models; Continuum Mechanics; Continuum Modeling; Polyethylenes; Nanotubes*

**20040086005** NASA Langley Research Center, Hampton, VA, USA
**Tensile Properties of Polymeric Matrix Composites Subjected to Cryogenic Environments**
Whitley, Karen S.; Gates, Thomas S.; [2004]; 13 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Polymer matrix composites (PMC s) have seen limited use as structural materials in cryogenic environments. One reason for the limited use of PMC s in cryogenic structures is a design philosophy that typically requires a large, validated database of material properties in order to ensure a reliable and defect free structure. It is the intent of this paper to provide an initial set of mechanical properties developed from experimental data of an advanced PMC (IM7/PETI-5) exposed to cryogenic temperatures and mechanical loading. The application of this data is to assist in the materials down-select and design of cryogenic fuel tanks for future reusable space vehicles. The details of the material system, test program, and experimental methods will be outlined. Tension modulus and strength were measured at room temperature, -196 C, and -269 C on five different laminates. These properties were also tested after aging at -186 C with and without loading applied. Microcracking was observed in one laminate.
Author
*Tensile Properties; Polymer Matrix Composites; Cryogenic Temperature; Fuel Tanks*

**20040086021** NASA Langley Research Center, Hampton, VA, USA
**Flow and Compaction During the Vacuum Assisted Resin Transfer Molding Process**
Grimsley, Brian W.; Hubert, Pascal; Song, Xiao-Lan; Cano, Roberto J.; Loos, Alfred C.; Pipes, R. Byron; [2001]; 14 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The flow of an epoxy resin and compaction behavior of carbon fiber preform during vacuum- assisted resin transfer molding (VARTM) infiltration was measured using an instrumented tool. Composite panels were fabricated by the VARTM process using SAERTEX(R)2 multi-axial non- crimp carbon fiber fabric and the A.T.A.R.D. SI-ZG-5A epoxy resin. Resin pressure and preform thickness variation was measured during infiltration. The effects of the resin on the compaction behavior of the preform were measured. The local preform compaction during the infiltration is a combination of wetting and spring-back deformations. Flow front position computed by the 3DINFIL model was compared with the experimental data.
Author
*Carbon Fibers; Composite Structures; Deformation; Epoxy Resins; Resin Transfer Molding*

**20040086038** Office of Air Quality Planning and Standards, Research Triangle Park, NC
**Regulatory Impact Analysis for the Final Automobile and Light-Duty Truck Surface Coating NESHAP**
Feb. 2004; 130 pp.; In English
Report No.(s): PB2004-106642; EPA-452/R-04-007; No Copyright; Avail: CASI; A07, Hardcopy

Under the Clean Air Act (CAA), Congress gave the U.S. Environmental Protection Agency (EPA) broad authority to protect air resources throughout the nation. Under Section 112 of the CAA, EPA has prepared a National Emission Standard for Hazardous Air Pollutants (NESHAP) designed to reduce emissions generated during the automobile coating process. This report presents a regulatory impact analysis (RIA) to evaluate the economic impacts associated with the regulatory options under consideration for the final rule.
NTIS
*Air Pollution; Air Quality; Automobiles; Economic Impact*

**20040086085** NASA Langley Research Center, Hampton, VA, USA

**Model For Bending Actuators That Use Electrostrictive Graft Elastomers**

Costen, Robert C.; Su, Ji; Harrison, Joycelyn S.; [2001]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Recently, it was reported that an electrostrictive graft elastomer exhibits large electric field-induced strain (4%). Combined with its high mechanical modulus, the elastomer can offer very promising electromechanical properties, in terms of output mechanical energy density, for an electroactive polymeric material. Therefore, it has been considered as one of the candidates that can be used in high performance, low mass actuation devices in many aerospace applications. Various bilayer-based bending actuators have been designed and fabricated. An analytic model based on beam theory in the strength of materials has been derived for the transverse deflection, or curvature, and the longitudinal strain of the bi-layer beam. The curvature and strain are functions of the applied voltage and the thickness, width, and Young s modulus of the active and passive layers. The model can be used to optimize the performance of electrostrictive graft elastomer-based actuators to meet the requirements of various applications. In this presentation, optimization and sensitivity studies are applied to the bending performance of such actuators.

Derived from text

*Electrostriction; Actuators; Aerospace Engineering; Elastomers; Bending*

**20040086459** Illinois Univ., Urbana, IL, USA

**Experimental Studies on the Physics and Technology of Polymer Drag-Reduction**

Hanratty, Thomas J.; McHugh, Anthony J.; Jul. 2004; 14 pp.; In English

Contract(s)/Grant(s): MDA972-01-C-0029; ARPA ORDER-K042/05/24

Report No.(s): AD-A424502; No Copyright; Avail: CASI; A03, Hardcopy

Experimental studies of polymer drag-reduction were carried out in the laboratory of Thomas J. Hanratty. Companion studies were carried out in the polymer laboratory of Anthony J. McHugh so that the performance of drag-reducing polymer solutions can be related to their rheological and rheo- optical properties in simple non-turbulent flows. The work was influenced by the notion that aggregation of polymer molecules could be an important role. A remarkable finding is that molecular weight and molecular weight distribution need not change as the drag-reducing ability of the polymer solution degraded. Rheo-optical studies in a Couette device showed that effective polymer solutions develop turbidity over a range of shear rates characteristic of those used in the flow loop. This study shows that the drag reduction can be enhanced by using mixing and delivery procedures which enhance the formation aggregates.

DTIC

*Drag Reduction*

**20040086512** NASA Langley Research Center, Hampton, VA, USA

**Ferroelectric and Piezoelectric Properties of Blends of Poly(Vinylidene-Trifluoroethylene) and Graft Elastomer**

Su, J.; Ounaies, Z.; Harrison, J. S.; [1999]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A piezoelectric polymeric blend system has been developed. The system contains two components: ferroelectric poly(vinylidene-trifluoroethylene) and graft elastomer. The remanent polarization, Pr, and the piezoelectric strain coefficient, d31, of the blends have been studied as a function of relative composition of the two components, temperature and frequency. Both blended copolymer and graft unit in the elastomer contribute to the total crystallinity of the blend-system, and hence to the remanent polarization and piezoelectricity. The piezoelectric strain coefficient, d31, of the blend systems shows dependence on both the remanent polarization and the mechanical stiffness, which in turn are determined by the fraction of the two components in the blends. This mechanism makes it possible for the piezoelectric strain response of the blend to be tailored by adjusting the relative composition. Although Pr of the copolymer is higher than that of the blends, the blend films containing 75 wt.% copolymer exhibit a higher d31 at room temperature, possibly due to their lower modulus. The blend films containing 50 wt.% copolymer exhibit a constant value of d31, from room temperature to 70 C.

Author

*Piezoelectricity; Ferroelasticity; Mixtures; Stiffness*

## 28
## PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

**20040085922** Pratt and Whitney Space Propulsion, West Palm Beach, FL, USA
**Experimental Simulation of Turbine-Exhaust Oxygen Recovery**
Clark, Jim A.; Branch, Ryan W.; [2004]; 9 pp.; In English; AIAA Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-01108; No Copyright; Avail: CASI; A02, Hardcopy

In some liquid-propellant rocket engines, the liquid-oxygen boost pump is driven by a turbine that is powered by high-pressure gaseous oxygen. Once it exits the turbine, this gaseous oxygen can be salvaged by injecting it into the subcooled liquid oxygen exiting the boost pump. If the main LOX pump is to function correctly under these circumstances, complete condensation of the gaseous oxygen must quickly follow its injection into the boost-pump discharge. The current investigation uses steam and water in a simple rig that allows the condensation process to be visualized and quantified. This paper offers dimensionless-parameter correlations of the data and trends observed.
Author
*Liquid Oxygen; Turbines; Simulation; Liquid Propellant Rocket Engines; Exhaust Gases*

**20040085970** NASA, Washington, DC, USA
**The Hybrid Propellant Module (HPM): A New Concept for Space Transfer in the Earth's Neighborhood and Beyond**
Mankins, John C.; Mazanek, Daniel D.; [2001]; 15 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The safe, affordable and effective transfer of ever-larger payloads and eventually personnel beyond Low Earth Orbit (LEO) is a major challenge facing future commercial development and human exploration of space. Without reusable systems, sustained exploration or large scale development beyond LEO appears to be economically non-viable. However, reusable systems must be capable of both good fuel efficiency and ″high utilization of capacity″, or else economic costs will remain unacceptably high. Various options exist that can provide high fuel efficiency - for example, Solar Electric Propulsion Systems (SEPS) - but only at the cost of low thrust and concomitant long transit times. Chemical propulsion systems offer the potential for high thrust and short transit times - including both cryogenic and non-cryogenic options - but only at the cost of relatively low specific impulse (Isp). Nuclear thermal propulsion systems offer relatively good thrust-to-weight and Isp - but involve public concerns that may be insurmountable for all except the most-critical of public purposes. Fixed infrastructures have been suggested as one approach to solving this challenge; for example, rotating tether approaches. However, these systems tend to suffer from high initial costs or unacceptable operational constraints. A new concept has been identified - the Hybrid Propellant Module (HPM) - that integrates the best features of both chemical and solar electric transportation architectures. The HPM approach appears to hold promise of solving the issues associated with other approaches, opening a new family of capabilities for future space exploration and development of near-Earth space and beyond. This paper provides a summary overview of the challenge of Earth neighborhood transportation and discusses how various systems concepts might be applied to meet the needs of these architectures. The paper describes a new approach, the HPM, and illustrates the application of the concept for a typical mission concept. The paper concludes with a discussion of needed technologies and a possible timeline for the development and evolution of this class of systems concepts.
Author
*Hybrid Propellants; Modules; Cryogenics; Propulsion System Performance; Solar Electric Propulsion; Thrust-Weight Ratio*

**20040086006** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Liquid Metal Propellant Feed System for Plasma Propulsion**
Markusic, T. E.; [2004]; 1 pp.; In English; 40th AIAA Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

High-power plasma thrusters that utilize molten metallic propellants (e.g., the Lithium Lorentz Force Accelerator) are currently being investigated as a primary propulsion option for in-space nuclear-electric systems. A critical component of the thruster is the propellant feed system, which must reliably and accurately pump liquid metal into the thruster discharge chamber. We present design details and calibration results for a compact liquid metal propellant feed system that contains no moving parts, for use in laboratory testing of plasma thrusters. Feed line pressure is maintained using an MHD flow coupler, and the flow rate is monitored using a simple voltage divider, which is submerged in the propellant reservoir. Results for

lithium and gallium propellants show capability to meter propellant at flow rates up to 10 +/- 0.1 mg/s.
Author
*Plasma Propulsion; Propellants; Feed Systems; Liquid Metals; Lorentz Force; Lithium; Plasma Engines*

**20040086074** Aerojet-General Corp., USA
**Ignition Characterization Tests of the LOX/Ethanol Propellant Combination**
Popp, Christopher G.; Robinson, Philip J.; Veith, Eric M.; [2004]; 1 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-01109; No Copyright; Avail: Other Sources; Abstract Only

A series of contracts have been issued by the Marshall Space Flight Center (MSFC) of the National Aeronautics and Space Administration (NASA) to explore candidate technologies considered to be important for the Next Generation Launch Technology (NGLT) effort. One aspect of the NGLT effort is to explore the potential of incorporating non-toxic propellants for Reaction Control Subsystems (RCS). Contract NAS8-01109 has been issued to Aerojet to develop a dual thrust Reaction Control Engine (RCE) that utilizes liquid oxygen and ethanol as the propellants. The dual thrust RCE incorporates a primary thrust level of 870 lbf, and a vernier thrust level of 10 - 30 lbf. Aerojet has designed and tested a workhorse LOX igniter to determine LOX/Ethanol ignition characteristics as part of a risk mitigation effort for the dual thrust RCE design. The objective of the ignition testing was to demonstrate successfid ignition from GOX to LOX, encompassing potential two-phase flow conditions. The workhorse igniter was designed to accommodate the full LOX design flowrate, as well as a reduced GOX flowrate. It was reasoned that the initial LOX flow through the igniter would flash to GOX due to the inherent heat stored in the hardware, causing a reduced oxygen flowrate because of a choked, or sonic, flow condition through the injection elements. As LOX flow continued, the inherent heat of the test hardware would be removed and the hardware would chill-in, with the injected oxygen flow transitioning from cold GOX through two-phase flow to subcooled LOX. Pressure and temperature instrumentation permitted oxygen state points to be determined, and gas-side igniter chamber thermocouples provided chamber thermal profile characteristics. The cold flow chamber pressure (P(sub c)) for each test was determined and coupled with the igniter chamber diameter (D(sub c)) to calculate the characteristic quench parameter (P(sub c) x D(sub c)), which was plotted as a function of core mixture ratio, MR(sub c). Ignition limits were determined over a broad range of valve inlet conditions, and ignition was demonstrated with oxygen inlet conditions that ranged from subcooled 173 R LOX to 480 R GQX. Once ignited at cold GOX conditions, combustion was continuous as the hardware chilled in and the core mixture ratio transitioned from values near 1.0 to over 12.5.
Author (revised)
*Ignition; Liquid Oxygen; Ethyl Alcohol; Igniters*

**20040086437** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Monopropellant Research**
Rodgers, Steve; [2004]; 1 pp.; In English; DIA Applied Technology Conference, 26-30 Jul. 2004, Huntsville, AL, USA; No Copyright; Avail: Other Sources; Abstract Only

NASA along with the Air Force is developing new monopropellant systems to replace the current hydrazine monopropellant systems. The monopropellants under consideration are environmentally friendly, have a higher density, and have better thermal characteristics than hydrazine. The near-term goal is to improve mission performance and greatly reduce ground operations costs. For the far-term, a very high performance (high specific impulse) system is being sought. The key to this goal is the development of a high-temperature catalyst; research in this area is underway.
Author
*Monopropellants; Research and Development; NASA Programs*

## 29
## SPACE PROCESSING

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

**20040086503** NASA Langley Research Center, Hampton, VA, USA
**Technology Assessment of Laser-Assisted Materials Processing in Space**
Nagarathnam, Karthik; Taminger, Karen M. B.; [2001]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Lasers are useful for performing operations such as joining, machining, built-up freeform fabrication, shock processing, and surface treatments. These attributes are attractive for the supportability of longer-term missions in space due to the multi-functionality of a single tool and the variety of materials that can be processed. However, current laser technology also has drawbacks for space-based applications, specifically size, power efficiency, lack of robustness, and problems processing highly reflective materials. A review of recent laser developments will be used to show how these issues may be reduced and indicate where further improvement is necessary to realize a laser-based materials processing capability in space. The broad utility of laser beams in synthesizing various classes of engineering materials will be illustrated using state-of-the art processing maps for select lightweight alloys typically found on spacecraft. With the advent of recent breakthroughs in diode-pumped solid-state lasers and fiber optic technologies, the potential to perform multiple processing techniques is increasing significantly. Lasers with suitable wavelengths and beam properties have tremendous potential for supporting future space missions to the moon, Mars and beyond.
Author
*Technology Assessment; Laser Applications; Space Processing; Spaceborne Lasers*

## 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*.

**20040085713** National Taiwan Univ. of Science and Technology, Taipei, Taiwan, Province of China
**Journal of the Chinese Institute of Engineers, Volume 27, No. 3**
Chen, Shun-Tyan, Editor; Shiou, Fang-Jung, Editor; Lee, Liang-Sun, Editor; Young, Der-Liang, Editor; Pan, Ching-Tsai, Editor; Chen, Jean-Lien, Editor; Chung, Chung-Ping, Editor; Chao, Ching-Kong, Editor; Chang, Kai, Editor; Tsai, Hsien-Lung, Editor, et al.; May 2004; ISSN 0253-3839; 142 pp.; In English; Copyright; Avail: Other Sources

The papers in this issue include: 1) Investigation on Block Displacements Due to a Shallow Tunnel Excavation in an Inclined Brick-Type Jointed Rock Mass Using Discontinuous Deformation Analysis; 2) Systematic Investigation of Time Scale in Movable-Bed Model; 3) Modeling Wastewater Discharge to the Ai Estuary, Kaohsiung, Taiwan; 4) An Irrigation Water Distribution Model for Area of A Mixed Cultivation; 5) Numerical Analysis of Shrinkage Stresses in a Mass Concrete; 6) Preliminary Study on the Fragility Curves for Highway Bridges in Taiwan; 7) Radiographic and Balance Characteristics for Patient with Osteoporotic Vertebral Fracture; 8) On the Bi-Stabilities of Vortex Shedding Flows behind a Pair of Square Solids; 9) Fatigue Strength Characteristics of Crack-Healing Materials - Al2O3/SiC Composite Ceramics and Monolithic Al2O3. 10) Mechanics Analysis for Implant-Soft Tissue Retained Overdenture; 11) Adaptive Diagnosis of Discrete Event Systems; 12) A Unified Approach to Eigenvalue Bounds of the Solution of the Riccati Equation: 13) Optimum Setting of PID Controllers Based on Using Evolutionary Programming Algorithm; 14) Radio Characteristics Evaluation Tests of an Experimental 3G WCDMA System in Taiwan Suburban Environments; 15) Adaptive Backstepping Motion Control of Induction Motor Drives.
Author
*Engineering; Taiwan*

## 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*.

**20040086041** Chemonics International, Inc., Washington, DC, USA
**Achievement of Market-Friendly Initiatives and Results Program (AMIR 2.0 Program). Compose Responses to Filings in MobileCom Complaint and Draft TRC Decision on FastLink Appeal**
Dec. 2003; 22 pp.; In English
Report No.(s): PB2004-106907; PN-ACX-213; No Copyright; Avail: CASI; A03, Hardcopy

The MobileCom complaint contends that Fastlink is preventing effective competition via its charging structure and argues that two measures prove their case. First, the average gross margin (price less terminating access charge) for the weighted average price for Fastlink subscribers calls to MobileCom exceeds 150 percent and second, the average gross margins for

Fastlink on-net calls assuming the utilization of the 70 fils/minute terminating access charge are negative. Fastlink's response argues that its pricing structure cannot support break-even cross-subsidization as there is far more on-net than off-net traffic and the off-net price would have to be much higher than is currently charged to counter-balance what MobileCom terms losses incurred for its on-net calls.
NTIS
*Traffic; Websites*

**20040086042** Chemonics International, Inc., Washington, DC, USA
**Achievement of Market-Friendly Initiatives and Results Program (AMIR 2.0 Program). Economic Analysis (MobileCom Pricing Complaint)**
Dec. 2003; 22 pp.; In English
Report No.(s): PB2004-106908; PN-ACX-216; No Copyright; Avail: CASI; A03, Hardcopy

On April 13, 2003, MobileCom filed a complaint with the Telecommunications Regulatory Commission (TRC) alleging that Fastlink was engaging in unfair competition, principally by charging less for many of its on-net calls than the terminating access rates charged to MobileCom as well as setting very high prices for calls to MobileCom's subscribers. On July 28, 2003, Fastlink responded to an information request sent by the TRC on this matter. This analysis examines the economic principles, and implications, relating to this issue, utilizing data from the MobileCom complaint and the Fastlink response as well as data provided by TRC staff. This paper provides background dealing with the many economic principles and concepts (network externalities, peak-load pricing, price discrimination, opportunity cost, and anti-competitive pricing) involved in the analysis.
NTIS
*Economic Analysis; Telecommunication; Websites*

**20040086043** Chemonics International, Inc., Washington, DC, USA
**Achievement of Market-Friendly Initiatives and Results Program (AMIR 2.0 Program). Assist TRC in Developing Guidelines on Private Networks**
Oct. 2003; 36 pp.; In English
Report No.(s): PB2004-106909; PN-ACX-220; No Copyright; Avail: CASI; A03, Hardcopy

The purpose of this memo is to provide options to guide the TRC in its decision to establish a set of guidelines for how private networks will be treated in Jordan. Basic principles for the treatment of private networks have been outlined in articles 21-24 of the Jordanian Telecommunications Law. Additionally, the government has issued a policy statement regarding its expected treatment of government-owned private networks. The recommendations included in this memo are consistent with both the Telecommunications Law and the government guidelines outlined in the policy statement. They are also consistent with Jordan Telecoms (JTC) monopoly on the provision of leased lines and the TRC's policies concerning VoIP.
NTIS
*Policies; Telecommunication; Network Analysis*

**20040086504** NASA Langley Research Center, Hampton, VA, USA
**Communications and Tracking of Visiting Vehicles near ISS: The Design of the Reusable Launch Vehicle Communications**
Stillwagen, Frederic H.; April 29, 1999; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The International Space Station (ISS) will provide for the visitation of various vehicles such as the Shuttle, Automated Transfer Vehicle (ATV), H-II Transfer Vehicle (HTV), Crew Return Vehicle (CRV), Reusable Launch Vehicle (RLV) and Soyuz. These vehicles will provide for crew replacement, consumables resupply, and equipment delivery. In order for these vehicles to approach and eventually dock with the ISS, there must be near continuous communications coverage between the visiting vehicle and the ISS, as well as communications between the vehicle and a Mission Control Center (MCC). Since the ISS communications systems are already designed and scheduled for ISS activation, the vehicles must either utilize these communications systems or provide their own. There are two means of two-way communications with the ISS. These are (1) S-Band communications using TDRSS, and (2) UHF communications using some form of the Space to Space Station Radio (SSSR) link. The RLV utilizes ISS compatible communications systems to communicate with both the ISS and a Mission Control Center. Since all vehicles must adhere to the Visiting Vehicle Interface requirements given in reference 1, the RLV communications system design must meet these requirements during entry into the ISS Approach Ellipsoid (AE) and during

Proximity Operations. Included in this paper are descriptions of these communications approaches as well as their potential utilization in the ISS communications system.
Author
*Automated Transfer Vehicle; Radio Communication; Reusable Launch Vehicles; Systems Engineering; Telecommunication*

## 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*.

**20040085555** McDermott Technology, Inc., Alliance, OH, USA, Ceramatec, Inc., Salt Lake City, UT, USA, Advanced Refractory Technologies, Inc., Buffalo, NY, USA
**Affordable Multi-Layer Ceramic (MLC) Manufacturing for Power Systems (AMPS)**
Barringer, E. A.; Nov. 27, 2002; In English
Report No.(s): DE2003-816425; No Copyright; Avail: National Technical Information Service (NTIS)

McDermott Technology, Inc. (MTI) is attempting to develop high-performance, cost-competitive solid oxide fuel cell (SOFC) power systems. Recognizing the challenges and limitations facing the development of SOFC stacks comprised of electrode-supported cells and metallic interconnects, McDermott Technology, Inc. (MTI) has chosen to pursue an alternate path to commercialization. MTI is developing a multi-layer, co-fired, planar SOFC stack that will provide superior performance and reliability at reduced costs relative to competing designs. The MTI approach combines state-of-the-art SOFC materials with the manufacturing technology and infrastructure established for multi-layer ceramic (MLC) packages for the microelectronics industry. The rationale for using MLC packaging technology is that high quality, low-cost manufacturing has been demonstrated at high volumes. With the proper selection of SOFC materials, implementation of MLC fabrication methods offers unique designs for stacks (cells and interconnects) that are not possible through traditional fabrication methods. The MTI approach eliminates use of metal interconnects and ceramic-metal seals, which are primary sources of stack performance degradation. Co-fired cells are less susceptible to thermal cycling stresses by using material compositions that have closely matched coefficients of thermal expansion between the cell and the interconnect.
NTIS
*Ceramics; Microelectronics*

**20040085731** NASA Langley Research Center, Hampton, VA, USA
**System Model for MEMS based Laser Ultrasonic Receiver**
Wilson, William C.; [2002]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

A need has been identified for more advanced nondestructive Evaluation technologies for assuring the integrity of airframe structures, wiring, etc. Laser ultrasonic inspection instruments have been shown to detect flaws in structures. However, these instruments are generally too bulky to be used in the confined spaces that are typical of aerospace vehicles. Microsystems technology is one key to reducing the size of current instruments and enabling increased inspection coverage in areas that were previously inaccessible due to instrument size and weight. This paper investigates the system modeling of a Micro OptoElectroMechanical System (MOEMS) based laser ultrasonic receiver. The system model is constructed in software using MATLAB s dynamical simulator, Simulink. The optical components are modeled using geometrical matrix methods and include some image processing. The system model includes a test bench which simulates input stimuli and models the behavior of the material under test.
Author
*Microelectromechanical Systems; Receivers; Ultrasonics; Systems Engineering; Mathematical Models; Lasers*

**20040085735** NASA Langley Research Center, Hampton, VA, USA
**Aging Wire Insulation Assessment by Phase Spectrum Examination of Ultrasonic Guided Waves**
Anastasi, Robert F.; Madaras, Eric I.; [2003]; 7 pp.; In English; SPIE's 8th International Symposium on NDE for Health Monitoring and Diagnostics, 2-6 Mar. 2003, San Diego, CA, USA
Report No.(s): Paper 29; No Copyright; Avail: CASI; A02, Hardcopy

Wire integrity has become an area of concern to the aerospace community including DoD, NASA, FAA, and Industry. Over time and changing environmental conditions, wire insulation can become brittle and crack. The cracks expose the wire

conductor and can be a source of equipment failure, short circuits, smoke, and fire. The technique of using the ultrasonic phase spectrum to extract material properties of the insulation is being examined. Ultrasonic guided waves will propagate in both the wire conductor and insulation. Assuming the condition of the conductor remains constant then the stiffness of the insulator can be determined by measuring the ultrasonic guided wave velocity. In the phase spectrum method the guided wave velocity is obtained by transforming the time base waveform to the frequency domain and taking the phase difference between two waveforms. The result can then be correlated with a database, derived by numerical model calculations, to extract material properties of the wire insulator. Initial laboratory tests were performed on a simple model consisting of a solid cylinder and then a solid cylinder with a polymer coating. For each sample the flexural mode waveform was identified. That waveform was then transformed to the frequency domain and a phase spectrum was calculated from a pair of waveforms. Experimental results on the simple model compared well to numerical calculations. Further tests were conducted on aircraft or mil-spec wire samples, to see if changes in wire insulation stiffness can be extracted using the phase spectrum technique.
Author
*Wire; Insulation; Brittleness; Failure; Fires*

**20040085917** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Numerical Simulation of Waves Driven by Plasma Currents Generated by Low-Frequency Alfven Waves in a Multi-Ion Plasma**
Singh, Nagendra; Khazanov, George; Journal of Geophysical Research; 2004; ISSN 0148-0227; Volume 109; 12 pp.; In English
Contract(s)/Grant(s): NAG5-13489; Copyright; Avail: Other Sources

When multi-ion plasma consisting of heavy and light ions is permeated by a low-frequency Alfven (LFA) wave, the crossed-electric-and-magnetic field (E x B), and the polarization drifts of the different ion species and the electrons could be quite different. The relative drifts between the charged-particle species drive waves, which energize the plasma. Using 2.5-dimensional (2.5-D) particle-in-cell simulations, we study this process of wave generation and its nonlinear consequences in terms of acceleration and heating plasma. Specifically, we study the situation for LFA wave frequency being lower than the heavy-ion cyclotron frequency in a multi-ion plasma. We impose such a wave to the plasma assuming that its wavelength is much larger than that of the waves generated by the relative drifts. For better understanding, the LFA-wave driven simulations are augmented by those driven by initialized ion beams. The driven high-frequency (HF) wave modes critically depend on the heavy ion density nh; for small values of nh, the lower hybrid (LH) waves dominate. On the other hand, for large nh a significantly enhanced level of waves occurs over a much broader frequency spectrum below the LH frequency and such waves are interpreted here as the ion Bernstein (IB) mode near the light ion cyclotron harmonics. Irrespective of the driven wave modes, both the light and heavy ions undergo significant transverse acceleration, but for the large heavy-ion densities, even the electrons are significantly accelerated in the parallel direction by the waves below the LH frequency. Even when the LFA wave drive is maintained, the ion heating leads to the cessation of HF wave excitation just after a few cycles of the former wave. On the basis of marginal stability seen in the simulations, an empirical relation for LFA wave amplitude, frequency and ion temperature is given.
Author
*Low Frequencies; Magnetohydrodynamic Waves; Plasma Currents; Simulation; Mathematical Models*

**20040085927** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Ring Current Electrodynamic Coupling**
Khazanov, G. V.; [2004]; 1 pp.; In English; 35th COSPAR, 18-24 Jul. 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

In this talk we will address the two primary issues of ring current (RC) electrodynamic coupling: 1. RC self-consistent coupling with electromagnetic ion cyclotron (EMIC) waves (small scale electrodynamic coupling); and 2. RC self-consistent magnetosphere-ionosphere coupling that includes calculation of the magnetospheric electric field (large scale electrodynamic coupling). Our study will be based on two RC models that we have recently developed in our group. The first model by Khazanov et al. [2002, 20031 couples the system of two kinetic equations: one equation which describes the RC ion dynamics and another equation which describes the energy density evolution of EMIC waves. The second model by Khazanov et al. [2003] deals with large scale electrodynamic coupling processes and provides a self-consistent simulation of RC ions, electrons and the magnetospheric electric field. There is presently no model that addresses both of these issues simultaneously in a self-consistent calculation. However, the need exists for such a model, because these two processes directly influence each other, with the mesoscale coupling changing the drift paths of the thermal and energetic particle populations in the inner magnetosphere, thereby changing the wave interactions, and the microscale coupling altering the pitch angle distributions and

ionospheric conductivities (through increased precipitation), thus changing the field-aligned currents and electric potential structure. The initial thrust of the work will be the development of a combined kinetic model of micro- and meso-scale RC electrodynamic coupling processes and to examine their interactions with each other on a global scale. We also discuss the nonlinear coupling of EMIC and lower hybrid waves in the RC region during the May 2-7, 1998 storm period.
Author
*Magnetosphere-Ionosphere Coupling; Ion Cyclotron Radiation; Ring Currents; Field Aligned Currents; Electric Potential; Electric Fields*

**20040085936** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The ISR Asymmetrical Capacitor Thruster: Experimental Results and Improved Designs**
Canning, Francis X.; Cole, John; Campbell, Jonathan; Winet, Edwin; [2004]; 21 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NCC8-225; No Copyright; Avail: CASI; A03, Hardcopy

A variety of Asymmetrical Capacitor Thrusters has been built and tested at the Institute for Scientific Research (ISR). The thrust produced for various voltages has been measured, along with the current flowing, both between the plates and to ground through the air (or other gas). VHF radiation due to Trichel pulses has been measured and correlated over short time scales to the current flowing through the capacitor. A series of designs were tested, which were increasingly efficient. Sharp features on the leading capacitor surface (e.g., a disk) were found to increase the thrust. Surprisingly, combining that with sharp wires on the trailing edge of the device produced the largest thrust. Tests were performed for both polarizations of the applied voltage, and for grounding one or the other capacitor plate. In general (but not always) it was found that the direction of the thrust depended on the asymmetry of the capacitor rather than on the polarization of the voltage. While no force was measured in a vacuum, some suggested design changes are given for operation in reduced pressures.
Author
*Asymmetry; Capacitors; Thrustors; Mechanical Engineering*

**20040086008** Ljubljana Univ., Ljubljana, Slovenia
**Electrotechnical Review, Volume 71, No. 3**
Zajc, Baldomir, Editor; Solina, Franc, Editor; Bajd, Tadej, Editor; Babic, Hrvoje, Editor; Brglez, Franc, Editor; Divjak, Sasa, Editor; Drnovsek, Janko, Editor; Furlan, Joze, Editor; Groselji, Bojan, Editor; Gubina, Ferdo, Editor, et al.; 2004; ISSN 0013-5852; 85 pp.; In English; In Slovene; Copyright; Avail: Other Sources

Ten of the thirteen papers in this issue are in Slovenian, with extended abstracts in English. They include the following titles: 1) Scheduling Production Activities Using Project Planning Tools; 2) Quality of Service in Packet Networks; 3) Selecting Appropriate EMI Filter by Signal Analysis in Frequency Domain; 4) Human Resolution of Virtual Sound Source Direction; 5) Architecture of ASR System with Confidence Measure Support; 6) Nash Equilibrium in the Electricity Market; 7) Evaluation of Algorithms for Distance Protection; 8) Slovenian Consumers' Load Profiles Determination; 9) Digital Simulation of Overvoltages Using an Air Circuit-Breaker Model; 10) Double-Mode Current-Programmed PWM. The other three papers are in English: 1) Provision of Fixed Broadband Wireless Access over Stratospheric Platforms; 2) Navigation-Related Services over Stratospheric Platforms; 3) Neighbor Discovery in Active Networks.
Author
*Electrical Engineering; Communication Networks; Market Research*

**20040086016** NASA Langley Research Center, Hampton, VA, USA
**Ultrasonic Guided Waves for Aging Wire Insulation Assessment**
Anastasi, Robert F.; Madaras, Eric I.; [2001]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Environmentally aged wire insulation can become brittle and crack and thus expose the underlying conductive wire to the potential for short circuits and fire. The feasibility of using ultrasonic guided waves to measure insulation condition was examined. First a simple model to study guided wave propagation in a bare and thin plastic coated wire was examined and then some aviation grade wire samples that had been heat-damaged. Initial measurements indicate that ultrasonic guided wave velocity can be used to monitor insulation stiffness.
Author
*Insulation; Ultrasonic Radiation; Wave Propagation; Aging (Materials); Electric Wire*

**20040086097** NASA Langley Research Center, Hampton, VA, USA

**Electrical Properties and Power Considerations of a Piezoelectric Actuator**

Jordan, T.; Ounaies, Z.; Tripp, J.; Tcheng, P.; [1999]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

This paper assesses the electrical characteristics of piezoelectric wafers for use in aeronautical applications such as active noise control in aircraft. Determination of capacitive behavior and power consumption is necessary to optimize the system configuration and to design efficient driving electronics. Empirical relations are developed from experimental data to predict the capacitance and loss tangent of a PZT5A ceramic as nonlinear functions of both applied peak voltage and driving frequency. Power consumed by the PZT is the rate of energy required to excite the piezoelectric system along with power dissipated due to dielectric loss and mechanical and structural damping. Overall power consumption is thus quantified as a function of peak applied voltage and driving frequency. It was demonstrated that by incorporating the variation of capacitance and power loss with voltage and frequency, satisfactory estimates of power requirements can be obtained. These relations allow general guidelines in selection and application of piezoelectric actuators and driving electronics for active control applications.

Author

*Electrical Properties; Piezoelectric Actuators; Wafers; Energy Consumption*

**20040086500** NASA Langley Research Center, Hampton, VA, USA

**Deep Flaw Detection with Giant Magnetoresistive (GMR) Based Self-Nulling Probe**

Wincheski, Buzz; Namkung, Min; [2004]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

In this paper a design modification to the Very-Low Frequency GMR Based Self-Nulling Probe has been presented to enable improved signal to noise ratio for deeply buried flaws. The design change consists of incorporating a feedback coil in the center of the flux focusing lens. The use of the feedback coil enables cancellation of the leakage fields in the center of the probe and biasing of the GMR sensor to a location of high magnetic field sensitivity. The effect of the feedback on the probe output was examined, and experimental results for deep flaw detection were presented. The experimental results show that the modified probe is capable of clearly identifying flaws up to 1 cm deep in aluminum alloy structures.

Derived from text

*Defects; Magnetoresistivity; Detection; Probes; Very Low Frequencies*

**20040086502** NASA Langley Research Center, Hampton, VA, USA

**Investigating the Use of Ultrasonic Guided Waves for Aging Wire Insulation Assessment**

Anastasi, Robert F.; Madaras, Eric I.; [2002]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Aging wiring has become a critical issue to DoD, NASA, FAA, and Industry. The problem is that insulation on environmentally aged wire becomes brittle and cracks. This exposes the underlying conductive wire to the potential for short circuits and fire. The difficulty is that techniques to monitor aging wire problems focus on applying electrical sensing techniques that are not very sensitive to the wire insulation. Thus, the development of methods to quantify and monitor aging wire insulation is highly warranted. Measurement of wire insulation stiffness by ultrasonic guided waves is being examined. Initial laboratory tests were performed on a simple model consisting of a solid cylinder and then a solid cylinder with a polymer coating. Experimental measurements showed that the lowest order axisymmetric mode may be sensitive to stiffness changes in the wire insulation. To test this theory, mil-spec wire samples MIL-W-81381, MIL-W-22759/34, and MIL-W-22759/87 (typically found in aircraft) were heat-damaged in an oven, in a range of heating conditions. The samples were 12, 16, and 20 gauge and the heat-damage introduced material changes in the wire-insulation that made the originally flexible insulation brittle and darker in color. Axisymmetric mode phase velocity increased for the samples that were exposed to heat for longer duration. For example, the phase velocity in the 20-gauge MIL-W-22759/34 wire changed from a baseline value of 2790m/s to 3280m/s and 3530m/s for one-hour exposures to 3490C and 3990C, respectively. Although the heat-damage conditions are not the same as environmental aging, we believe that with further development and refinements, the ultrasonic guided waves can be used to inspect wire-insulation for detrimental environmental aging conditions.

Author

*Aging (Materials); Wire; Insulation; Brittleness; Cracks; Ultrasonic Radiation*

## 34
## FLUID MECHANICS AND THERMODYNAMICS

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics*.

**20040085757** NASA Langley Research Center, Hampton, VA, USA
**Best Practices for Reduction of Uncertainty in CFD Results**
Mendenhall, Michael R.; Childs, Robert E.; Morrison, Joseph H.; [2003]; 10 pp.; In English
Report No.(s): AIAA Paper 2003-0411; Copyright; Avail: CASI; A02, Hardcopy

This paper describes a proposed best-practices system that will present expert knowledge in the use of CFD. The best-practices system will include specific guidelines to assist the user in problem definition, input preparation, grid generation, code selection, parameter specification, and results interpretation. The goal of the system is to assist all CFD users in obtaining high quality CFD solutions with reduced uncertainty and at lower cost for a wide range of flow problems. The best-practices system will be implemented as a software product which includes an expert system made up of knowledge databases of expert information with specific guidelines for individual codes and algorithms. The process of acquiring expert knowledge is discussed, and help from the CFD community is solicited. Benefits and challenges associated with this project are examined.
Author
*Grid Generation (Mathematics); Expert Systems; Computational Fluid Dynamics*

**20040085769** NASA Langley Research Center, Hampton, VA, USA
**Properties of the Residual Stress of the Temporally Filtered Navier-Stokes Equations**
Pruett, C. D.; Gatski, T. B.; Grosch, C. E.; Thacker, W. D.; [2002]; 6 pp.; In English
Contract(s)/Grant(s): NAG1-02027; NAG1-02033; NAG1-02005; NSF OCE-01-36403; No Copyright; Avail: CASI; A02, Hardcopy

The development of a unifying framework among direct numerical simulations, large-eddy simulations, and statistically averaged formulations of the Navier-Stokes equations, is of current interest. Toward that goal, the properties of the residual (subgrid-scale) stress of the temporally filtered Navier-Stokes equations are carefully examined. Causal time-domain filters, parameterized by a temporal filter width 0 less than Delta less than infinity, are considered. For several reasons, the differential forms of such filters are preferred to their corresponding integral forms; among these, storage requirements for differential forms are typically much less than for integral forms and, for some filters, are independent of Delta. The behavior of the residual stress in the limits of both vanishing and in infinite filter widths is examined. It is shown analytically that, in the limit Delta to 0, the residual stress vanishes, in which case the Navier-Stokes equations are recovered from the temporally filtered equations. Alternately, in the limit Delta to infinity, the residual stress is equivalent to the long-time averaged stress, and the Reynolds-averaged Navier-Stokes equations are recovered from the temporally filtered equations. The predicted behavior at the asymptotic limits of filter width is further validated by numerical simulations of the temporally filtered forced, viscous Burger's equation. Finally, finite filter widths are also considered, and a priori analyses of temporal similarity and temporal approximate deconvolution models of the residual stress are conducted.
Author
*Residual Stress; Navier-Stokes Equation; Fluid Filters*

**20040085777** NASA Langley Research Center, Hampton, VA, USA
**A Wind Tunnel Model to Explore Unsteady Circulation Control for General Aviation Applications**
Cagle, Christopher M.; Jones, Gregory S.; [2002]; 13 pp.; In English; 22nd AIAA Aerodynamic Measurement Technology and Ground Testing, 24-26 Jun. 2002, Saint Louis, MO, USA
Report No.(s): AIAA Paper 2002-3240; Copyright; Avail: CASI; A03, Hardcopy

Circulation Control airfoils have been demonstrated to provide substantial improvements in lift over conventional airfoils. The General Aviation Circular Control model is an attempt to address some of the concerns of this technique. The primary focus is to substantially reduce the amount of air mass flow by implementing unsteady flow. This paper describes a wind tunnel model that implements unsteady circulation control by pulsing internal pneumatic valves and details some preliminary results from the first test entry.
Author
*Circulation Control Airfoils; General Aviation Aircraft; Unsteady Flow; Wind Tunnel Models; Computational Fluid Dynamics*

**20040085779** NASA Langley Research Center, Hampton, VA, USA

**Heat Transfer in High-Temperature Fibrous Insulation**

Daryabeigi, Kamran; [2002]; 16 pp.; In English; 8th AIAA/ASME Joint Thermophysics and Heat Transfer Conference, 24-26 Jun. 2002, Saint Louis, MO, USA

Report No.(s): AIAA Paper 2002-3332; Copyright; Avail: CASI; A03, Hardcopy

The combined radiation/conduction heat transfer in high-porosity, high-temperature fibrous insulations was investigated experimentally and numerically. The effective thermal conductivity of fibrous insulation samples was measured over the temperature range of 300-1300 K and environmental pressure range of 1.33 x 10(exp -5)-101.32 kPa. The fibrous insulation samples tested had nominal densities of 24, 48, and 72 kilograms per cubic meter and thicknesses of 13.3, 26.6 and 39.9 millimeters. Seven samples were tested such that the applied heat flux vector was aligned with local gravity vector to eliminate natural convection as a mode of heat transfer. Two samples were tested with reverse orientation to investigate natural convection effects. It was determined that for the fibrous insulation densities and thicknesses investigated no heat transfer takes place through natural convection. A finite volume numerical model was developed to solve the governing combined radiation and conduction heat transfer equations. Various methods of modeling the gas/solid conduction interaction in fibrous insulations were investigated. The radiation heat transfer was modeled using the modified two-flux approximation assuming anisotropic scattering and gray medium. A genetic-algorithm based parameter estimation technique was utilized with this model to determine the relevant radiative properties of the fibrous insulation over the temperature range of 300-1300 K. The parameter estimation was performed by least square minimization of the difference between measured and predicted values of effective thermal conductivity at a density of 24 kilograms per cubic meters and at nominal pressures of 1.33 x 10(exp -4) and 99.98 kPa. The numerical model was validated by comparison with steady-state effective thermal conductivity measurements at other densities and pressures. The numerical model was also validated by comparison with a transient thermal test simulating reentry aerodynamic heating conditions.

Author

*Heat Transfer; High Temperature; Insulation; Fibers; Mathematical Models*

**20040085895** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Torque Transient of Magnetically Drive Flow for Viscosity Measurement**

Ban, Heng; Li, Chao; Su, Ching-Hua; Lin, Bochuan; Scripa, Rosalia N.; Lehoczky, Sandor L.; [2004]; 1 pp.; In English; 2004 Heat Transfer/Fluids Engineering Summer Conference, 11-15 Jul. 2004, Charlotte, NC, USA; No Copyright; Avail: Other Sources; Abstract Only

Viscosity is a good indicator of structural changes for complex liquids, such as semiconductor melts with chain or ring structures. This paper discusses the theoretical and experimental results of the transient torque technique for non-intrusive viscosity measurement. Such a technique is essential for the high temperature viscosity measurement of high pressure and toxic semiconductor melts. In this paper, our previous work on oscillating cup technique was expanded to the transient process of a magnetically driven melt flow in a damped oscillation system. Based on the analytical solution for the fluid flow and cup oscillation, a semi-empirical model was established to extract the fluid viscosity. The analytical and experimental results indicated that such a technique has the advantage of short measurement time and straight forward data analysis procedures

Author

*Torque; Ring Structures; Nonintrusive Measurement; Viscosity; Semiconductors (Materials); High Temperature; Melts (Crystal Growth)*

**20040085906** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Numerical Simulations of Vortex Shedding in Hydraulic Turbines**

Dorney, Daniel; Marcu, Bogdan; [2004]; 5 pp.; In English; AIAA/ASME/SAE/ASEE 40th Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; Copyright; Avail: CASI; A01, Hardcopy

Turbomachines for rocket propulsion applications operate with many different working fluids and flow conditions. Oxidizer boost turbines often operate in liquid oxygen, resulting in an incompressible flow field. Vortex shedding from airfoils in this flow environment can have adverse effects on both turbine performance and durability. In this study the effects of vortex shedding in a low-pressure oxidizer turbine are investigated. Benchmark results are also presented for vortex shedding behind a circular cylinder. The predicted results are compared with available experimental data.

Author

*Turbomachinery; Vortex Shedding; Computational Fluid Dynamics; Direct Numerical Simulation; Hydraulic Equipment*

**20040085938** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Experimental and Analytical Investigation of Pressure Differentials for Clean and Loaded Wire Meshes Used in Zeolite Retention**

Knox, James C.; [2004]; 10 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA

Report No.(s): SAE-04ICES-75; Copyright; Avail: CASI; A02, Hardcopy

Following failure of the carbon dioxide removal assembly (CDRA) on the ISS, a CDRA teardown, test, and evaluation (TT&E) effort found that the sorbent material was not retained as intended by the packed beds and that presence of the sorbent in the check valve and selector valve was the cause of the failure of these components. This paper documents the development of design data for an in-line filter element. The purpose of the in-line filter is to provide temporary protection for on-orbit CDRA hardware until the bed retainment system can be redesigned and replaced.

Author

*Carbon Dioxide Removal; Zeolites; Sorbents; Failure; System Effectiveness; Mesh*

**20040085939** Spectral Sciences, Inc., Burlington, MA, USA

**Simulations of Hyperthermal Oxygen Beam Exposures**

Finchum, A., Technical Monitor; Cline, Jason A.; Minton, Timothy K.; Braunstein, Matthew; April 06, 2004; 8 pp.; In English; 37th AIAA Thermophysics Conference, 28 Jun. - 1 Jul. 2004, Portland, OR, USA

Contract(s)/Grant(s): NAS8-00201; AFOSR-49620-01-I-0335; F49620-01-I-0276

Report No.(s): AIAA Paper 2004-2685; Copyright; Avail: CASI; A02, Hardcopy

Pulsed sources of hyper-thermal O-atoms are now being extensively used to simulate low-earth orbit (LEO) surface exposure environments. The peak flux of these sources is many orders of magnitude larger than the corresponding LEO flux. Although it is desirable to accelerate the test by using higher fluxes than found in LEO, even commonly used fluxes are large enough to produce multi-collision effects by causing a build-up of gas at the sample surface. In this paper we characterize the physical consequences to the experiment using the direct simulation Monte Carlo (DSMC) method, DSMC allows us to extract the distributions of energy and impact angle for the O-atoms that reach the surface, and to record how strongly the gas build-up at the target assembly deflects flux from downstream instrumentation. By considering a range of source fluxes, we determine the onset conditions and severity of these multi-collision effects. We find that even at common experimental fluxes with a normally incident beam string a flat surface sample, the energy distribution of incident O-atoms broadens and develops a significant low-energy tail. The angular distributions also broaden significantly. The number of O-atoms that reach downstream instrumentation is decreased by approximately 50%. These simulations will aid in the calibration of ground-based O-atom measurements,a nd provide a model for the energy and angular distributions of O-atoms that actually impinge on surface samples.

Author

*Computerized Simulation; Oxygen Atoms; Low Earth Orbits; Beams (Radiation); Thermal Conductivity*

**20040085946** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Experiments on Suppression of Thermocapillary Oscillations in Sodium Nitrate Floating Half-Zones by High-frequency End-wall Vibrations**

Anilkumar, A.; Grugel, R. N.; Bhowmick, J.; Wang, T.; [2004]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Experiments to suppress thermocapillary oscillations using high-frequency vibrations were carried out in sodium nitrate floating half-zones. Such a half-zone is formed by melting one end of a vertically held sodium nitrate crystal rod in contact with a hot surface at the top. Thermocapillary convection occurs in the melt because of the temperature gradient at the free surface of the melt. In the experiments, when thermocapillary oscillations occurred, the bottom end of the crystal rod was vibrated at a high frequency to generate a streaming flow in a direction opposite to that of the thermocapillary convection. It is observed that, by generating a sufficiently strong streaming flow, the thermocapillary flow can be offset enough such that the associated thermocapillary oscillations can be quenched.

Author

*Capillary Flow; High Frequencies; Sodium Nitrates; Thermocapillary Migration; Vibration*

**20040085951** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Inducer Hydrodynamic Forces in a Cavitating Environment**

Skelley, Stephen E.; [2004]; 9 pp.; In English; 2004 ASME Heat Transfer/Fluids Engineering Summer Conference, 11-15 Jul. 2004, Charlotte, NC, USA

Report No.(s): HT-FED2004-56115; Copyright; Avail: CASI; A02, Hardcopy

Marshall Space Flight Center has developed and demonstrated a measurement device for sensing and resolving the hydrodynamic loads on fluid machinery. The device - a derivative of the six-component wind tunnel balance - senses the forces and moments on the rotating device through a weakened shaft section instrumented with a series of strain gauges. This rotating balance was designed to directly measure the steady and unsteady hydrodynamic loads on an inducer, thereby defining the amplitude and frequency content associated with operating in various cavitation modes. The rotating balance was calibrated statically using a dead-weight load system in order to generate the 6 x 12 calibration matrix later used to convert measured voltages to engineering units. Structural modeling suggested that the rotating assembly first bending mode would be significantly reduced with the balance s inclusion. This reduction in structural stiffness was later confirmed experimentally with a hammer-impact test. This effect, coupled with the relatively large damping associated with the rotating balance waterproofing material, limited the device s bandwidth to approximately 50 Hertz Other pre-test validations included sensing the test article rotating assembly built-in imbalance for two configurations and directly measuring the assembly mass and buoyancy while submerged under water. Both tests matched predictions and confirmed the device s sensitivity while stationary and rotating. The rotating balance was then demonstrated in a water test of a full-scale Space Shuttle Main Engine high-pressure liquid oxygen pump inducer. Experimental data was collected a scaled operating conditions at three flow coefficients across a range of cavitation numbers for the single inducer geometry and radial clearance. Two distinct cavitation modes were observed symmetric tip vortex cavitation and alternate-blade cavitation. Although previous experimental tests on the same inducer demonstrated two additional cavitation modes at lower inlet pressures, these conditions proved unreachable with the rotating balance installed due to the intense dynamic environment. The sensed radial load was less influenced by flow coefficient than by cavitation number or cavitation mode although the flow coefficient range was relatively narrow. Transition from symmetric tip vortex to alternate-blade cavitation corresponded to changes in both radial load magnitude and radial load orientation relative to the inducer. Sensed moments indicated that the effective load center moved downstream during this change in cavitation mode. An occurrence of ″higher+rdex cavitation″ was also detected in both the stationary pressures and the rotating balance data although the frequency of the phenomena was well above the reliable bandwidth of the rotating balance. In summary the experimental tests proved both the concept and device s capability despite the limitations and confirmed that hydrodynamically-induced forces and moments develop in response to the unbalanced pressure field, which is, in turn, a product of the cavitation environment.

Author

*Hydrodynamics; Cavitation Flow; Fluid Mechanics*

**20040085959** Oak Ridge National Lab., TN

**Cartesian Methods for the Shallow Water Equations on a Sphere**

Drake, J. B.; Swarztrauber, P. N.; Williamson, D. L.; 2003; In English

Report No.(s): DE2003-816851; ORNL/TM-13430; No Copyright; Avail: National Technical Information Service (NTIS)

The shallow water equations in a spherical geometry are solved using a 3-dimensional Cartesian method. Spatial discretization of the 2-dimensional, horizontal differential operators is based on the Cartesian form of the spherical harmonics and an icosahedral (spherical) grid. Computational velocities are expressed in Cartesian coordinates so that a problem with a singularity at the pole is avoided. Solution of auxiliary elliptic equations is also not necessary. A comparison is made between the standard form of the Cartesian equations and a rotational form using a standard set of test problems. Error measures and conservation properties of the method are reported for the test problems.

NTIS

*Differential Equations; Flow Equations; Cartesian Coordinates*

**20040085960** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Transient Three-Dimensional Analysis of Side Load in Liquid Rocket Engine Nozzles**

Wang, Ten-See; [2004]; 10 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: CASI; A02, Hardcopy

Three-dimensional numerical investigations on the nozzle start-up side load physics were performed. The objective of this study is to identify the three-dimensional side load physics and to compute the associated aerodynamic side load using an anchored computational methodology. The computational methodology is based on an unstructured-grid, and pressure-based

computational fluid dynamics formulation, and a simulated inlet condition based on a system calculation. Finite-rate chemistry was used throughout the study so that combustion effect is always included, and the effect of wall cooling on side load physics is studied. The side load physics captured include the afterburning wave, transition from free- shock to restricted-shock separation, and lip Lambda shock oscillation. With the adiabatic nozzle, free-shock separation reappears after the transition from free-shock separation to restricted-shock separation, and the subsequent flow pattern of the simultaneous free-shock and restricted-shock separations creates a very asymmetric Mach disk flow. With the cooled nozzle, the more symmetric restricted-shock separation persisted throughout the start-up transient after the transition, leading to an overall lower side load than that of the adiabatic nozzle. The tepee structures corresponding to the maximum side load were addressed.
Author
*Three Dimensional Flow; Liquid Propellant Rocket Engines; Nozzle Efficiency; Computational Fluid Dynamics; Aerodynamic Loads*

**20040085997** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Transient Two-Dimensional Analysis of Side Load in Liquid Rocket Engine Nozzles**
Wang, Ten-See; [2004]; 11 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Report No.(s): AIAA Paper 2004-3680; No Copyright; Avail: CASI; A03, Hardcopy

Two-dimensional planar and axisymmetric numerical investigations on the nozzle start-up side load physics were performed. The objective of this study is to develop a computational methodology to identify nozzle side load physics using simplified two-dimensional geometries, in order to come up with a computational strategy to eventually predict the three-dimensional side loads. The computational methodology is based on a multidimensional, finite-volume, viscous, chemically reacting, unstructured-grid, and pressure-based computational fluid dynamics formulation, and a transient inlet condition based on an engine system modeling. The side load physics captured in the low aspect-ratio, two-dimensional planar nozzle include the Coanda effect, afterburning wave, and the associated lip free-shock oscillation. Results of parametric studies indicate that equivalence ratio, combustion and ramp rate affect the side load physics. The side load physics inferred in the high aspect-ratio, axisymmetric nozzle study include the afterburning wave; transition from free-shock to restricted-shock separation, reverting back to free-shock separation, and transforming to restricted-shock separation again; and lip restricted-shock oscillation. The Mach disk loci and wall pressure history studies reconfirm that combustion and the associated thermodynamic properties affect the formation and duration of the asymmetric flow.
Author
*Computational Fluid Dynamics; Liquid Propellant Rocket Engines; Two Dimensional Flow; Nozzle Design; Numerical Analysis; Transient Loads*

**20040086024** Oak Ridge National Lab., TN, USA
**Flow Regimes of Air-Water Counterflow through Cross Corrugated Parallel Plates**
de Almeida, V. F.; Riahi-Nezhad, C. K.; Apr. 2000; In English
Report No.(s): DE2003-815779; ORNL/TM-2000/101; No Copyright; Avail: National Technical Information Service (NTIS)

Heretofore unknown flow regimes of air-water counterflow through a pair of transparent vertical parallel cross corrugated plates were observed via high-speed video. Air flows upward driven by pressure gradient and water, downward driven by gravity. The crimp geometry of the corrugations was drawn from typical corrugated sheets used as filling material in modern structured packed towers. Four regimes were featured, namely, rivulet, bicontinuous, flooding fronts, and flooding waves. It is conceivable that the regimes observed might constitute the basis for understanding how gas and liquid phases contend for available space in the interstices of structured packings in packed towers. Flow regime transitions were expressed in terms of liquid load (liquid superficial velocity) and gas flow factor parameters commonly used in pressure drop and capacity curves. We have carefully examined the range of parameters equivalent to the ill-understood high-liquid-flow operation in packed towers. More importantly, our findings should prove valuable in validating improved first-principles modeling of gas-liquid flows in these industrially important devices.
NTIS
*Air Flow; Parallel Plates; Gas Flow*

**20040086079** Ohio Aerospace Inst., Brook Park, OH, USA
**Injection Induced Mixing in Flows Separating From Smooth Surfaces**
Adamczyk, John J., Technical Monitor; Wundrow, David W.; July 2004; 18 pp.; In English
Contract(s)/Grant(s): 22-IRD00002; NCC3-1070
Report No.(s): NASA/CR-2004-213176; E-14667; No Copyright; Avail: CASI; A03, Hardcopy

An analytic model for predicting the effect of unsteady local surface injection on the flow separating from a streamlined body at angle of attack is proposed. The model uses the premise that separation control results from enhanced mixing along the shear layer that develops between the main stream and the fluid in the underlying recirculation zone. High-Reynolds-number asymptotic methods are used to connect the unsteady surface injection to an instability wave propagating on the separating shear layer and then to the large-scale coherent structures that produce the increased mixing. The results is a tool that can guide the choice of fluid-actuator parameters to maximize flow-control effectiveness and may also facilitate computer-based numerical experiments.
Author
*Mathematical Models; Fluid Injection; Actuators; Surface Geometry; Multiphase Flow; Boundary Layer Separation*

**20040086475** NASA Langley Research Center, Hampton, VA, USA
**Towards Optimal Multigrid Efficiency for the Navier-Stokes Equations**
Swanson, R. C.; [2001]; 10 pp.; In English; 15th Computational Fluid Dynamics Conference, 11-14 Jun. 2001, Anaheim, CA, USA
Report No.(s): AIAA Paper 2001-2574; Copyright; Avail: CASI; A02, Hardcopy
A fast multigrid solver for the steady incompressible Navier-Stokes equations is presented. Unlike time-marching schemes, this approach uses relaxation of the steady equations. Application of this method results in a discretization that correctly distinguishes between the advection and elliptic parts of the operator, allowing efficient smoothers to be constructed. Numerical solutions are shown for flow over a flat plate and a Karman-Trefftz airfoil. Using collective Gauss-Seidel line relaxation in both the vertical and horizontal directions, multigrid convergence behavior approaching that of O(N) methods is achieved. The computational efficiency of the numerical scheme is compared with that of a Runge-Kutta based multigrid method.
Author
*Navier-Stokes Equation; Multigrid Methods; Numerical Analysis; Algorithms*

**20040086479** NASA Langley Research Center, Hampton, VA, USA
**Application of Nonstandard Analysis to the Study of the Shock Structure in a Viscous Heat Conducting Fluid**
Farassat, F.; Baty, R. S.; August 12, 2000; 14 pp.; In English; 53rd Annual Meeting of the American Physical Society's Division of Fluid Dynamics, 19-21 Nov. 2000, Washington, DC, USA; No Copyright; Avail: CASI; A03, Hardcopy
The study of the shock structure in a viscous heat conducting fluid is an old problem. We study this problem from a novel mathematical point of view. A new class of generalized functions is defined where multiplication of any two functions is allowed with the usual properties. A Heaviside function in this class has the unit jump at occurring on an infinitesimal interval of the nonstandard analysis (NSA) in the halo of . This jump has a smooth microstructure over the infinitesimal interval . From this point of view, we have a new class of Heaviside functions, and their derivatives the Dirac delta functions, which are equivalent when viewed as continuous linear functionals over the test function space of Schwartz. However, they differ in their microstructures which in applications are determined from physics of the problem as shown in our presentation.
Derived from text
*Conducting Fluids; Dynamic Pressure; Fluid Pressure; Viscous Fluids*

**20040086486** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Multidimensional Unstructured-Grid Liquid Rocket Engine Nozzle Performance and Heat Transfer Analysis**
Wang, Ten-See; [2004]; 12 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Report No.(s): AIAA Paper 2004-4016; No Copyright; Avail: CASI; A03, Hardcopy
The objectives of this study are to conduct a unified computational analysis for computing the design parameters such as axial thrust, convective and radiative wall heat fluxes for liquid rocket engine nozzles, so as to develop a computational strategy for computing those design parameters through parametric investigations. The computational methodology is based on a multidimensional, finite-volume, turbulent, chemically reacting, radiating, unstructured-grid, and pressure-based formulation, with grid refinement capabilities. Systematic parametric studies on effects of wail boundary conditions, combustion chemistry, radiation coupling, computational cell shape, and grid refinement were performed and assessed. Comparisons of the computed axial thrust performance, flow features, and wail heat fluxes with those of available test data and design calculations are presented.
Author
*Liquid Propellant Rocket Engines; Rocket Nozzles; Heat Transfer*

**20040086505** NASA Langley Research Center, Hampton, VA, USA
**Receptivity and Bypass Dynamics**
Lasseigne, D. G.; Criminale, W. O.; Joslin, R. D.; Jackson, T. L.; [1999]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Problems concerning laminar-turbulent transition are addressed by solving a series of initial value problems. Solutions to the temporal, initial-value problem .with an inhomogeneous forcing term imposed upon the flow are sought. It is shown that: (1) A transient disturbance lying located outside of the boundary layer can lead to the growth of an unstable Tollmein-Schlicting wave; (2) A resonance with the continuous spectrum may provide a mechanism for bypass transition; and (3) The continuum modes of a disturbance feed directly into the Tollmein-Schlicting wave downstream through non-parallel effects.
Author
*Turbulent Boundary Layer; Laminar Flow; Boundary Layer Transition*

**20040086516** Air Force Research Lab., Wright-Patterson AFB, OH, USA
**Hinge Moment Predictions Using CFD**
Grismer, M.; Kinsey, D.; Grismer, D.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 511-532; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

The present result indicated that: 1. Accurate predictions of aircraft control surface hinge moments needed for design. 2. Accurate predictions are difficult to obtain due to nonlinear effects. 3. CFD has not been providing accurate predictions. 4. Air vehicles directorate initiated a two part study to determine the factors leading to the large prediction errors. 5. Experimental investigation: provide an accurate database of hinge moment data; used constant cross section, rectangular wing with partial span flap; wing/flap section taken from discarded AF drone to reduce coast. 6. Numerical investigation: compare against experimental database; consider varying levels of modeling physics; and consider varying levels of geometric complexity.
Derived from text
*Computational Fluid Dynamics; Errors; Data Bases; Aircraft Control*

**20040086517** Lockheed Martin Aeronautics Co., Fort Worth, TX, USA
**Rapid Euler CFD for High-Performance Aircraft Design**
Charlton, Eric F.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 593-637; In English; See also 20040086515
Contract(s)/Grant(s): NAS1-96014; No Copyright; Avail: CASI; A03, Hardcopy

The goal here was to present one approach to rapid CFD for S&C using an unstructured inviscid method, in order to eventually assess S&C properties as early in the design process as possible. Specific results are presented regarding time, accuracy (as compared to a baseline wind tunnel database) and simplicity for the user. For COMSAC, it s more important to talk about the ″specifications″ required by Advanced Design and S&C, as well as how the CFD results can be combined for envelope evaluation.
Derived from text
*Computational Fluid Dynamics; Aircraft Design; Data Bases*

**20040086519** Cobalt Solutions, LLC, Springfield, OH, USA
**Application of CFD to Abrupt Wing Stall Using RANS and DES**
Forsythe, Jim; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 433-488; In English; See also 20040086515
Contract(s)/Grant(s): NAS1-00135; No Copyright; Avail: CASI; A04, Hardcopy

For DES, RANS is responsible for predicting boundary layer growth and separation. LES is responsible for predicting the geometry dependent turbulent flow features. Grid adaptation done using NASA Langley s RefineMesh program. Adaptation on time average of vorticity
Author
*Computational Fluid Dynamics; Aerodynamic Stalling; Turbulent Flow*

**20040086520** California Univ., Davis, CA, USA
**CFD Simulation of Aircraft in Coning Motion**
Saephan, Syta; vanDam, Case P.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 533-564; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

Accurate determination of the stability and control characteristics of an aircraft is critical to the safety of that aircraft. The flight envelope of some aircraft often pushes the limits on angle of attack and rapid motion maneuvers. At these flight conditions the flow about the aircraft tends to be unsteady and separated and the variation in the forces and moments with angle of attack or motion rate are often nonlinear.
Derived from text
*Computational Fluid Dynamics; Coning Motion; Flight Conditions; Simulation*

**20040086524** NASA Langley Research Center, Hampton, VA, USA
**Application of Computational Stability and Control Techniques Including Unsteady Aerodynamics and Aeroelastic Effects**
Schuster, David M.; Edwards, John W.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 489-510; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

The motivation behind the inclusion of unsteady aerodynamics and aeroelastic effects in the computation of stability and control (S&C) derivatives will be discussed as they pertain to aeroelastic and aeroservoelastic analysis. This topic will be addressed in the context of two applications, the first being the estimation of S&C derivatives for a cable-mounted aeroservoelastic wind tunnel model tested in the NASA Langley Research Center (LaRC) Transonic Dynamics Tunnel (TDT). The second application will be the prediction of the nonlinear aeroservoelastic phenomenon known as Residual Pitch Oscillation (RPO) on the B-2 Bomber. Techniques and strategies used in these applications to compute S&C derivatives and perform flight simulations will be reviewed, and computational results will be presented.
Derived from text
*Computation; Stability Derivatives; Unsteady Aerodynamics; Aeroservoelasticity*

**20040086525** Jacobs Sverdrup Technology, Inc., Eglin AFB, FL, USA
**Use of CFD-Generated Aerodynamic Data for an F-15E/SLV Flying/Handling Qualities Analysis**
Batte, Jeffery; Westmoreland, Shawn; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 565-592; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

Air Force Research Laboratory (AFRL) requested an assessment by the USAF seek eagle office for carriage of the microSatellite Launch Vehicle (SLV) on an F-15E aircraft.
Derived from text
*Computational Fluid Dynamics; Flight Characteristics; Launch Vehicles; Microsatellites*

**20040086527** Nielsen Engineering and Research, Inc., Mountain View, CA, USA
**A Best Practices System to Enhance CFD Use in Stability and Control Applications**
Morrison, Joseph H.; Mendenhall, Michael R.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 656-670; In English; See also 20040086515
Contract(s)/Grant(s): NAS1-03053; No Copyright; Avail: CASI; A03, Hardcopy

Successful use of CFD to provide aerodynamics for stability and control (S&C) applications will require that the traditional time and costs associated with CFD be reduced and that the errors and uncertainties currently associated with CFD be better understood. CFD will be required to work under a wide range of flow conditions and provide fast and reliable aerodynamics if it is to contribute to this next generation of S&C analyses. CFD solutions have errors and uncertainties due to poorly converged solutions, solution anomalies caused by grids, turbulence models, and parameter selection, and other manifold reasons. In addition to the above problems, there will be a requirement for communications between the CFD expert and the S&C expert and possibly experts from other related disciplines. The CFD expert may not understand the technical problems associated with S&C, and it is almost certain the converse is true.
Author
*Computational Fluid Dynamics; Aerodynamic Stability; Turbulence Models*

**20040086528** AeroArts, LLC, Palos Verdes Peninsula, CA, USA
**Dynamic Water Tunnel Testing for Code Benchmarking**
Hodgkins, John; Smith, Brooke; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 671-691; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

Dynamic water tunnel testing can detect anomalous aerodynamic, flying, and handling qualities missed in ground tests before the flight test phase of aircraft development. The three pillars of modern water tunnel usage are: 1) Flow Visualization;

2) Force Measurement; 3) Motion Control. This viewgraph presentation also examines motion scaling, and introduces the AeroArts Scorpio system for water tunnel test analysis.
CASI
*Water Tunnel Tests; Flow Visualization; Computer Programs*

## 35
## INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Avionics and Aircraft Instrumentation*; and *19 Spacecraft Instrumentation and Astrionics*.

**20040085486** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Development of a Breakthrough Detector for Gas Masks: An 'End of Service Life Indicator'**
Linders, M. J. G.; December 2003; 29 pp.; In Dutch
Contract(s)/Grant(s): A95/KL/431; A/01/KL/502; TNO Proj. 014.12716; TNO Proj. 014.13091
Report No.(s): TD-2002-0266; PML-2003-A92; Copyright; Avail: Other Sources

Activated carbon filters in respiratory protection devices form a reliable means of protection against toxic gases. Because their sorption capacity is limited, the time filters can be used is restricted. It is useful for the wearer of a mask, to have a detection method to warn for the imminent exhaustion of the filter. At TNO an approach is under development to realize such a detection method, which is known as End of Service Life Indicator - ESLI. The principle of the ESLI is the detection of the release of a pre-adsorbed signal compound from a special adsorbent as a result of the adsorption of a chemical warfare agent or any other atmospheric contaminant. The focus in this work has been directed to the development of a suitable adsorbent. Important characteristics of such an adsorbent are: the signal compound must remain adsorbed while an air flow is passed through, have good temperature stability, and be able to withstand high relative humidities while the signal compound must be released easily (desorbed) by other compounds (contaminants). Although good progress has been made, the combination of adsorbent and signal compound that fulfills the complex range of demands has not yet been realized.
Author
*Product Development; Gas Detectors; Carbon; Filters; Masks*

**20040085591** Swiss Federal Inst. for Snow and Avalanche Research, Dorf, Switzerland
**Determining Structural and Mechanical Properties of Snow with a High-Resolution Penetrometer**
Kronholm, K.; Johnson, J. B.; Schneebeli, M.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

On Earth, and possibly in extraterrestrial environments, the snow cover consists of individual snow layers that metamorphose over time. The stratigraphic record of snow layers is the result of erosional and depositional events. Adjacent layers differ in terms of their structural and mechanical properties. The structural properties of the upper snow layers are important for the chemical exchange between the atmosphere and the snow cover, snow hydrology, and the spectral properties of the snow cover. The mechanical properties are relevant for over-snow trafficability of vehicles and animals, and for avalanche release. Traditionally, snow is characterized by subjective measures of grain shape and size, and hardness. Until recently, no fully automatic and objective methods to describe snow microstructure were available. The recent development of a snow micropenetrometer (SMP) now provides an objective way to measure the structural and mechanical properties of snow layers at different spatial scales. The SMP interpretation methods used for snow have also been used to objectively characterize soil.
Author
*Penetrometers; Snow Cover*

**20040085709** NASA Langley Research Center, Hampton, VA, USA
**Development of Next Generation Lifetime PSP Imaging Systems**
Watkins, A. Neal; Jordan, Jeffrey D.; Leighty, Bradley D.; Ingram, JoAnne L.; Oglesby, Donald M.; [2002]; 12 pp.; In English
Contract(s)/Grant(s): IA1-568; No Copyright; Avail: CASI; A03, Hardcopy

This paper describes a lifetime PSP system that has recently been developed using pulsed light-emitting diode (LED) lamps and a new interline transfer CCD camera technology. This system alleviates noise sources associated with lifetime PSP

systems that use either flash-lamp or laser excitation sources and intensified CCD cameras for detection. Calibration curves have been acquired for a variety of PSP formulations using this system, and a validation test was recently completed in the Subsonic Aerodynamic Research Laboratory (SARL) at Wright-Patterson Air Force Base (WPAFB). In this test, global surface pressure distributions were recovered using both a standard intensity-based method and the new lifetime system. Results from the lifetime system agree both qualitatively and quantitatively with those measured using the intensity-based method. Finally, an advanced lifetime imaging technique capable of measuring temperature and pressure simultaneously is introduced and initial results are presented.
Author
*Light Emitting Diodes; CCD Cameras; Imaging Techniques; Calibrating*

**20040085737** NASA Langley Research Center, Hampton, VA, USA
**Multi-Image Registration for an Enhanced Vision System**
Hines, Glenn; Rahman, Zia-Ur; Jobson, Daniel; Woodell, Glenn; [2002]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

An Enhanced Vision System (EVS) utilizing multi-sensor image fusion is currently under development at the NASA Langley Research Center. The EVS will provide enhanced images of the flight environment to assist pilots in poor visibility conditions. Multi-spectral images obtained from a short wave infrared (SWIR), a long wave infrared (LWIR), and a color visible band CCD camera, are enhanced and fused using the Retinex algorithm. The images from the different sensors do not have a uniform data structure: the three sensors not only operate at different wavelengths, but they also have different spatial resolutions, optical fields of view (FOV), and bore-sighting inaccuracies. Thus, in order to perform image fusion, the images must first be co-registered. Image registration is the task of aligning images taken at different times, from different sensors, or from different viewpoints, so that all corresponding points in the images match. In this paper, we present two methods for registering multiple multi-spectral images. The first method performs registration using sensor specifications to match the FOVs and resolutions directly through image resampling. In the second method, registration is obtained through geometric correction based on a spatial transformation defined by user selected control points and regression analysis.
Author
*Enhanced Vision; Pattern Registration; Visibility; Multisensor Applications; Imaging Techniques*

**20040085907** ATK-Thiokol Propulsion, Brigham City, UT, USA
**Pressure Oscillations and Structural Vibrations in Space Shuttle RSRM and ETM-3 Motors**
Mason, D. R.; Morstadt, R. A.; Cannon, S. M.; Gross, E. G.; Nielsen, D. B.; March 24, 2004; 17 pp.; In English; AIAA/ASME/SAE/ASEE 40th Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-97238
Report No.(s): AIAA Paper 2004-3898; Copyright; Avail: CASI; A03, Hardcopy

The complex interactions between internal motor pressure oscillations resulting from vortex shedding, the motor's internal acoustic modes, and the motor's structural vibration modes were assessed for the Space Shuttle four-segment booster Reusable Solid Rocket Motor and for the five-segment engineering test motor ETM-3. Two approaches were applied 1) a predictive procedure based on numerically solving modal representations of a solid rocket motor s acoustic equations of motion and 2) a computational fluid dynamics two-dimensional axi-symmetric large eddy simulation at discrete motor burn times.
Author
*Pressure Oscillations; Solid Propellant Rocket Engines; Structural Vibration; Computational Fluid Dynamics; Space Shuttle Boosters*

**20040085920** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Finding a Cold Needle in a Warm Haystack: Infrared Imaging Applied to Locating Cryocooled Crystals in Loops**
Snell, E. H.; vanderWoerd, M. J.; Miller, M. D.; Deacon, A. M.; [2004]; 1 pp.; In English
Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

We demonstrate the use of inbred imaging to locate crystals mounted in cryoloops and cryopreserved in a nitrogen gas stream at 100K. In the home laboratory crystals are clearly seen in the infrared images with light transmitting through the sample while irradiating the crystal from behind, and with illumination from a direction perpendicular to the direction of view. The crystals transmit and reflect infrared radiation differently from the surrounding mother liquor and loop. Because of differences in contrast between crystals and their surrounding mother liquor, it is possible to clearly identify the crystal

position. In use at the synchrotron, with robotically mounted crystals the small depth of field of the lens required the recording of multiple images at different focal points. Image processing techniques were then used to produce a clear image of the crystal. The resulting infrared images and intensity profiles show that infrared imaging can be a powerful complement to visual imaging in locating crystals in cryocooled loops.
Author
*Infrared Imagery; Cryogenic Cooling; Crystals; Imaging Techniques*

**20040086003** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Performance of the Zero Degree Detector**
Christl, Mark J.; [2004]; 1 pp.; In English; Committee on Space Research Assembly, 18-25 Jul. 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

The Zero Degree Detector (ZDD) is a large area pixelated silicon detector that measures secondary particle angular distributions from heavy ion interactions. The ZDD is part of the instrumentation being used in an ongoing measurement program to measure fragmentation cross-sections of heavy nuclei and evaluate the relative effectives of novel materials for spacecraft shielding. The initial performance of the ZDD has been assessed using the primary heavy ions measured. We report here on the ZDD's design, capabilities and signal calibration using heavy ions.
Author
*Silicon; Detectors; Systems Engineering; Heavy Ions*

**20040086056** NASA Langley Research Center, Hampton, VA, USA
**Thermographic Imaging of Material Loss in Boiler Water-Wall Tubing by Application of Scanning Line Source**
Cramer, K. Elliott; Winfree, William P.; [2000]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Localized wall thinning due to corrosion in utility boiler water-wall tubing is a significant inspection concern for boiler operators. Historically, conventional ultrasonics has been used for inspection of these tubes. This technique has proven to be very manpower and time intensive. This has resulted in a spot check approach to inspections, documenting thickness measurements over a relatively small percentage of the total boiler wall area. NASA Langley Research Center has developed a thermal NDE technique designed to image and quantitatively characterize the amount of material thinning present in steel tubing. The technique involves the movement of a thermal line source across the outer surface of the tubing followed by an infrared imager at a fixed distance behind the line source. Quantitative images of the material loss due to corrosion are reconstructed from measurements of the induced surface temperature variations. This paper will present a discussion of the development of the thermal imaging system as well as the techniques used to reconstruct images of flaws. The application of the thermal line source coupled with the analysis technique represents a significant improvement in the inspection speed for large structures such as boiler water-walls. A theoretical basis for the technique will be presented which explains the quantitative nature of the technique. Further, a dynamic calibration system will be presented for the technique that allows the extraction of thickness information from the temperature data. Additionally, the results of applying this technology to actual water-wall tubing samples and in situ inspections will be presented.
Author
*Thermography; Imaging Techniques; Boilers; Water; Walls; Turbine Pumps*

**20040086078** NASA Langley Research Center, Hampton, VA, USA
**Design of a Far-Infrared Spectrometer for Atmospheric Thermal Emission Measurements**
Johnson, David G.; [2004]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Global measurements of far infrared emission from the upper troposphere are required to test models of cloud radiative forcing, water vapor continuum emission, and cooling rates. Spectra with adequate resolution can also be used for retrieving atmospheric temperature and humidity profiles, and yet there are few spectrally resolved measurements of outgoing longwave flux at wavelengths longer than 16 m. It has been difficult to make measurements in the far infrared due to the need for liquid-helium cooled detectors and large optics to achieve adequate sensitivity and bandwidth. We review design considerations for infrared Fourier transform spectrometers, including the dependence of system performance on basic system parameters, and discuss the prospects for achieving useful sensitivity from a satellite platform with a lightweight spectrometer using uncooled detectors.
Author
*Design Analysis; Far Infrared Radiation; Spectrometers; Thermal Emission; Temperature Measurement*

**20040086082** NASA Langley Research Center, Hampton, VA, USA
**Development of an Intelligent Videogrammetric Wind Tunnel Measurement System**
Graves, Sharon S.; Burner, Alpheus W.; [2004]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

A videogrammetric technique developed at NASA Langley Research Center has been used at five NASA facilities at the Langley and Ames Research Centers for deformation measurements on a number of sting mounted and semispan models. These include high-speed research and transport models tested over a wide range of aerodynamic conditions including subsonic, transonic, and supersonic regimes. The technique, based on digital photogrammetry, has been used to measure model attitude, deformation, and sting bending. In addition, the technique has been used to study model injection rate effects and to calibrate and validate methods for predicting static aeroelastic deformations of wind tunnel models. An effort is currently underway to develop an intelligent videogrammetric measurement system that will be both useful and usable in large production wind tunnels while providing accurate data in a robust and timely manner. Designed to encode a higher degree of knowledge through computer vision, the system features advanced pattern recognition techniques to improve automated location and identification of targets placed on the wind tunnel model to be used for aerodynamic measurements such as attitude and deformation. This paper will describe the development and strategy of the new intelligent system that was used in a recent test at a large transonic wind tunnel.
Derived from text
*Photogrammetry; Computer Vision; Image Processing; Deformation; Aeroelasticity*

**20040086094** Army Research Lab., Hampton, VA, USA
**Validation of High Displacement Piezoelectric Actuator Finite Element Models**
Taleghani, Barmac; [2000]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The paper presents the results obtained by using NASTRAN(R) and ANSYS(R) finite element codes to predict doming of the THUNDER piezoelectric actuators during the manufacturing process and subsequent straining due to an applied input voltage. To effectively use such devices in engineering applications, modeling and characterization are essential. Length, width, dome height, and thickness are important parameters for users of such devices. Therefore, finite element models were used to assess the effects of these parameters. NASTRAN(R) and ANSYS(R) used different methods for modeling piezoelectric effects. In NASTRAN(R) , a thermal analogy was used to represent voltage at nodes as equivalent temperatures, while ANSYS processed the voltage directly using piezoelectric finite elements. The results of finite element models were validated by using the experimental results.
Author
*Piezoelectric Actuators; Finite Element Method; Nastran*

**20040086100** NASA Langley Research Center, Hampton, VA, USA
**Videogrammetric Model Deformation Measurement Technique**
Burner, A. W.; Liu, Tian-Shu; [2001]; 31 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The theory, methods, and applications of the videogrammetric model deformation (VMD) measurement technique used at NASA for wind tunnel testing are presented. The VMD technique, based on non-topographic photogrammetry, can determine static and dynamic aeroelastic deformation and attitude of a wind-tunnel model. Hardware of the system includes a video-rate CCD camera, a computer with an image acquisition frame grabber board, illumination lights, and retroreflective or painted targets on a wind tunnel model. Custom software includes routines for image acquisition, target-tracking/identification, target centroid calculation, camera calibration, and deformation calculations. Applications of the VMD technique at five large NASA wind tunnels are discussed.
Derived from text
*Deformation; Photogrammetry; Aeroelasticity; Wind Tunnels; Algorithms*

**20040086469** Army Research Lab., Hampton, VA, USA
**Synchronized Electronic Shutter System (SESS) for Thermal Nondestructive Evaluation**
Zalameda, Joseph N.; [2001]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The purpose of this paper is to describe a new method for thermal nondestructive evaluation. This method uses a synchronized electronic shutter system (SESS) to remove the heat lamp's influence on the thermal data during and after flash heating. There are two main concerns when using flash heating. The first concern is during the flash when the photons are reflected back into the camera. This tends to saturate the detectors and potentially introduces unknown and uncorrectable errors when curve fitting the data to a model. To address this, an electronically controlled shutter was placed over the infrared camera

lens. Before firing the flash lamps, the shutter is opened to acquire the necessary background data for offset calibration. During flash heating, the shutter is closed to prevent the photons from the high intensity flash from saturating the camera's detectors. The second concern is after the flash heating where the lamps radiate heat after firing. This residual cooling introduces an unwanted transient thermal response into the data. To remove this residual effect, a shutter was placed over the flash lamps to block the infrared heat radiating from the flash head after heating. This helped to remove the transient contribution of the flash. The flash lamp shutters were synchronized electronically with the camera shutter. Results are given comparing the use of the thermal inspection with and without the shutter system.
Author
*Camera Shutters; Nondestructive Tests; Synchronism; Thermography; Electronic Control*

**20040086492** NASA Langley Research Center, Hampton, VA, USA
**Response Times in Correcting Non-Normal System Events When Collocating Status, Alerts and Procedures, and Controls**
Trujillo, Anna C.; [2002]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Currently, most of the displays in control rooms can be categorized as status, alerts/procedures, or control screens. With the advent and use of CRTs and the associated computing power available to compute and display information, it is now possible to combine these different elements of information and control onto a single display. An experiment was conducted to determine which, if any, of these functions should be collocated in order to better handle simple anticipated non-normal system events. The results indicated that there are performance benefits and subject preferences to combining all the information onto one screen or combining the status and alert/procedure information onto one screen and placing the controls in another area.
Author
*Time Dependence; Display Devices; Alertness*

## 36
## LASERS AND MASERS

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*.

**20040085703** NASA Langley Research Center, Hampton, VA, USA
**High Power Laser Diode Arrays for 2-Micron Solid State Coherent Lidars Applications**
Amzajerdian, Farzin; Meadows, Byron; Kavaya, Michael J.; Singh, Upendra; Sudesh, Vikas; Baker, Nathaniel; [2003]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Laser diode arrays are critical components of any diode-pumped solid state laser systems, constraining their performance and reliability. Laser diode arrays (LDAs) are used as the pump source for energizing the solid state lasing media to generate an intense coherent laser beam with a high spatial and spectral quality. The solid state laser design and the characteristics of its lasing materials define the operating wavelength, pulse duration, and power of the laser diodes. The pump requirements for high pulse energy 2-micron solid state lasers are substantially different from those of more widely used 1-micron lasers and in many aspects more challenging [1]. Furthermore, the reliability and lifetime demanded by many coherent lidar applications, such as global wind profiling from space and long-range clear air turbulence detection from aircraft, are beyond the capability of currently available LDAs. In addition to the need for more reliable LDAs with longer lifetime, further improvement in the operational parameters of high power quasi-cw LDAs, such as electrical efficiency, brightness, and duty cycle, are also necessary for developing cost-effective 2-micron coherent lidar systems for applications that impose stringent size, heat dissipation, and power constraints. Global wind sounding from space is one of such applications, which is the main driver for this work as part of NASA s Laser Risk Reduction Program. This paper discusses the current state of the 792 nm LDA technology and the technology areas being pursued toward improving their performance. The design and development of a unique characterization facility for addressing the specific issues associated with the LDAs for pumping 2-micron coherent lidar transmitters and identifying areas of technological improvement will be described. Finally, the results of measurements to date on various standard laser diode packages, as well as custom-designed packages with potentially longer lifetime, will be reported.
Derived from text
*High Power Lasers; Semiconductor Lasers; Solid State Lasers; Coherent Radar; Laser Arrays*

**20040086063** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Advanced Receiver/Converter Experiments for Laser Wireless Power Transmission**

Howell, Joe T.; ONeill, Mark; Fork, Richard; [2004]; 2 pp.; In English; Fourth International Conference on Solar Power from Space, 30 Jun. - 2 Jul. 2004, Granada, Spain; Copyright; Avail: CASI; A01, Hardcopy

For several years NASA Marshall Space Flight Center, UAH and ENTECH have been working on various aspects of space solar power systems. The current activity was just begun in January 2004 to further develop this new photovoltaic concentrator laser receiver/converter technology. During the next few months, an improved prototype will be designed, fabricated, and thoroughly tested under laser illumination. The final paper will describe the new concept, present its advantages over other laser receiver/converter approaches (including planar photovoltaic arrays), and provide the latest experiment results on prototype hardware (including the effects of laser irradiance level and cell temperature). With NASA's new human exploration plans to first return to the Moon, and then to proceed to Mars, the new photovoltaic concentrator laser receiver/converter technology could prove to be extremely useful in providing power to the landing sites and other phases of the missions. For example, to explore the scientifically interesting and likely resource-rich poles of the Moon (which may contain water) or the poles of Mars (which definitely contain water and carbon dioxide), laser power beaming could represent the simplest means of providing power to these regions, which receive little or no sunlight, making solar arrays useless there. In summary, the authors propose a paper on definition and experimental results of a novel photovoltaic concentrator approach for collecting and converting laser radiation to electrical power. The new advanced photovoltaic concentrator laser receiver/converter offers higher performance, lighter weight, and lower cost than competing concepts, and early experimental results are confirming the expected excellent Performance levels. After the small prototypes are successfully demonstrated, a larger array with even better performance is planned for the next phase experiments and demonstrations. Thereafter, a near-term flight experiment of the new technology should be developed and flown, to lay the groundwork for future space power applications in the Earth-Moon neighborhood, and ultimately encompassing Mars and its environs.

Author (revised)

*Laser Power Beaming; Receivers; Photovoltaic Cells*

## 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*.

**20040085923** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Thrust Stand for Electric Propulsion Performance Evaluation**

Markusic, T. E.; Jones, J. E.; Cox, M. D.; [2004]; 10 pp.; In English; AIAA/ASME/SAE/ASEE 40th Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA

Report No.(s): AIAA Paper 2004-3441; No Copyright; Avail: CASI; A02, Hardcopy

An electric propulsion thrust stand capable of supporting thrusters with total mass of up to 125 kg and 1 mN to 1 N thrust levels has been developed and tested. The mechanical design features a conventional hanging pendulum arm attached to a balance mechanism that transforms horizontal motion into amplified vertical motion, with accommodation for variable displacement sensitivity. Unlike conventional hanging pendulum thrust stands, the deflection is independent of the length of the pendulum arm, and no reference structure is required at the end of the pendulum. Displacement is measured using a non-contact, optical linear gap displacement transducer. Mechanical oscillations are attenuated using a passive, eddy current damper. An on-board microprocessor-based level control system, which includes a two axis accelerometer and two linear-displacement stepper motors, continuously maintains the level of the balance mechanism - counteracting mechanical %era drift during thruster testing. A thermal control system, which includes heat exchange panels, thermocouples, and a programmable recirculating water chiller, continuously adjusts to varying thermal loads to maintain the balance mechanism temperature, to counteract thermal drifts. An in-situ calibration rig allows for steady state calibration both prior to and during thruster testing. Thrust measurements were carried out on a well-characterized 1 kW Hall thruster; the thrust stand was shown to produce repeatable results consistent with previously published performance data.

Author

*Electric Propulsion; Thrust Measurement; Systems Engineering; Temperature Control; Mechanical Engineering*

**20040085979** NASA Langley Research Center, Hampton, VA, USA

**Refinements to the Mixed-Mode Bending Test for Delamination Toughness**

Reeder, James R.; [2000]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The mixed-mode bending (MMB) test for delamination toughness was first introduced in 1988. This simple test is a combination of the standard Mode I (opening) test and a Mode II (sliding) test. This MMB test has become widely used in the USA and around the world for mixed-mode toughness measurements. Because of the widespread use of this test method, it is being considered for standardization by ASTM Committee D30. This paper discusses several improvements to the original test method. The improvements to the MMB test procedure include an improved method for calculating toughness from the measured test quantities, a more accurate way of setting the mixed-mode ratio to be tested, and the inclusion of a new alignment criterion for improved consistency in measured values.

Author

*Bend Tests; Toughness; Sliding*

**20040085984** NASA Langley Research Center, Hampton, VA, USA

**Boiler Tube Corrosion Characterization with a Scanning Thermal Line**

Cramer, K. Elliott; Jacobstein, Ronald; Reilly, Thomas; [2001]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Wall thinning due to corrosion in utility boiler water wall tubing is a significant operational concern for boiler operators. Historically, conventional ultrasonics has been used for inspection of these tubes. Unfortunately, ultrasonic inspection is very manpower intense and slow. Therefore, thickness measurements are typically taken over a relatively small percentage of the total boiler wall and statistical analysis is used to determine the overall condition of the boiler tubing. Other inspection techniques, such as electromagnetic acoustic transducer (EMAT), have recently been evaluated, however they provide only a qualitative evaluation - identifying areas or spots where corrosion has significantly reduced the wall thickness. NASA Langley Research Center, in cooperation with ThermTech Services, has developed a thermal NDE technique designed to quantitatively measure the wall thickness and thus determine the amount of material thinning present in steel boiler tubing. The technique involves the movement of a thermal line source across the outer surface of the tubing followed by an infrared imager at a fixed distance behind the line source. Quantitative images of the material loss due to corrosion are reconstructed from measurements of the induced surface temperature variations. This paper will present a discussion of the development of the thermal imaging system as well as the techniques used to reconstruct images of flaws. The application of the thermal line source coupled with the analysis technique represents a significant improvement in the inspection speed and accuracy for large structures such as boiler water walls. A theoretical basis for the technique will be presented to establish the quantitative nature of the technique. Further, a dynamic calibration system will be presented for the technique that allows the extraction of thickness information from the temperature data. Additionally, the results of the application of this technology to actual water wall tubing samples and in-situ inspections will be presented.

Author

*Boilers; Corrosion; Pipes (Tubes); Thermal Analysis; Scanning*

**20040085993** NASA Langley Research Center, Hampton, VA, USA

**Exploratory Investigation of Failure Mechanisms in Transition Regions between Solid Laminates and X-cor(registered tm) Truss Sandwich**

OBrien, T. Kevin; Paris, Isabelle L.; [2004]; 35 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Small sub-component specimens consisting of solid laminates at the ends that transition to X-cor(R) truss sandwich in the center, were tested in a combination of three point bending, uni-axial tension, and combined tension and bending. The failure process in the transition region was documented for each loading using digital video and high-resolution cameras. For the 3-point bending tests, most of the deformation occurred in the solid laminate regions on either end of the specimen. Some pin debonding from the skin of the X-cor(R) truss sandwich was observed in the transition region and was accompanied by audible ″pings″ throughout the loading. Tension loaded specimens failed in the sandwich skin in the middle of the gage length, accompanied by separation of the sandwich core from the back skin and by delamination between the top skin and bottom skin at the transition region. The pinging associated with pin debonding occurred as the load was increased. However, the frequency of the pinging exceeded any visual observations of pin debonding in the video of the transition region. For specimens tested in combined tension and bending, the greatest amount of pinging occurred during initial application of the axial load. High-resolution images in the transition region indicated that the pinging corresponded to pins debonding and

buckling due to the through-thickness Poisson contraction of the specimen. This buckling continued to a much smaller extent as the transverse load was applied.
Author
*Failure; Solid Phases; Laminates; Measuring Instruments; Deformation*

**20040086029** Illinois Dept. of Commerce and Community Affairs, Springfield, IL, USA, Argonne National Lab., IL, USA
**Fuel-Cycle Energy and Emission Impacts of Ethanol-Diesel Blends in Urban Buses and Farming Tractors**
Jul. 2003; In English
Report No.(s): DE2003-815668; No Copyright; Avail: National Technical Information Service (NTIS)

About 2.1 billion gallons of fuel ethanol was used in the USA in 2002, mainly in the form of gasoline blends containing up to 10% ethanol (E10). Ethanol use has the potential to increase in the U.S. blended gasoline market because methyl tertiary butyl ether (MTBE), formerly the most popular oxygenate blendstock, may be phased out owing to concerns about MTBE contamination of the water supply. Ethanol would remain the only viable near-term option as an oxygenate in reformulated gasoline production and to meet a potential federal renewable fuels standard (RFS) for transportation fuels. Ethanol may also be blended with additives (co-solvents) into diesel fuels for applications in which oxygenation may improve diesel engine emission performance. Numerous studies have been conducted to evaluate the fuel-cycle energy and greenhouse gas (GHG) emission effects of ethanol-gasoline blends relative to those of gasoline for applications in spark-ignition engine vehicles.
NTIS
*Ethyl Alcohol; Diesel Fuels*

**20040086034** EHKTTechnologies, Vancouver, WA, USA
**Opportunities for Low Cost Titanium in Reduced Fuel Consumption, Improved Emissions, and Enhanced Durability Heavy-Duty Vehicles**
Jul. 2002; In English
Report No.(s): DE2003-814648; No Copyright; Avail: National Technical Information Service (NTIS)

The purpose of this study was to determine which components of heavy-duty highway vehicles are candidates for the substitution of titanium materials for current materials if the cost of those Ti components is very significantly reduced from current levels. The processes which could be used to produce those low cost components were also investigated. Heavy-duty highway vehicles are defined as all trucks and busses included in Classes 2C through 8. These include heavy pickups and vans above 8,500 lbs. GVWR, through highway tractor trailers. Class 8 is characterized as being a very cyclic market, with 'normal' year volume, such as in 2000, of approximately 240,000 new vehicles. Classes 3-7 are less cyclic, with ″normal″ i.e., year 2000, volume totaling approximately 325,000 new vehicles. Classes 3-8 are powered about 88.5% by diesel engines, and Class 2C at very roughly 83% diesel. The engine portion of the study therefore focused on diesels. Vehicle production volumes were used in estimates of the market size for candidate components.
NTIS
*Fuel Consumption; Low Cost; Titanium*

**20040086089** National Academy of Sciences - National Research Council, Hampton, VA, USA
**A Shell/3D Modeling Technique for the Analyses of Delaminated Composite Laminates**
Krueger, Ronald; OBrien, T. Kevin; Composites Part A: Applied Science and Manufacturing; 2001; Volume 32, No. 1, pp. 25-44; In English; No Copyright; Avail: CASI; A03, Hardcopy

A shell/3D modeling technique was developed for which a local three-dimensional solid finite element model is used only in the immediate vicinity of the delamination front. The goal was to combine the accuracy of the full three-dimensional solution with the computational efficiency of a plate or shell finite element model. Multi-point constraints provided a kinematically compatible interface between the local three-dimensional model and the global structural model which has been meshed with plate or shell finite elements. Double Cantilever Beam (DCB), End Notched Flexure (ENF), and Single Leg Bending (SLB) specimens were modeled using the shell/3D technique to study the feasibility for pure mode I (DCB), mode II (ENF) and mixed mode I/II (SLB) cases. Mixed mode strain energy release rate distributions were computed across the width of the specimens using the virtual crack closure technique. Specimens with a unidirectional layup and with a multidirectional layup where the delamination is located between two non-zero degree plies were simulated. For a local three-dimensional model, extending to a minimum of about three specimen thicknesses on either side of the delamination front, the results were in good agreement with mixed mode strain energy release rates obtained from computations where the entire specimen had been modeled with solid elements. For large built-up composite structures modeled with plate elements,

the shell/3D modeling technique offers a great potential for reducing the model size, since only a relatively small section in the vicinity of the delamination front needs to be modeled with solid elements.
Author
*Three Dimensional Models; Shells (Structural Forms); Composite Structures; Finite Element Method; Laminates*

**20040086093** NASA Langley Research Center, Hampton, VA, USA
**SMA Hybrid Composites for Dynamic Response Abatement Applications**
Turner, Travis L.; [2000]; 13 pp.; In English; 7th International Conference on Recent Advances in Structural Dynamics, 24-7 Jul. 2000, Southampton, UK; No Copyright; Avail: CASI; A03, Hardcopy

A recently developed constitutive model and a finite element formulation for predicting the thermomechanical response of Shape Memory Alloy (SMA) hybrid composite (SMAHC) structures is briefly described. Attention is focused on constrained recovery behavior in this study, but the constitutive formulation is also capable of modeling restrained or free recovery. Numerical results are shown for glass/epoxy panel specimens with embedded Nitinol actuators subjected to thermal and acoustic loads. Control of thermal buckling, random response, sonic fatigue, and transmission loss are demonstrated and compared to conventional approaches including addition of conventional composite layers and a constrained layer damping treatment. Embedded SMA actuators are shown to be significantly more effective in dynamic response abatement applications than the conventional approaches and are attractive for combination with other passive and/or active approaches.
Author
*Acoustic Fatigue; Actuators; Dynamic Response; Epoxy Matrix Composites; Nitinol Alloys*

**20040086438** NASA Marshall Space Flight Center, Huntsville, AL, USA
**New Hydrophilic, Composite Membranes for Air Removal from Water Coolant Systems**
Ritchie, Stephen M. C.; Luo, Qiang; Curtis, Salina S.; Holladay, Jon B.; Clark, Dallas W.; [2004]; 12 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA; Copyright; Avail: CASI; A03, Hardcopy

Liquid coolants are commonly used as thermal transport media to increase efficiency and flexibility in aerospace vehicle design. The introduction of gas bubbles into the coolant can have negative consequences, including: loss of centrifugal pump prime, irregular sensor readings, and blockage of coolant flow to remote systems. One solution to mitigate these problems is the development of a passive gas removal device, or gas trap, installed in the flight cooling system. In this study, a new hydrophilic, composite membrane has been developed for passage of the coolant fluid and retention of gas bubbles. The trapped bubbles are subsequently vented from the system by a thin, hydrophobic, microporous membrane. The original design for this work employed a homogeneous membrane that was susceptible to fouling and pore plugging. Spare gas traps of this variety have degraded during storage, and recreation of the membranes has been complicated due to problems with polymer duplication and property variations in the final membranes. In this work, replacements have been developed based on deposition of a hydrophilic polymer on the bore-side of a porous polyethylene (PE) tube. The tube provides excellent chemical and mechanical stability, and the hydrophilic layer provides retention of gas bubbles. Preliminary results have shown that intimate contact is required between the deposited layer and the substrate to overcome material differences. This has been accomplished by presoaking the membrane tube in the solvent to raise its surface energy. Polymer solutions of various concentrations have been used to promote penetration of the polymer layer into the porous substrate and to control separation layer thickness. The resulting composite membranes have shown repeatable decrease in nitrogen permeability, which is indicative of a decrease in membrane pore size. Studies with water permeation have yielded similar results. We have observed some swelling of the added polymer layer, which causes a slight decrease in membrane pore size, and should result in improved bubble retention. Preliminary studies have also been performed on gas retention in flowing systems. Initial results have been promising, with negligible gas permeation for the coated membranes compared to 100% gas permeation in the uncoated tube.
Author
*Cooling Systems; Composite Materials; Membranes; Hydrophobicity; Liquid Cooling; Aeration*

# 39
# STRUCTURAL MECHANICS

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

**20040085707** National Inst. of Aerospace, Hampton, VA, USA
**Implementation of Interlaminar Fracture Mechanics in Design: An Overview**
Krueger, Ronald; Minguet, Pierre J.; OBrien, T. Kevin; [2003]; 10 pp.; In English; 14th International Conference on Composite Materials, 14-18 Jul. 2003, San Diego, CA, USA; Copyright; Avail: CASI; A02, Hardcopy

The state-of-the-art in the areas of delamination characterization, interlaminar fracture mechanics analysis tools and experimental verification of life predictions is demonstrated using skin/stringer debonding failure as an engineering problem to describe the overall methodology.
Author
*Delaminating; Fracture Mechanics; General Overviews; Composite Materials; Aerospace Engineering*

**20040085721** NASA Langley Research Center, Hampton, VA, USA
**Accurate Thermal Stresses for Beams: Normal Stress**
Johnson, Theodore F.; Pilkey, Walter D.; [2002]; 4 pp.; In English; 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
*Thermal Stresses; Thermoelasticity; Mechanical Properties; Rectangular Beams*

**20040085734** NASA Langley Research Center, Hampton, VA, USA
**On the Use of Equivalent Linearization for High-Cycle Fatigue Analysis of Geometrically Nonlinear Structures**
Rizzi, Stephen A.; [2003]; 13 pp.; In English; 8th International Conference on Recent Advances in Structural Dynamics, 14-16 Jul. 2003, Southampton, UK
Report No.(s): Paper 56; No Copyright; Avail: CASI; A03, Hardcopy

The use of stress predictions from equivalent linearization analyses in the computation of high-cycle fatigue life is examined. Stresses so obtained differ in behavior from the fully nonlinear analysis in both spectral shape and amplitude. Consequently, fatigue life predictions made using this data will be affected. Comparisons of fatigue life predictions based upon the stress response obtained from equivalent linear and numerical simulation analyses are made to determine the range over which the equivalent linear analysis is applicable.
Author
*Structural Analysis; Fatigue Life; Life (Durability); Nonlinearity*

**20040085759** NASA Langley Research Center, Hampton, VA, USA
**Mode Jumping of an Isogrid Panel Under Quasi-Static Compression**
Muheim, Danniella M.; Johnson, Eric R.; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-1790; No Copyright; Avail: CASI; A03, Hardcopy

A wide column test of a composite isogrid panel subjected to quasi-static, axial compression is modeled with a hybrid-static dynamic computational method. The data from the test panel exhibited discontinuous responses in the compressive load for slowly increased end-shortening. The computational model was developed to corroborate these discontinuities with the phenomenon of mode jumping. Mode jumping refers to the transient response of the panel from an unstable bifurcation point on a postbuckled equilibrium path to a second stable equilibrium state on a new equilibrium path. On the new equilibrium path, both the analysis and test show that the panel can resist increased endshortening beyond that

of the unstable critical point. Fair agreement is achieved between the analysis and test.
Author
*Transient Response; Axial Compression Loads; Compression Tests*

**20040085971** NASA Langley Research Center, Hampton, VA, USA
**On the Exploitation of Sensitivity Derivatives for Improving Sampling Methods**
Cao, Yanzhao; Hussaini, M. Yousuff; Zang, Thomas A.; [2003]; 9 pp.; In English; 44th AIAA Structures, Structural Dynamics and Mechanics Conference, 7-10 Apr. 2003, Norfolk, VA, USA
Report No.(s): AIAA Paper 2003-1656; Copyright; Avail: CASI; A02, Hardcopy

Many application codes, such as finite-element structural analyses and computational fluid dynamics codes, are capable of producing many sensitivity derivatives at a small fraction of the cost of the underlying analysis. This paper describes a simple variance reduction method that exploits such inexpensive sensitivity derivatives to increase the accuracy of sampling methods. Three examples, including a finite-element structural analysis of an aircraft wing, are provided that illustrate an order of magnitude improvement in accuracy for both Monte Carlo and stratified sampling schemes.
Author
*Computational Fluid Dynamics; Finite Element Method; Structural Analysis; Cost Analysis; Sampling; Sensitivity*

**20040085989** NASA Langley Research Center, Hampton, VA, USA
**Fracture Evaluation of In-Situ Sensors for High Temperature Applications**
Forth, Scott C.; Staroselsky, Alexander; [2003]; 6 pp.; In English
Report No.(s): ICF100776PR; No Copyright; Avail: CASI; A02, Hardcopy

The feasibility of fabricating an in-situ crack sensor for real-time detection of surface cracks propagating in engine components was evaluated using a computational fracture mechanics model. The in-situ sensor system would be required to: (1) Be capable of sustaining normal function in a severe environment; (2) Transmit a signal if a detected crack in the component was above a predetermined length, but below a critical length that would lead to failure; (3) Act neutrally upon the overall performance of the engine system and not interfere with the engine maintenance operations. In this work, fracture mechanics methodologies are used to identify the requirements for an in-situ sensor system that could withstand the engine operating environment, foreign object damage, and minimally degrade engine performance. A computational fracture mechanics model was developed to evaluate the feasibility of fabricating an in-situ crack sensor for real-time damage propagation detection in engine components.
Author
*Engine Monitoring Instruments; In Situ Measurement; Fracture Mechanics; Surface Cracks; Engine Parts*

**20040086015** NASA Langley Research Center, Hampton, VA, USA
**An Assessment of the State-of-the-Art in the Design and Manufacturing of Large Composite Structures for Aerospace Vehicles**
Harris, Charles E.; Shuart, Mark J.; [2001]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

An assessment of the State-of-the-Art in the design and manufacturing of large composite structures has been conducted. The focus of the assessment is large structural components in commercial and military aircraft. Applications of composites are reviewed for commercial transport aircraft, general aviation aircraft, rotorcraft, and military aircraft.
Author
*Aerospace Vehicles; Composite Structures; Manufacturing; Structural Design; General Aviation Aircraft; Technology Assessment*

**20040086072** Army Research Lab., Hampton, VA, USA
**A Viscoelastic Hybrid Shell Finite Element**
Johnson, Arthur; [1999]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

An elastic large displacement thick-shell hybrid finite element is modified to allow for the calculation of viscoelastic stresses. Internal strain variables are introduced at he element's stress nodes and are employed to construct a viscous material model. First order ordinary differential equations relate the internal strain variables to the corresponding elastic strains at the stress nodes. The viscous stresses are computed from the internal strain variables using viscous moduli which are a fraction of the elastic moduli. The energy dissipated by the action of the viscous stresses in included in the mixed variational functional. Nonlinear quasi-static viscous equilibrium equations are then obtained. Previously developed Taylor expansions of the

equilibrium equations are modified to include the viscous terms. A predictor-corrector time marching solution algorithm is employed to solve the algebraic-differential equations. The viscous shell element is employed to numerically simulate a stair-step loading and unloading of an aircraft tire in contact with a frictionless surface.
Author
*Finite Element Method; Viscoelasticity; Stress Analysis; Mathematical Models; Algorithms; Shells (Structural Forms); Hybrid Structures*

**20040086466** NASA Langley Research Center, Hampton, VA, USA
**Finite Element Model Development and Validation for Aircraft Fuselage Structures**
Buehrle, Ralph D.; Fleming, Gary A.; Pappa, Richard S.; Grosveld, Ferdinand W.; [2000]; 8 pp.; In English; 18th International Modal Analysis Conference, 7-10 Feb. 2000, San Antonio, TX, USA; No Copyright; Avail: CASI; A02, Hardcopy

The ability to extend the valid frequency range for finite element based structural dynamic predictions using detailed models of the structural components and attachment interfaces is examined for several stiffened aircraft fuselage structures. This extended dynamic prediction capability is needed for the integration of mid-frequency noise control technology. Beam, plate and solid element models of the stiffener components are evaluated. Attachment models between the stiffener and panel skin range from a line along the rivets of the physical structure to a constraint over the entire contact surface. The finite element models are validated using experimental modal analysis results. The increased frequency range results in a corresponding increase in the number of modes, modal density and spatial resolution requirements. In this study, conventional modal tests using accelerometers are complemented with Scanning Laser Doppler Velocimetry and Electro-Optic Holography measurements to further resolve the spatial response characteristics. Whenever possible, component and subassembly modal tests are used to validate the finite element models at lower levels of assembly. Normal mode predictions for different finite element representations of components and assemblies are compared with experimental results to assess the most accurate techniques for modeling aircraft fuselage type structures.
Author
*Aircraft Structures; Finite Element Method; Fuselages; Mathematical Models; Frequency Control; Structural Engineering*

## 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*.

**20040085502** California Inst. of Tech., Pasadena, CA, USA
**Interannual Variability of Snow and Ice and Impact on the Carbon Cycle**
Yung, Yuk L.; [2004]; 4 pp.; In English
Contract(s)/Grant(s): NAG5-9487; No Copyright; Avail: CASI; A01, Hardcopy

The goal of this research is to assess the impact of the interannual variability in snow/ice using global satellite data sets acquired in the last two decades. This variability will be used as input to simulate the CO2 interannual variability at high latitudes using a biospheric model. The progress in the past few years is summarized as follows: 1) Albedo decrease related to spring snow retreat; 2) Observed effects of interannual summertime sea ice variations on the polar reflectance; 3) The Northern Annular Mode response to Arctic sea ice loss and the sensitivity of troposphere-stratosphere interaction; 4) The effect of Arctic warming and sea ice loss on the growing season in northern terrestrial ecosystem.
Author (revised)
*Annual Variations; Ice Environments; Snow; Environment Effects; Carbon Cycle*

**20040085694** NASA Langley Research Center, Hampton, VA, USA
**Evaluation of Experimental Data from the GAINS Balloon GPS Surface Reflection Instrument**
Gance, George G.; Johnson, Thomas A.; [2004]; 5 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

The GPS Surface Reflection Instrument was integrated as an experiment on the GAINS (Global Airocean IN-situ System) 48-hour balloon mission flown in September 2001. The data collected by similar instruments in the past has been used to measure sea state from which ocean surface winds can be accurately estimated. The GPS signal has also been shown to be reflected from wetland areas and even from subsurface moisture. The current version of the instrument has been redesigned to be more compact, use less power, and withstand a greater variation in environmental conditions than previous versions. This

instrument has also incorporated a new data collection mode to track 5 direct satellites (providing a continuous navigation solution) and multiplex the remaining 7 channels to track the reflected signal of the satellite tracked in channel 0. The new software mode has been shown to increase the signal to noise ratio of the collected data and enhance the science return of the instrument. During the 48-hour flight over the Northwest US, the instrument will measure surface reflections that can be detected over the balloon's ground track. Since ground surface elevations in this area vary widely from the WGS-84 ellipsoid altitude, the instrument software has been modified to incorporate a surface altitude correction based on USGS 30-minute Digital Elevation Models. Information presented will include facts about instrument design goals, data collection methodologies and algorithms, and results of the science data analyses for the 48-hour mission.
Author
*Global Positioning System; Ocean Surface; High Altitude Balloons; Reflection; Air Water Interactions; In Situ Measurement*

**20040085890** NASA Langley Research Center, Hampton, VA, USA
**Evaluation of Experimental Data from the Gains Balloon GPS Surface Reflection Instrument**
Ganoe, George G.; Johnson, Thomas A.; Somero, John Ryan; [2002]; 9 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The GPS Surface Reflection Instrument was integrated as an experiment on the GAINS (Global Airocean IN-situ System) 48-hour balloon mission flown in June 2002. The data collected by similar instruments in the past has been used to measure sea state from which ocean surface winds can be accurately estimated. The GPS signal has also been shown to be reflected from wetland areas and even from subsurface moisture. The current version of the instrument has been redesigned to be more compact, use less power, and withstand a greater variation in environmental conditions than previous versions. This instrument has also incorporated a new data collection mode to track 5 direct satellites (providing a continuous navigation solution) and multiplex the remaining 7 channels to track the reflected signal of the satellite tracked in channel 0. The new software mode has been shown to increase the signal to noise ratio of the collected data and enhance the science return of the instrument. During the GAINS balloon flight over the Northwest US, the instrument measured surface reflections as they were detected over the balloon's ground track. Since ground surface elevations in this area vary widely from the WGS-84 ellipsoid altitude, the instrument software has been modified to incorporate a surface altitude correction based on USGS 30-minute Digital Elevation Models. Information presented will include facts about instrument design goals, data collection methodologies and algorithms, and will focus on results of the science data analyses for the mission.
Author
*Data Acquisition; Reflection; Remote Sensing; Soil Moisture*

**20040085902** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Estimating Spatially-distributed Surface Fluxes in a Semi-arid Great Basin Desert Using Landsat TM Thermal Data**
Quattrochi, Dale A.; Luvall, Jeffrey C.; [2004]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The research described in this chapter demonstrates a method for using Landsat Thematic Mapper data to estimate instantaneous regional-scale energy fluxes over an arid valley in eastern Nevada, U.S.A. Here point-based models of surface energy and water balance fluxes were applied to individual pixels of a Landsat Thematic Mapper scene over the study area. Although the method used to estimate these instantaneous fluxes requires certain assumptions be made about the spatial distribution of several physical parameters, the results from this analysis and modeling suggest that it is possible to scale from point measurements of environmental state variables (i.e., net radiation flux, surface heat flux, sensible heat flux, and latent heat flux) to regional estimates of energy exchange to obtain an understanding of the spatial relationship between these fluxes and landscape variables.
Author
*Arid Lands; Deserts; Spatial Distribution; Surface Energy; Thematic Mappers (Landsat); Great Basin (Us)*

**20040086055** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Land Use and Change**
Irwin, Daniel E.; [2004]; 161 pp.; In Spanish; Mesoamerican Environmental Information System-NASA Monitoring and Visualization System Workshop, 10-17 Jul. 2004, Panama City, Panama; No Copyright; Avail: CASI; A08, Hardcopy

The overall purpose of this training session is to familiarize Central American project cooperators with the remote sensing and image processing research that is being conducted by the NASA research team and to acquaint them with the data products being produced in the areas of Land Cover and Land Use Change and carbon modeling under the NASA SERVIR project. The training session, therefore, will be both informative and practical in nature. Specifically, the course will focus on the physics

of remote sensing, various satellite and airborne sensors (Landsat, MODIS, IKONOS, Star-3i), processing techniques, and commercial off the shelf image processing software.
Author
*Land Use; Remote Sensing; Image Processing*

**20040086440** Army Cold Regions Research and Engineering Lab., Hanover, NH
**Lake Thompson, Mojave Desert, California: A Desiccating Late Quaternary Lake System**
Orme, Antony R.; Yuretich, Richard; Jan. 2004; 61 pp.; In English
Report No.(s): AD-A424332; ERDC/CRREL-TR-04-1; No Copyright; Avail: CASI; A04, Hardcopy

In late Pleistocene time, Lake Thompson rose to 710 meters above sea level and covered 950 square kilometers of the western Mojave Desert, California. During the Holocene time, the lake desiccated and is today represented mainly by Rogers, Rosamond, and Buckhorn Dry Lakes, which cover 200 square kilometers of Edwards AFB. Elsewhere the former lake basin is characterized by exposed lake beds and beach ridges or mantled by aeolian and fluvial deposits. This study reports on the spatial and temporal components of former Lake Thompson. The spatial dimension identifies seven major geomorphic and lithostratigraphic units within the former lake basin, of which the most important are the modern playa, former lake system, aeolian mantle, interfingering fluvial deposits, and various bedrock outcrops. These units and their subdivisions are presented on a map entitled ″Geomorphology and Quaternary Geology of Lake Thompson within Edwards AFB, California.″ The temporal component is represented by a chronology of Lake Thompson based on accelerator mass spectrometry dating of the stratigraphic sequence. Although a former deep lake beneath the modern dry lakes had long been inferred from borehole data, its age and development remained unknown. The present study recovered four cores for stratigraphic and sediment analysis and dating. Ages for the deep lake range from 30,000 to 17,000 BP, a humid interval typified by frequent inputs of fluvial sediment. After 17,000 BP, the lake began to desiccate, and its exposed floor was lowered by deflation. However, shallow perennial lakes returned during the late Pleistocene and early Holocene time, prior to the present phase of desiccation. Clay minerals from the cores support this scenario. High smectite values reflect deposition in a large lake under humid conditions around 30,000 BP, followed by diminishing smectite as conditions became drier. A more saline, alkaline lake existed under drier climatic conditions before 30,000 BP. (33 refs7
DTIC
*Drying; Geomorphology; Lakes; Lithology; Mojave Desert (Ca); Quaternary Period; Sedimentary Rocks; Stratigraphy; Structural Basins*

## 45
## ENVIRONMENT POLLUTION

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

**20040085478** California Inst. of Tech., Pasadena, CA, USA
**Chemistry and Transport in a Multi-Dimensional Model**
Yung, Yuk L.; [2004]; 4 pp.; In English
Contract(s)/Grant(s): NAG1-02081; No Copyright; Avail: CASI; A01, Hardcopy

Our work has two primary scientific goals, the interannual variability (IAV) of stratospheric ozone and the hydrological cycle of the upper troposphere and lower stratosphere. Our efforts are aimed at integrating new information obtained by spacecraft and aircraft measurements to achieve a better understanding of the chemical and dynamical processes that are needed for realistic evaluations of human impact on the global environment. A primary motivation for studying the ozone layer is to separate the anthropogenic perturbations of the ozone layer from natural variability. Using the recently available merged ozone data (MOD), we have carried out an empirical orthogonal function EOF) study of the temporal and spatial patterns of the IAV of total column ozone in the tropics. The outstanding problem about water in the stratosphere is its secular increase in the last few decades. The Caltech/PL multi-dimensional chemical transport model (CTM) photochemical model is used to simulate the processes that control the water vapor and its isotopic composition in the stratosphere. Datasets we will use for comparison with model results include those obtained by the Total Ozone Mapping Spectrometer (TOMS), the Solar Backscatter Ultraviolet (SBUV and SBUV/2), Stratosphere Aerosol and Gas Experiment (SAGE I and II), the Halogen Occultation Experiment (HALOE), the Atmospheric Trace Molecular Spectroscopy (ATMOS) and those soon to be obtained by the Cirrus Regional Study of Tropical Anvils and Cirrus Layers Florida Area Cirrus Experiment (CRYSTAL-FACE)

mission. The focus of the investigations is the exchange between the stratosphere and the troposphere, and between the troposphere and the biosphere.
Author
*Mathematical Models; Atmospheric Chemistry; Hydrology; Ozone*

**20040085542** Denver Univ., Denver, CO, USA
**On-Road Remote Sensing of Automobile Emissions in the La Brea Area: Year 3, October 2003**
Bishop, G. A.; Burgard, D. A.; Stedman, D. H.; May 2004; In English
Report No.(s): PB2004-106604; No Copyright; Avail: National Technical Information Service (NTIS)

The University of Denver conducted a five-day remote sensing study in the La Brea, California area in October of 2003. The remote sensor used in this study measures the ratios of CO, HC, and NO to CO2 in motor vehicle exhaust. From these ratios, we calculate the percent concentrations of CO, CO2, HC and NO in the exhaust that would be observed by a tailpipe probe, corrected for water and any excess oxygen not involved in combustion. Mass emissions per mass or volume of fuel can also be determined. The system used in this study was configured to determine the speed and acceleration of the vehicle, and was accompanied by a video system to record the license plate of the vehicle. Five days of fieldwork, October 27-31, 2003, were conducted as vehicles entered I-10 eastbound frontage road from La Brea Blvd. in west Lost Angles basin. A database was compiled containing 25,847 records. Of these records, the State of California provided make and model year information on 20,191 which contained valid measurements for at least CO and CO2, and most contained valid measurements for HC and NO as well.
NTIS
*Remote Sensing; Exhaust Emission*

**20040085549** Oak Ridge National Lab., TN
**Eberline Alpha 7L Test Report**
Chiaro, P. J.; Gibson, F. R.; Shourbaji, A. A.; Dixon, J. E.; 2003; In English
Report No.(s): DE2003-814652; ORNL/TM-2002/147; No Copyright; Avail: National Technical Information Service (NTIS)

An Eberline continuous alpha air monitor model Alpha 7L was evaluated at Oak Ridge National Laboratory (ORNL) using the capabilities available at the Environmental Effects Laboratory (EELab). A series of tests were performed to ensure that procured units meet the requirements of the purchasing facility, Los Alamos National Laboratory (LANL). In addition to reporting on the results of each test, other activities were performed to reduce discovered susceptibilities.
NTIS
*Environment Effects; Air Sampling*

**20040085948** Purdue Univ., West Lafayette, IN, USA
**Relating Surface Texture of Rigid Pavements with Noise and Skid Resistance**
Olek, J.; Weiss, W. J.; Garcia-Villarreal, R.; Jan. 2004; In English
Report No.(s): PB2004-106155; SQDH-2004-1; No Copyright; Avail: National Technical Information Service (NTIS)

Although pavements are primarily developed to carry traffic load, they also have to satisfy other functional characteristics. While functionality has historically been defined as the ability to provide a smooth, safe ride to the user, an aspect that is often overlooked is the comfort to the user and the residents living near the pavement. The logical order of how pavement surface characteristics should be considered in the design process includes: safety, smoothness, and then comfort (including noise generation). However, there is a necessary trade off between these different characteristics. To improve the safety on a concrete pavement it is necessary to increase the friction between tire and pavement. This is usually accomplished by applying texture to the surface. Different textures provide different skid resistance and different noise levels. There is also, common thought that noisy surfaces are the best ones to provide skid resistance. This research attempts to link the contact stress between the tire and the pavement to the noise generated as the tire travels over the surface.
NTIS
*Concretes; Pavements; Noise Intensity*

**20040085949** Purdue Univ., West Lafayette, IN, USA
**Visualization of the Tire Vibration and Sound Radiation and Modeling of Tire Vibration with an Emphasis on Wave Propagation**
Bolton, J. S.; Kim, Y. J.; Aug. 2003; In English
Report No.(s): PB2004-106153; SQDH-2003-4; No Copyright; Avail: National Technical Information Service (NTIS)

It is now known that tire/road interaction noise is the major contributor to exterior automobile noise and establishes the background noise level in many environments. Thus, the reduction of tire/road noise is a major environmental noise issue today. Among the numerous tire noise mechanisms, tire vibration has been established as the primary source: i.e., a tire's tread block hits the road surface, and then the underlying reinforcing belts vibrate owing to the force transmitted through the tread block, resulting in sound radiation from the vibrating tire surface. In an attempt to identify the dominant tire noise sources, a sound field visualization procedure referred to as Nearfield Acoustical Holography was applied to a rolling tire: it has been shown that sound radiation originates close to the contact patch of a tire. An experimental procedure has also been introduced to identify the main characteristics of tire vibration.
NTIS
*Wave Propagation; Vibration; Tires; Sound Waves; Noise (Sound); Acoustical Holography*

**20040086022** Science Applications International Corp., McLean, VA, USA
**Greenhouse Emission Reductions and Natural Gas Vehicles: A Resource Guide on Technology Options and Project Development**
Sep. 2002; In English
Report No.(s): DE2003-816573; No Copyright; Avail: National Technical Information Service (NTIS)
Accurate and verifiable emission reductions are a function of the degree of transparency and stringency of the protocols employed in documenting project- or program-associated emissions reductions. The purpose of this guide is to provide a background for law and policy makers, urban planners, and project developers working with the many Greenhouse Gas (GHG) emission reduction programs throughout the world to quantify and/or evaluate the GHG impacts of Natural Gas Vehicle (NGVs). In order to evaluate the GHG benefits and/or penalties of NGV projects, it is necessary to first gain a fundamental understanding of the technology employed and the operating characteristics of these vehicles, especially with regard to the manner in which they compare to similar conventional gasoline or diesel vehicles.
NTIS
*Greenhouse Effect; Natural Gas*

**20040086039** Office of Air Quality Planning and Standards, Research Triangle Park, NC
**Economic Impact Analysis for the Wood Building Products NESHAP**
Beach, R. H.; Jan. 2003; 14 pp.; In English
Report No.(s): PB2004-106645; EPA-452/R-03-003; No Copyright; Avail: CASI; A03, Hardcopy
The environmental regulation of the wood building products (WBP) industry potentially affects large and small manufacturers engaged in the surface coating of WBP, but small firms may encounter special problems with compliance. The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement and Fairness Act of 1996 (SBREFA), requires the U.S. Environmental Protection Agency (EPA) to consider the economic impacts of this regulatory action on these small entities. Therefore, RTI completed a preliminary screening analysis to assist the Agency in determining whether this rule is likely to impose a significant impact on a substantial number of small businesses. This analysis consists of a ″sales test″ and a ″profit test″. The ″sales test″ involves computing the annualized compliance cost as a share of sales for each company and comparing the distribution of these costs across large and small companies. The ″profit test″ involves comparing the company profit margins with and without regulation, assuming full cost absorption by industry.
NTIS
*Wood; Industries; Economic Impact; Costs*

## 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*.

**20040085487** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**Accurate Realization of GPS Vertical Global Reference Frame**
Elosegui, Pedro; July 2004; 5 pp.; In English
Contract(s)/Grant(s): NAG5-13748; No Copyright; Avail: CASI; A01, Hardcopy
The few millimeter per year level accuracy of radial global velocity estimates with the Global Positioning System (GPS) is at least an order of magnitude poorer than the accuracy of horizontal global motions. An improvement in the accuracy of

radial global velocities would have a very positive impact on a number of geophysical studies of current general interest such as global sea-level and climate change, coastal hazards, glacial isostatic adjustment, atmospheric and oceanic loading, glaciology and ice mass variability, tectonic deformation and volcanic inflation, and geoid variability. The goal of this project is to improve our current understanding of GPS error sources associated with estimates of radial velocities at global scales. GPS error sources relevant to this project can be classified in two broad categories: (1) those related to the analysis of the GPS phase observable, and (2) those related to the combination of the positions and velocities of a set of globally distributed stations as determined from the analysis of GPS data important aspect in the first category include the effect on vertical rate estimates due to standard analysis choices, such as orbit modeling, network geometry, ambiguity resolution, as well as errors in models (or simply the lack of models) for clocks, multipath, phase-center variations, atmosphere, and solid-Earth tides. The second category includes the possible methods of combining and defining terrestrial reference flames for determining vertical velocities in a global scale. The latter has been the subject of our research activities during this reporting period.
Derived from text
*Global Positioning System; Geophysics; Radial Velocity; Geodetic Accuracy; Geodetic Coordinates*

**20040085572** Copenhagen Univ., Denmark
**Basal Water at the NorthGRIP Drill Site**
Dahl-Jensen, Dorthe; Johnsen, Sigfus; Willerslev, Eske; Miller, Heinz; Thorsteinsonn, Thorsteinn; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The main purpose of the NGRIP project has been to obtain ice dating from the last interglacial period, the Eemian (ca. 115-135 ka BP). A full record of Eemian climate has hitherto not been obtained from a Greenland ice core and the occurrence of rapid climate change during the Eemian, originally inferred from studies of the GRIP ice core, has not been confirmed by other records. Results from airborne radar measurements showed that internal layers, isochrones could be traced from the deep coring sites at Summit in Central Greenland (GRIP and GISP2) to the North GRIP site. However, as the drilling progressed and measurements of ice temperature were made in the borehole, it became clear that the geothermal heat flux was unusually high at NGRIP and that the ice at the bottom was at the melting point. The basal water frozen to the NGRIP drill is mainly glacial basal melt water that contains air from the glacial ice. The reddish color however indicates evidence of a content of sediments in the water. Is it possible to find traces of ancient DNA and microbiological life in the melt water found under the ice which has been closed from the surface for the last 2-5 million years? We hope to return next year and drill cores of the frozen basal water now standing 47 m up in the borehole.
Author
*Glaciers; Ice; Chronology; Climate Change; Time Measurement; Core Sampling*

**20040085609** National Energy Authority, Iceland
**Dust Flux into the Grimsvotn Subglacial Lake, Vatnajokull Ice Cap, Iceland, Estimated from Ice Core Data**
Thorsteinsson, T.; Johannesson, T.; Larsen, G.; Sigurdsson, O.; Schmidt, K. G.; Forwick, M.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The center of hot-spot volcanic activity in Iceland is located beneath the NW-part of the Vatnaj kull ice cap. Continuous melting of the ice cap from below sustains the Grimsvotn subglacial lake; the source of large jokulhlaups which regularly flood regions south of the ice cap [1]. The lake is covered by an ice shelf with an area of 25 sq km and thickness varying between 100 and 300 m. The bottom of the subglacial lake is covered with sediments of volcanic origin [2], and dust released into the lake by melting of the ice shelf from below is continually being deposited at the lake bed. The Grimsvotn lake has recently attracted the interest of researchers investigating the possible existence of microbial life in Antarctic subglacial lakes and ice covered oceans in the solar system [3].
Author
*Volcanoes; Ice; Dust; Beds (Geology)*

**20040085659** Bradford Univ., UK
**Antarctic Analogues for Mars Exploration: A Raman Spectroscopic Study of Biogeological Signatures**
Edwards, Howell G. M.; Moody, Caroline A.; Villar, Susana E. Jorge; Wynn-Williams, David D.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The present conditions at the surface of Mars are not conducive to the survival of life forms, with the thin atmosphere, lack of water, a highly-oxidising regolith and significant UV insolation. The Antarctic provides a terrestrial model with a transect from the maritime, where epilithic colonies can survive through the production of protectant biochemicals, to endolithic systems at the ″limits of life″ where existence at the surface is impossible [ 1,2 ] . In the Antarctic Dry Valleys, the extremely low humidity coupled with low temperatures reaching - 35 C, strong katabatic winds blowing from the Polar plateau and intense UVradiation exacerbated by atmospheric ozone depletion at higher latitudes provides a putative analogue for the hostile conditions that life must tolerate for survival at or near the Martian surface [ 3,4 ].
Author
*Spectroscopy; Mars Surface; Biochemistry; Signatures*

**20040085685** Kansas Univ., Lawrence, KS, USA
**A Radar System for High-Resolution Mapping of Near-Surface Internal Layers in the Polar Ice Sheets**
Gogineni, S.; Parthasarthy, R.; Kanagaratnam, P.; Braaten, D.; Akins, T.; Wuite, J.; Jezek, K.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Abstract Only; Available from CASI on CD-ROM only as part of the entire parent document

Accumulation rate is an important variable in determining the mass balance of polar ice sheets. It is currently determined by analyzing ice cores and identifying layers in snow pits, which limits spatial extent over which accumulation rate may be determined. Near-surface internal layers caused by density and conductivity changes can be mapped with a high-resolution radar for estimating accumulation rate. We designed and developed two radars for mapping near-surface internal layers. We developed an airborne radar to operate over the frequency range 600-900 MHz. with a range resolution of about 50 cm to a depth of about 100m. We developed a surface-based system that operates over the frequency range from 500 to 2000 MHz to map layers with 10-cm resolution to a depth of about 100 m. During the 2002 and 2003 field seasons, we collected a large volume of data with the airborne system over the ice sheet in Greenland. We also collected data with the surface-based system at North Greenland Ice Core (NGRIP) drill site in conjunction with detailed in-situ observations from several snow pits and a 15-m firn core. Results from these experiments show that we can map near-surface layers to a depth of at least 150 m in the dry-snow zone, 120 m in the percolation zone, and 20 m in the melt zone. In this paper we will discuss the scientific requirements for mapping near-surface internal layers, design considerations and system performance, and present results from airborne and surface-based field experiments. We will also discuss the design of a system for mapping polar-layered deposits in Martian ice caps.
Author
*Ice Mapping; Radar Imagery; Airborne Radar*

**20040086064** NASA Langley Research Center, Hampton, VA, USA
**Atmospheric Ionizing Radiation (AIR) Project Review**
Singleterry, R. C., Jr.; Wilson, J. W.; Whitehead, A. H.; Goldhagen, P. E., et al.; [1999]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The National Council on Radiation Protection and Measurement (NCRP) and the National Academy of Science (NAS) established that the uncertainty in the data and models associated with the high-altitude radiation environment could and should be reduced. In response, the National Aeronautics and Space Administration (NASA) and the U.S. Department of Energy Environmental Measurements Laboratory (EML) created the Atmospheric Ionizing Radiation (AIR) Project under the auspices of the High Speed Research (HSR) Program Office at the Langley Research Center. NASA's HSR Program was developed to address the potential of a second-generation supersonic transport. A critical element focussed on the environmental issues, including the threat to crew and passengers posed by atmospheric radiation. Various international investigators were solicited to contribute instruments to fly on an ER-2 aircraft at altitudes similar to those proposed for the High Speed Civil Transport (HSCT). A list of participating investigators, their institutions, and instruments with quantities measured is presented. The flight series took place at solar minimum (radiation maximum) with northern, southern, and east/west flights. The investigators analyzed their data and presented preliminary results at the AIR Workshop in March, 1998. A review of these results are included.
Derived from text
*Atmospheric Radiation; Ionizing Radiation; NASA Programs; Civil Aviation*

# 47
# METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

**20040085482** Ohio State Univ., Columbus, OH, USA
**Regional Scale Meteorological Analysis and Prediction Using GPS Occultation and EOS Data**
Bromwich, David H.; Shum, C. K.; Zhao, Changyin; Kuo, Bill; Rocken, Chris; [2004]; 24 pp.; In English
Contract(s)/Grant(s): OSU-539000; NAG5-9518; 739301
Report No.(s): UCAR-199-283; No Copyright; Avail: CASI; A03, Hardcopy

The main objective of the research under this award is to improve regional meteorological analysis and prediction for traditionally data limited regions, particularly over the Southern Ocean and Antarctica, using the remote sensing observations from current and upcoming GPS radio occultation missions and the EOS instrument suite. The major components of this project are: 1.Develop and improve the methods for retrieving temperature, moisture, and pressure profiles from GPS radio occultation data and EOS radiometer data. 2. Develop and improve a regional scale data assimilation system (MM5 4DVAR). 3. Perform case studies involving data analysis and numerical modeling to investigate the impact of different data for regional meteorological analysis and the importance of data assimilation for regional meteorological simulation over the Antarctic region. 4. Apply the findings and improvements from the above studies to weather forecasting experiments. 5. In the third year of the award we made significant progress toward the remaining goals of the project. The work included carefully evaluating the performance of an atmospheric mesoscale model, the Polar MM5 in Antarctic applications and improving the upper boundary condition.
Author
*Atmospheric Models; Meteorological Parameters; Boundary Conditions; Data Systems; Mathematical Models; Pressure Distribution*

**20040085547** Oak Ridge National Lab., TN
**Carbon Dioxide Information Analysis Center and World Data Center for Atmospheric Trace Gases**
Cushman, R. M.; Boden, T. A.; Hook, L. A.; Jones, S. B.; Kaiser, D. P.; May 2002; In English
Report No.(s): DE2003-814459; ORNL/CDIAC-137; No Copyright; Avail: National Technical Information Service (NTIS)

The Carbon Dioxide Information Analysis Center (CDIAC), which includes the World Data Center (WDC) for Atmospheric Trace Gases, is the primary global change data and information analysis center of the U.S. Department of Energy (DOE). More than just an archive of data sets and publications, CDIAC has, since its inception in 1982, enhanced the value of its holdings through intensive quality assurance, documentation, and integration. Whereas many traditional data centers are discipline-based (for example, meteorology or oceanography), CDIAC's scope includes potentially anything and everything that would be of value to users concerned with the greenhouse effect and global climate change, including concentrations of carbon dioxide (CO(sub 2)) and other radiatively active gases in the atmosphere; the role of the terrestrial biosphere and the oceans in the biogeochemical cycles of greenhouse gases; emissions of CO(sub 2) and other trace gases to the atmosphere; long-term climate trends; the effects of elevated CO(sub 2) on vegetation; and the vulnerability of coastal areas to rising sea levels. CDIAC is located within the Environmental Sciences Division (ESD) at Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee. CDIAC is co-located with ESD researchers investigating global-change topics, such as the global carbon cycle and the effects of carbon dioxide on climate and vegetation. CDIAC staff are also connected with current ORNL research on related topics, such as renewable energy and supercomputing technologies.
NTIS
*Atmospheric Composition; Trace Elements; Carbon Dioxide*

**20040085563** National Renewable Energy Lab., Golden, CO
**Mitigation of Wind Turbine/Vortex Interaction Using Disturbance Accommodating Control**
Hand, M. M.; Dec. 2003; In English
Report No.(s): DE2004-15006832; NREL/TP-500-35172; No Copyright; Avail: National Technical Information Service (NTIS)

Wind turbines, a competitive source of emission-free electricity, are being designed with diameters and hub heights approaching 100 m, to further reduce the cost of the energy they produce. At this height above the ground, the wind turbine is exposed to atmospheric phenomena such as low-level jets, gravity waves, and Kelvin-Helmholtz instabilities, which are not currently modeled in wind turbine design codes. These atmospheric phenomena can generate coherent turbulence that causes

high cyclic loads on wind turbine blades. These fluctuating loads lead to fatigue damage accumulation and blade lifetime reduction. The National Renewable Energy Laboratory (NREL) conducted an experiment to record wind turbine load response and inflow measurements.
NTIS
*Wind Turbines; Electricity*

**20040085581** Texas Univ., Bastrop, TX, USA
**Echo Source Discrimination in Airborne Radar Sounding Data for Mars Analog Studies, Dry Valleys, Antarctica**
Holt, J. W.; Blankenship, D. D.; Peters, M. E.; Kempf, S. D.; Morse, D. L.; Williams, B. J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-12693; NSF OPP-98-14816; NSF OPP-93-19379; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The recent identification of features on Mars exhibiting morphologies consistent with ice/rock mixtures, near-surface ice bodies and near-surface liquid water [1,2], and the importance of such features to the search for water on Mars, highlights the need for appropriate terrestrial analogs in order to prepare for upcoming radar missions targeting these and other water-related features. Climatic, hydrological, and geological conditions in the McMurdo Dry Valleys of Antarctica are analogous in many ways to those on Mars, and a number of ice-related features in the Dry Valleys may have direct morphologic and compositional counterparts on Mars.
Author
*Planetary Geology; Mars Surface; Ice; Rocks; Radar Data; Airborne Radar*

**20040085612** Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany
**Modeling Martian Fog Formation in the Northern High Latitudes During the Retreat of the Seasonal North Polar Cap**
Inada, A.; Richardson, M. I.; Toigo, A. D.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The simulation of fogs in the polar region is implemented with the Mars MM5 described by Toigo and Richardson (2002). This model is based on the Pennsylvania State University (PSU)/National Center for Atmosphere Research (NCAR) Mesoscale Model Version 5 (MM5) (Dudhia, 1993) and converted for use on Mars. It has been developed to research atmospheric dynamics on scales of a few hundreds meters to a few hundreds of kilometers, so that it is the most suitable model to study fog formation. The surface topography is taken from MGS Mars Orbiter Laser Altimeter (MOLA) high resolution data set. Boundary conditions are provided by the GFDL Mars GCM (Richardson and Wilson, 2002). For this study, we add the fog model of Inada (2002) to the Mars MM5. This enables the mesoscale atmospheric model to better simulate the water ice cycle. The microphysical processes of nucleation, condensation, sublimation and sedimentation are included. Coagulation due to sedimentation will be added in the future. Brownian coagulation is negligible because it affects only small particles with r less than 0.01 micrometers, where r is particle radius. The nucleation rate is a function of the radius of the nuclei particles, with nucleation on large dust particles being faster than that on small particles. all dust particles are assumed to act as nuclei. Since there are typically many large dust particles near the surface, little nucleation occurs on particles with r less than 1.0 micrometer.
Derived from text
*Atmospheric Physics; Fog; Polar Caps; Seasons; Polar Regions; Mesometeorology; Atmospheric Models*

**20040085615** Academy of Sciences (Russia), Moscow, Russia
**Vast Atmospheric Cold Traps Within the Large Ringed Topographic Features in NE Siberia: Implications for Mars**
Burba, G. A.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The ridges within the vast mountain country of the NE Siberia have been revealed recently to comprise two giant ring structures (RS), 500 and 400 km in diameter [1] . Such evidence is a new look on the general topographic structure of the area and could be of importance for climatic consequences.The central lower areas of these structures, which are enclosed within

a ring wall of mountain ridges, work as giant ″cold traps″ for the atmospheric air. During the winter seasons the temperature inversion in the near-surface layer of the atmosphere take place there.
Author
*Ring Structures; Cold Traps; Temperature Inversions; Topography*

**20040085695** NASA Langley Research Center, Hampton, VA, USA
**Characteristics and Trade-Offs of Doppler Lidar Global Wind Profiling**
Kavaya, Michael J.; Emmitt, G David; [2004]; 3 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

Accurate, global profiling of wind velocity is highly desired by NASA, NOAA, the DOD/DOC/NASA Integrated Program Office (IPO)/NPOESS, DOD, and others for many applications such as validation and improvement of climate models, and improved weather prediction. The most promising technology to deliver this measurement from space is Doppler Wind Lidar (DWL). The NASA/NOAA Global Tropospheric Wind Sounder (GTWS) program is currently in the process of generating the science requirements for a space-based sensor. In order to optimize the process of defining science requirements, it is important for the scientific and user community to understand the nature of the wind measurements that DWL can make. These measurements are very different from those made by passive imaging sensors or by active radar sensors. The purpose of this paper is to convey the sampling characteristics and data product trade-offs of an orbiting DWL.
Derived from text
*Doppler Radar; Optical Radar; Tradeoffs; Wind Velocity; Characteristics*

**20040085903** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Doppler Radar and Lightning Network Observations of a Severe Outbreak of Tropical Cyclone Tornadoes**
Mccaul, Eugene W., Jr.; Buechler, Dennis E.; Goodman, Steven J.; Cammarata, Michael; [2004]; 17 pp.; In English; Copyright; Avail: Other Sources

Data from a single Weather Surveillance Radar-1988 Doppler (WSR-88D) and the National Lightning Detection Network are used to examine the characteristics of the convective storms that produced a severe tornado outbreak, including three tornadoes that reached F3 intensity, within Tropical Storm Beryl s remnants on 16 August 1994. Comparison of the radar data with reports of tornadoes suggests that only 13 cells produced the 29 tornadoes that were documented in Georgia and the Carolinas on that date. Six of these cells spawned multiple tornadoes, and the radar data confirm the presence of miniature supercells. One of the cells was identifiable on radar for 11 h. spawning tornadoes over a time period spanning approximately 6.5 h. Several other tornadic cells also exhibited great longevity, with cell lifetimes longer than ever previously documented in a landfalling tropical cyclone (TC) tornado event. This event is easily the most intense TC tornado outbreak yet documented with WSR-88Ds. Time-height analyses of the three strongest tornadic supercells are presented in order to document storm kinematic structure and to show how these storms appear at different ranges from a WSR-88D. In addition, cloud-to-ground (CG) lightning data are examined in Beryl s remnants. Although the tornadic cells were responsible for most of Beryl's CG lightning, their flash rates were only weak to moderate, and in all the tornadic storms the lightning flashes were almost entirely negative in polarity. A few of the single-tornado storms produced no detectable CG lightning at all. There is evidence that CG lightning rates decreased during the tornadoes, compared to 30-min periods before the tornadoes. A number of the storms spawned tornadoes just after producing their final CG lightning flashes. Contrary to the findings for flash rates, both peak currents and positive flash percentages were larger in Beryl's nontornadic storms than in the tornadic ones.
Author
*Cyclones; Doppler Radar; Lightning; Tornadoes; Tropical Storms; Weather*

**20040085918** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Multivariate Statistical Inference of Lightning Occurrence, and Using Lightning Observations**
Boccippio, Dennis; January 2004; 1 pp.; In English; International Lightning Detection Conference, 7-9 Jun. 2004, Helsinki, Finland; No Copyright; Avail: Other Sources; Abstract Only

Two classes of multivariate statistical inference using TRMM Lightning Imaging Sensor, Precipitation Radar, and Microwave Imager observation are studied, using nonlinear classification neural networks as inferential tools. The very large and globally representative data sample provided by TRMM allows both training and validation (without overfitting) of neural networks with many degrees of freedom. In the first study, the flashing / or flashing condition of storm complexes is diagnosed using radar, passive microwave and/or environmental observations as neural network inputs. The diagnostic skill of these simple lightning/no-lightning classifiers can be quite high, over land (above 80% Probability of Detection; below 20% False Alarm Rate). In the second, passive microwave and lightning observations are used to diagnose radar reflectivity vertical

structure. A priori diagnosis of hydrometeor vertical structure is highly important for improved rainfall retrieval from either orbital radars (e.g., the future Global Precipitation Mission ″mothership″) or radiometers (e.g., operational SSM/I and future Global Precipitation Mission passive microwave constellation platforms), we explore the incremental benefit to such diagnosis provided by lightning observations.
Author
*Inference; Lightning; Multivariate Statistical Analysis; Remote Sensing; Precipitation (Meteorology)*

**20040085943** National Center for Atmospheric Research, Boulder, CO, USA
**Scientific Description of the Sea Ice Component in the Community Climate System Model, Version Three**
Briegleb, B. P.; Bitz, C. M.; Hunke, E. C.; Lipscomb, W. H.; Holland, M. M.; Jun. 2004; 82 pp.; In English
Report No.(s): PB2004-106574; NCAR/TN-463-STR; No Copyright; Avail: CASI; A05, Hardcopy

The Community Climate System Model (CCSM) is a coupled climate model consisting of atmosphere, ocean, land, and sea ice components. The model includes a coupler which passes fluxes and state variables from one model component to another. The model has been designed to support experiments that contribute to the understanding of past, present and future climates.
NTIS
*Climate Models; Sea Ice*

**20040085987** NASA Langley Research Center, Hampton, VA, USA
**Near-Real Time Cloud Properties and Aircraft Icing Indices from GEO and LEO Satellites**
Minnis, Patrick; Smith, William L., Jr.; Nguyen, Louis; Spangenberg, D. A.; Heck, Patrick W.; Palikonda, Rabindra; Ayers, J. Kirk; Wolff, Cory; Murray, John J.; July 16, 2004; 12 pp.; In English; SPIE's 49th Annual Meeting, 2-6 Aug. 2004, Denver, CO, USA
Contract(s)/Grant(s): DE-AI02-97ER-62341; 23-728-40-10; No Copyright; Avail: CASI; A03, Hardcopy

Imagers on many of the current and future operational meteorological satellites in geostationary Earth orbit (GEO) and lower Earth orbit (LEO) have enough spectral channels to derive cloud microphysical properties useful for a variety of applications. The products include cloud amount, phase, optical depth, temperature, height and pressure, thickness, effective particle size, and ice or liquid water path, shortwave albedo, and outgoing longwave radiation for each imager pixel. Because aircraft icing depends on cloud temperature, droplet size, and liquid water content as well as aircraft variables, it is possible to estimate the potential icing conditions from the cloud phase, temperature, effective droplet size, and liquid water path. A prototype icing index is currently being derived over the contiguous USA in near-real time from Geostationary Operational Environmental Satellite (GOES-10 and 12) data on a half-hourly basis and from NOAA- 16 Advanced Very High Resolution (AVHRR) data when available. Because the threshold-based algorithm is sensitive to small errors and differences in satellite imager and icing is complex process, a new probability based icing diagnosis technique is developed from a limited set of pilot reports. The algorithm produces reasonable patterns of icing probability and intensities when compared with independent model and pilot report data. Methods are discussed for improving the technique for incorporation into operational icing products.
Author
*Aircraft Icing; Geosynchronous Orbits; Low Earth Orbits; Remote Sensing; Cloud Physics; Real Time Operation; Goes Satellites*

**20040085991** NASA Langley Research Center, Hampton, VA, USA
**The Chesapeake Lighthouse and Aircraft Measurements for Satellites (CLAMS) Experiment**
Smith, William L., Jr.; Charlock, Thomas; Wielicki, Bruce; Kahn, Ralph; Martins, J. Vanderlei; Gatebe, Charles; Hobbs, Peter V.; Purgold, G. Carl; Redemann, Jens; Remer, Lorraine, et al.; January 2004; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

NASA has developed an Earth Observing System (EOS) consisting of a series of satellites designed to study global change from space. The EOS flagship is the EOS TERRA satellite, launched in December 1999, equipped with five unique sensors to monitor and study the Earth s heat budget and many of the key controlling variables governing the Earth's climate system. CLAMS, the Chesapeake Lighthouse and Aircraft Measurements for Satellites field campaign was conducted from NASA Wallops Flight Facility and successfully executed over the middle Atlantic eastern seaboard from July 10 August 2, 2001. CLAMS is primarily a shortwave closure experiment designed to validate and improve EOS TERRA satellite data products being derived from three sensors: CERES (Clouds and Earth's Radiant Energy System), MISR (Multi-angle Imaging

Spectro-Radiometer) and MODIS (MODerate Resolution Imaging Spectroradiometer). CLAMS is jointly sponsored by the CERES, MISR and MODIS instrument teams and the NASA GEWEX Global Aerosol Climatology Project (GACP). CLAMS primary objectives are to validate satellite-based retrievals of aerosol properties and vertical profiles of radiative flux, temperature and water vapor. Central to CLAMS measurement strategy is the Chesapeake Lighthouse, a stable sea platform located in the Atlantic Ocean, 13 miles east of Virginia Beach near the mouth of the Chesapeake Bay and the site of an ongoing CERES Ocean Validation Experiment (COVE). Six research aircraft were deployed to make detailed measurements of the atmosphere and ocean surface in the vicinity of COVE, over the surrounding ocean, over nearby NOAA buoys and over a few land sites. The measurements are used to validate and provide ground truth for simultaneous products being derived from TERRA data, a key step toward an improved understanding and ability to predict changes in the Earth's climate. One of the two CERES instruments on-board TERRA was programmed for Rotating Azimuth Plane Scans (RAPS) during CLAMS, increasing the CERES coverage over COVE by a factor of 10. Nine coordinated aircraft missions and numerous additional sorties were flown under a variety of atmospheric conditions and aerosol loadings. On one golden day, July 17, all six aircraft flew coordinated patterns, vertically stacked between 100 ft and 65,000 ft over the COVE site as the TERRA satellite orbited overhead. A summary of CLAMS measurement campaign and a description of the platforms and measurements is given.
Derived from text
*Climatology; Earth Observing System (Eos); Research Aircraft; Remote Sensing; Satellite Instruments*

**20040086470** NASA Langley Research Center, Hampton, VA, USA
**Lidar Measurements of Relative Humidity and Ice Supersaturation in the Upper Troposphere**
Ferrare, Richard A.; Browell, Edward V.; Ismail, Syed; Brackett, Vincent G.; Clayton, Marian B.; Fenn, Marta; Heilman, Lorraine; Kooi, Susan A.; Turner, David D.; Mahoney, Michael J., et al.; [2000]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

We compute upper tropospheric relative humidity profiles using water vapor profiles measured by an airborne DIAL and a ground-based Raman lidar. LASE water vapor and MTP temperature profiles acquired from the NASA DC-8 aircraft during the recent Pacific Exploratory Mission Tropics B (PEM Tropics B) field mission in the tropical Pacific and the SAGE-III Ozone Loss and Validation Experiment (SOLVE) in the Arctic as well as water vapor profiles derived from the ground-based DOE ARM Southern Great Plains (SGP) CART Raman lidar are used. Comparisons of the lidar water vapor measurements with available in situ measurements show reasonable agreement for water vapor mixing ratios above 0.05 g/kg. Relative humidity frequency distributions computed using LASE data indicate that ice supersaturation occurred about 5-11% of the time when temperatures were below -35 C. While a higher frequency of ice supersaturation was observed during SOLVE, higher peak values of relative humidity were observed during PEM Tropics B. The relative humidity fields associated with cirrus clouds are also examined.
Author
*Troposphere; Optical Radar; Radar Measurement; In Situ Measurement; Humidity Measurement*

**20040086482** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Earth GRAM-99 and Trace Constituents**
Justus, C. G.; Duvall, Aleta; Keller, Vernon W.; April 09, 2004; 8 pp.; In English; 35th COSPAR Scientific Assembly, 18-25 Jul. 2004, Paris, France
Contract(s)/Grant(s): NNM04AA02C; No Copyright; Avail: CASI; A02, Hardcopy

Global Reference Atmospheric Model (GRAM-99) is an engineering-level model of Earth's atmosphere. It provides both mean values and perturbations for density, temperature, pressure, and winds, as well as monthly- and geographically-varying trace constituent concentrations. From 0-27 km, GRAM thermodynamics and winds are based on National Oceanic and Atmospheric Administration Global Upper Air Climatic Atlas (GUACA) climatology. Above 120 km, GRAM is based on the NASA Marshall Engineering Thermosphere (MET) model. In the intervening altitude region, GRAM is based on Middle Atmosphere Program (MAP) climatology that also forms the basis of the 1986 COSPAR International Reference Atmosphere (CIRA). Atmospheric composition is represented in GRAM by concentrations of both major and minor species. Above 120 km, MET provides concentration values for N2, O2, Ar, O, He, and H. Below 120 km, species represented also include H2O, O3, N2O, CO, CH4, and CO2. At COSPAR 2002 a comparison was made between GRAM constituents below 120 km and those provided by Naval Research Laboratory (NRL) climatology. No current need to update GRAM constituent climatology in that height range was identified. This report examines GRAM (MET) constituents between 100 and 1000 km altitudes. Discrepancies are noted between GRAM (MET) constituent number densities and mass density or molecular weight. Near 110 km altitude, there is up to about 25% discrepancy between MET number density and mass density (with mass density being valid and number densities requiring adjustment). Near 700 km altitude there is also up to about 25% discrepancy between

MET number density and mean molecular weight (with molecular weight requiring adjustment). In neither case are MET mass density estimates invalidated. These discrepancies have been traced to MET subroutines SLV (which affects 90-170 km height range) and SLVH (which affects helium above 440 km altitude). With these discrepancies corrected, results are presented to illustrate GRAM (MET) constituent mole fractions in terms of height-latitude cross sections from 100 to 1000 km altitude, and latitude-longitude 'maps' at 450 km (approximate height of International Space Station). Plans are discussed for an update of MET (and GRAM) to correct these constituent inconsistencies and to incorporate several new thermospheric model features.
Author
*Thermosphere; Atmospheric Composition; Atmospheric Models; Trace Elements*

**20040086511** NASA Langley Research Center, Hampton, VA, USA
**S'COOL Provides Research Opportunities and Current Data for Today's Technological Classroom**
Green, Carolyn J.; Chambers, Lin H.; Racel, Anne M.; [1999]; 2 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

NASA's Students' Cloud Observations On-Line (S'COOL) project, a hands-on educational project, was an innovative idea conceived by the scientists in the Radiation Sciences Branch at NASA Langley Research Center, Hampton, Virginia, in 1996. It came about after a local teacher expressed the idea that she wanted her students to be involved in real-life science. S'COOL supports NASA's Clouds and the Earth's Radiant Energy System (CERES) instrument, which was launched on the Tropical Rainforest Measuring Mission (TRMM) in November, 1997, as part of NASA's Earth Science Enterprise. With the S'COOL project students observe clouds and related weather conditions, compute data and note vital information while obtaining ground truth observations for the CERES instrument. The observations can then be used to help validate the CERES measurements, particularly detection of clear sky from space. In addition to meeting math, science and geography standards, students are engaged in using the computer to obtain, report and analyze current data, thus bringing modern technology into the realm of classroom, a paradigm that demands our attention.
Author
*Radiant Flux Density; On-Line Systems; Students; Rain Forests; Education*

**20040086514** NASA Langley Research Center, Hampton, VA, USA
**CRYSTAL: The Cirrus Regional Study of Tropical Anvils and Layers**
Delnore, Victor E.; Cox, Stephen K.; Curran, Robert J.; [1999]; 5 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

CRYSTAL the Cirrus Regional Study of Tropical Anvils and Layers is part of the ongoing series of field experiments to study clouds and their impact on world weather and climate, and will attempt to improve the application of cloud effects in global climate models. CRYSTAL is being planned as two parts: a limited CRYSTAL field campaign in 2001 to examine towering clouds and anvil genesis over the Everglades of Florida, and the main CRYSTAL field campaign in the summer of 2003 in the Tropical Western Pacific. The latter is timed to take advantage of several cloud measurement satellites that will be operational at that time. This paper discusses some of the issues to be addressed in CRYSTAL, gives a brief description of the research plan, and describes its relationship to other important field experiments.
Author
*Climate Models; Clouds (Meteorology); Climatology*

## 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*.

**20040085507** Lockheed Martin Space Operations, Bay Saint Louis, MS, USA
**Spatio-Temporal Distribution of Particulate and CDOM in the Mississippi River Bight (MRB) from Optical Measurements**
D'Sa, Eurico; Miller, Richard; DelCastillo, Carlos; February 23, 2004; 22 pp.; In English; AGU Ocean Sciences Meeting, 26-30 Jan. 2004, Portland, OR, USA
Contract(s)/Grant(s): NAS13-650
Report No.(s): SE-2003-10-00094-SSC; No Copyright; Avail: CASI; A03, Hardcopy

NASA's projects for the Mississippi River Coastal Margin Study include Mississippi River Interdisciplinary Research (MiRIR) and NASA Experimental Program to Stimulate Competitive Research (EPSCoR). These projects, undertaken with

the help of Tulane University and the Louisiana Universities Marine Consortium (LUMCON) sampled water in the Gulf of Mexico to measure colored dissolved organic matter (CDOM). This viewgraph presentation contains images of each program's sampling strategy and equipment.
CASI
*Water Sampling; Dissolved Organic Matter; Mississippi River (Us); Gulf of Mexico; Water Color; Geographic Distribution; Annual Variations; Coastal Water*

## 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*.

**20040085935** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Structural Basis for the Catalytic Activity of Human Serine/Threonine Protein Phosphatase type 5 (PP5)**
Swingle, Mark R.; Ciszak, Ewa M.; Honkanen, Richard E.; [2004]; 1 pp.; In English; Federation of American Societies for Experimental Biology, 17-22 Jul. 2004, Snowman Village, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

Serine/threonine protein phosphatase-5 (PP5) is a member of the PPP-gene family of protein phosphatases that is widely expressed in mammalian tissues and is highly conserved among eukaryotes. PP5 associates with several proteins that affect signal transduction networks, including the glucocorticoid receptor (GR)-heat shock protein-90 (Hsp90)-heterocomplex, the CDC16 and CDC27 subunits of the anaphase-promoting complex, elF2alpha kinase, the A subunit of PP2A, the G12-alpha / G13-alpha subunits of heterotrimeric G proteins and DNA-PK. The catalytic domain of PP5 (PP5c) shares 35-45% sequence identity with the catalytic domains of other PPP-phosphatases, including protein phosphatase-1 (PP1), -2A (PP2A), -2B / calcineurin (PP2B), -4 (PP4), -6 (PP6), and -7 (PP7). Like PP1, PP2A and PP4, PP5 is also sensitive to inhibition by okadaic acid, microcystin, cantharidin, tautomycin, and calyculin A. Here we report the crystal structure of the PP5 catalytic domain (PP5c) at a resolution of 1.6 angstroms. From this structure we propose a mechanism for PP5-mediated hydrolysis of phosphoprotein substrates, which requires the precise positioning of two metal ions within a conserved Asp(sup 271)-M(sub 1):M(sub 2)-W(sup 1)-His(sup 304)-Asp(sup 274) catalytic motif. The structure of PP5c provides a possible structural basis for explaining the exceptional catalytic proficiency of protein phosphatases, which are among the most powerful known catalysts. Resolution of the entire C-terminus revealed a novel subdomain, and the structure of the PP5c should also aid development of type-specific inhibitors.
Author
*Catalytic Activity; Proteins; Crystal Structure*

**20040086018** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Carnobacterium Pleistocaenium sp. nov.: A Novel Psychrotolerant, Facultative Anaerobe Isolated from Permafrost of the Fox Tunnel in Alaska**
Pikuta, Elena V.; Marsic, Damien; Bej, Asim; Tang, Jane; Krader, Paul; Hoover, Richard B.; [2004]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

A novel, psychrotolerant, facultative anaerobe, strain FTRIT1(sup T), was isolated from Pleistocene ice from the permafrost tunnel in Fox, Alaska. Gram-positive, motile, rod-shaped cells with sizes 0.6-0.7 x 0.9-1.5 micrometers were observed. Growth occurred within the pH range 6.5-9.5 and optimum at pH 7.3-7.5. The temperature range of the new isolate was 0-28 C and optimum growth occurred at 24 C. The novel isolate requires NaCl (growth absent at 0 %) and growth was observed between 0 and 5% NaCl with optimum at 0.5% (w/v). The new isolate was a catalase-negative chemoorganoheterotroph that used as substrates sugars and some products of proteolysis. The metabolic end products were: acetate, ethanol and CO2. Strain FTRl was sensitive to ampicillin, tetracycline, chloramphenicol, rifampin, kanamycin, and gentamycin. The 16S rDNA sequence analysis showed 99.8% similarity of strain FTR1 with Carnobacterium alterfunditum, but the DNA-DNA hybridization between them demonstrated 39 plus or minus 5% homology. On the basis of genotypic and phenotypic characteristics, it is proposed that the strain FTR1(sup T) (= ATCC BAA-754(sup T) = JSM 12174(sup T) is assigned to the new species of the genus Carnobacterium with proposed name Carnobacterium pleistocaenium sp. nov.
Author
*Anaerobes; Permafrost; Alaska; Bacteria*

**20040086456** Southwest Louisiana Healthcare System, Lake Charles, LA, USA
**Community Hospital Telehealth Consortium**
Williams, Elton L., Jr; Apr. 2004; 24 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAMD17-02-C-0078
Report No.(s): AD-A424728; No Copyright; Avail: CASI; A03, Hardcopy

The Community Hospital Telehealth Consortium is a unique, forward-thinking, community-based healthcare service project organized around 5 not-for-profit community hospitals located throughout Louisiana and Mississippi. The central tenet of the CHTC project is the utilization of TeleHealth technology to improve and expand the opportunity for rural and urban underserved populations to receive quality, affordable health care. The CHTC's goals are to improve quality of and access to health care, to reduce system costs without jeopardizing outcomes, to position Louisiana and Mississippi for the emerging domestic marketplace, and to position Louisiana and Mississippi for the international marketplace. Considerable progress has been made in the second year of the project through our Telemedicine Clinics, our Home Health Telehealth initiatives, and our distance learning initiatives.
DTIC
*Health; Hospitals; Medical Services; Organizations*

**20040086457** State Univ. of New York, Buffalo, NY, USA
**Organic Isothiocyanates: Dietary Modulators of Doxorubicin Resistance in Breast Cancer**
Morris, Marilyn E.; Jun. 2003; 120 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAMD17-00-1-0376
Report No.(s): AD-A424671; No Copyright; Avail: CASI; A06, Hardcopy

Drug resistance is the main cause for therapeutic failure and death in breast cancer. Our goal is to evaluate dietary organic isothiocyanates (ITCs) as inhibitors of MDR. Our studies have demonstrated that phenethyl ITC (PEITC), benzyl ITC (BITC) and naphthyl ITC (NITC) can inhibit P- glycoprotein-mediated efflux in cell lines that overexpress P- gp, as well as in cell lines that overexpress another MDR protein, Multidrug Resistance-associated protein (MRP1). Studies evaluating the mechanism of this interaction have suggested that PEITC is an inhibitor, but not a substrate for P-gp. ITCs inhibit MRP1 through binding interactions, as well as the depletion of the cofactor for transport, glutathione. HPLC assays have been developed to determine the concentrations of these ITCs in biological samples, and a novel LC/MS/MS assay developed for PEITC, in order to obtain the needed specificity and sensitivity for in vivo studies. The stability and pharmacokinetics of NITC and PEITC have been determined. Both NITC and PEITC exhibit dose-dependent disposition, with clearance decreasing with increasing dose. The bioavailability of PEITC was determined for the first time, and found to be excellent (\g80%). The ITCs may represent a new class of inhibitors of MDR in breast cancer.
DTIC
*Cancer; Diets; Mammary Glands; Modulators*

## 53
## BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**20040086464** NASA Langley Research Center, Hampton, VA, USA
**Helping Video Games Rewire ″Our Minds″**
Pope, Alan T.; Palsson, Olafur S.; [2001]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Biofeedback-modulated video games are games that respond to physiological signals as well as mouse, joystick or game controller input; they embody the concept of improving physiological functioning by rewarding specific healthy body signals with success at playing a video game. The NASA patented biofeedback-modulated game method blends biofeedback into popular off-the- shelf video games in such a way that the games do not lose their entertainment value. This method uses physiological signals (e.g., electroencephalogram frequency band ratio) not simply to drive a biofeedback display directly, or periodically modify a task as in other systems, but to continuously modulate parameters (e.g., game character speed and mobility) of a game task in real time while the game task is being performed by other means (e.g., a game controller). Biofeedback-modulated video games represent a new generation of computer and video game environments that train valuable mental skills beyond eye-hand coordination. These psychophysiological training technologies are poised to exploit the

revolution in interactive multimedia home entertainment for the personal improvement, not just the diversion, of the user. Author

*Biofeedback; Coordination; Education; Games; Sensorimotor Performance*

## 54
## MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human factors engineering, bionics, man-machine systems, life support, space suits and protective clothing. For related information see also *16 Space Transportation and Safety* and *52 Aerospace Medicine*.

**20040085699** NASA Langley Research Center, Hampton, VA, USA

**Preliminary Effect of Synthetic Vision Systems Displays to Reduce Low-Visibility Loss of Control and Controlled Flight Into Terrain Accidents**

Glaab, Louis J.; Takallu, Mohammad A.; [2002]; 13 pp.; In English

Report No.(s): Rept-2002-01-1550; No Copyright; Avail: CASI; A03, Hardcopy

An experimental investigation was conducted to study the effectiveness of Synthetic Vision Systems (SVS) flight displays as a means of eliminating Low Visibility Loss of Control (LVLOC) and Controlled Flight Into Terrain (CFIT) accidents by low time general aviation (GA) pilots. A series of basic maneuvers were performed by 18 subject pilots during transition from Visual Meteorological Conditions (VMC) to Instrument Meteorological Conditions (IMC), with continued flight into IMC, employing a fixed-based flight simulator. A total of three display concepts were employed for this evaluation. One display concept, referred to as the Attitude Indicator (AI) replicated instrumentation common in today's General Aviation (GA) aircraft. The second display concept, referred to as the Electronic Attitude Indicator (EAI), featured an enlarged attitude indicator that was more representative of a glass display that also included advanced flight symbology, such as a velocity vector. The third concept, referred to as the SVS display, was identical to the EAI except that computer-generated terrain imagery replaced the conventional blue-sky/brown-ground of the EAI. Pilot performance parameters, pilot control inputs and physiological data were recorded for post-test analysis. Situation awareness (SA) and qualitative pilot comments were obtained through questionnaires and free-form interviews administered immediately after the experimental session. Initial pilot performance data were obtained by instructor pilot observations. Physiological data (skin temperature, heart rate, and muscle flexure) were also recorded. Preliminary results indicate that far less errors were committed when using the EAI and SVS displays than when using conventional instruments. The specific data example examined in this report illustrates the benefit from SVS displays to avoid massive loss of SA conditions. All pilots acknowledged the enhanced situation awareness provided by the SVS display concept. Levels of pilot stress appear to be correlated with skin temperature measurements. Author

*Display Devices; Enhanced Vision; Low Visibility; Terrain; Aircraft Accidents; Flight Control; General Aviation Aircraft*

**20040085774** NASA Langley Research Center, Hampton, VA, USA

**The Results of a Simulator Study to Determine the Effects on Pilot Performance of Two Different Motion Cueing Algorithms and Various Delays, Compensated and Uncompensated**

Guo, Li-Wen; Cardullo, Frank M.; Telban, Robert J.; Houck, Jacob A.; Kelly, Lon C.; [2003]; 11 pp.; In English; AIAA Modeling and Simulation Technologies Conference and Exhibition, 11-14 Aug. 2003, Austin, TX, USA

Report No.(s): AIAA Paper 2003-5676; Copyright; Avail: CASI; A03, Hardcopy

A study was conducted employing the Visual Motion Simulator (VMS) at the NASA Langley Research Center, Hampton, Virginia. This study compared two motion cueing algorithms, the NASA adaptive algorithm and a new optimal control based algorithm. Also, the study included the effects of transport delays and the compensation thereof. The delay compensation algorithm employed is one developed by Richard McFarland at NASA Ames Research Center. This paper reports on the analyses of the results of analyzing the experimental data collected from preliminary simulation tests. This series of tests was conducted to evaluate the protocols and the methodology of data analysis in preparation for more comprehensive tests which will be conducted during the spring of 2003. Therefore only three pilots were used. Nevertheless some useful results were obtained. The experimental conditions involved three maneuvers; a straight-in approach with a rotating wind vector, an offset approach with turbulence and gust, and a takeoff with and without an engine failure shortly after liftoff. For each of the maneuvers the two motion conditions were combined with four delay conditions (0, 50, 100 & 200ms), with and without compensation.

Author

*Algorithms; Cues; Motion Simulators; Pilot Performance; Delay*

**20040085897** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Evolution of the Baseline ISS ECLSS Technologies: The Next Logical Steps**

Carrasquillo, Robyn L.; Bagdigian, Bob; Perry, Jay; Lewis, John; Williams, Dave; [2004]; 1 pp.; In English; 34th International Conference on Environmental Systems, 19-22 Jul. 2004, Colorado Springs, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

The baseline Environmental Control and Life Support Systems which are currently deployed on the International Space Station or planned to be launched in Node 3 are based on technologies selected in the early 1990's. While they are generally meeting or exceeding requirements for supporting the ISS crew, lessons learned from years of on orbit and ground testing, new advances in technology state of the art, and requirements for future manned missions prompt consideration of the next logical step to enhance these systems to increase performance, robustness, reliability, and reduce on-orbit and logistical resource requirements. This paper discusses the current state of the art in ISS ECLSS technologies, and possible areas for enhancement/improvement. Potential utilization of the ISS as a testbed for on-orbit checkout of selected technology improvements is also addressed.

Author

*Environmental Control; Life Support Systems; International Space Station; Ground Tests; Robustness (Mathematics)*

**20040086020** NASA Langley Research Center, Hampton, VA, USA

**Shuttle Spacesuit: Fabric/LCVG Model Validation**

Wilson, J. W.; Tweed, J.; Zeitlin, C.; Kim, M.-H. Y.; Anderson, B. M.; Cucinotta, F. A.; Ware, J.; Persans, A. E.; [2001]; 5 pp.; In English

Report No.(s): SAE Paper 01ICES-2372; Copyright; Avail: CASI; A01, Hardcopy

A detailed spacesuit computational model is being developed at the Langley Research Center for radiation exposure evaluation studies. The details of the construction of the spacesuit are critical to estimation of exposures and assessing the risk to the astronaut on EVA. Past evaluations of spacesuit shielding properties assumed the basic fabric lay-up (Thermal Micrometeroid Garment, fabric restraints, and pressure envelope) and Liquid Cooling and Ventilation Garment (LCVG) could be homogenized as a single layer overestimating the protective properties over 60 percent of the fabric area. The present spacesuit model represents the inhomogeneous distributions of LCVG materials (mainly the water filled cooling tubes). An experimental test is performed using a 34-MeV proton beam and highresolution detectors to compare with model-predicted transmission factors. Some suggestions are made on possible improved construction methods to improve the spacesuit's protection properties.

Author

*Space Suits; Mathematical Models; Space Shuttles; Extraterrestrial Radiation*

## 55
## EXOBIOLOGY

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

**20040085613** Desert Research Inst., Reno, NV, USA

**Bacterial Distribution and Production Within Lake Ice and Glacial Ice Along the Fringe of the Antarctic Ice Cap**

Fritsen, C. H.; Priscu, J. C.; Doran, P. T.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Microbial growth within Earth s icy habitats can help define where microbial consortia may survive and function within similar environments on other planets. Herein, we report on ice properties, bacterial biomass and rates, of bacterial production within perennial lake ice covers and glacial ice environments within the McMurdo Dry Valleys, Antarctica which lie at the border of the Antarctic polar ice cap along the Victoria land coast.

Author

*Extraterrestrial Life; Bacteria; Lake Ice*

**20040085647** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Astrobiology Exploration Strategies for the Mars Polar Regions Using Balloon Platforms**

Mahaffy, P. R.; Atreya, S. A.; Fairbrother, D. A.; Farrell, W. M.; Gorevan, S.; Jones, J.; Mitrofanov, I.; Scott, J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Montgolfiere balloons can provide a unique near-surface platform for an extended traverse over the polar regions of Mars. During the polar summer, such solar powered balloons would remain in the constant sun of the polar summer and could remain airborne for many weeks or even months as the atmospheric circulation would drive the balloons around the polar region many times before the balloon would cross the terminator. Such a platform for scientific measurements could provide in situ sampling of the atmosphere for trace disequilibrium species that might be indicators of present geological or biological activity in this region. It could furthermore provide high resolution imaging, deep electromagnetic (EM) sounding for subsurface stratigraphy and liquid water, and high spatial resolution neutron measurements of subsurface ice. Technologies for robust balloon deployment on entry and controlled encounters with the surface and near subsurface for sample acquisition in otherwise inaccessible regions are presently being studied and developed with support from NASA.

Author

*Balloons; Mars Surface; Polar Regions; Trace Elements*

**20040085649** NASA Ames Research Center, Moffett Field, CA, USA

**An Automated, Low Mass, Low Power Drill for Acquiring Subsurface Samples of Ground Ice for Astrobiology Studies on Earth and on Mars**

Briggs, G. A.; McKay, C.; George, J.; Derkowski, G.; Cooper, G.; Zacny, K.; Baker, R. Fincher; Pollard, W.; Clifford, S.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Abstract Only; Available from CASI on CD-ROM only as part of the entire parent document

As a project that is part of NASA s Astrobiology Technology & Instrument Development Program (ASTID), we are developing a low mass (approx.20kg) drill that will be operated without drilling fluids and at very low power levels (approx.60 watts electrical) to access and retrieve samples from permafrost regions of Earth and Mars. The drill, designed and built as a joint effort by NASA JSC and Baker-Hughes International, takes the form of a down-hole unit attached to a cable so that it can, in principle, be scaled easily to reach significant depths. A parallel laboratory effort is being carried out at UC Berkeley to characterize the physics of dry drilling under martian conditions of pressure, temperature and atmospheric composition. Data from the UCB and JSC laboratory experiments are being used as input to a drill simulation program which is under development to provide autonomous control of the drill. The first Arctic field test of the unit is planned for May 2004. A field expedition to Eureka on Ellesmere Island in Spring 2003 provided an introduction for several team members to the practical aspects of drilling under Arctic conditions. The field effort was organized by Wayne Pollard of McGill University and Christopher McKay of NASA ARC. A conventional science drill provided by New Zealand colleagues was used to recover ground ice cores for analysis of their microbial content and also to develop techniques using tracers to track the depth of penetration of contamination from the core surface into the interior of the samples.

Author

*Drilling; Ice; Microorganisms; Exobiology; Permafrost; Mars Surface*

**20040085683** Search for Extraterrestrial Intelligence Inst., Moffett Field, CA, USA

**Life in Polar Impact-shocked Rocks: An Analog for Micro-Habitats at the Martian Poles**

Cockell, Charles; Lee, Pascal; Osinski, Gordon; Fike, David; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

We describe the colonization of shocked gneissic rocks from the Haughton impact structure in the Canadian High Arctic (75 N) as a potential analog for habitats at the Martian poles for speculative indigenous life or contaminants that have already been transferred to Mars by vehicles such as the crashed Mars Polar Lander. We have used 16s RNA sequencing and SEM to demonstrate the presence of a diverse heterotrophic community of microorganisms throughout the rocks, including spore-forming Bacillus spp., which are a known genus of microorganisms to be found on spacecraft surfaces.

Author

*Mars Surface; Gneiss; Earth Analogs; Extraterrestrial Life*

**20040085684** Montana State Univ., Bozeman, MT, USA
**Earth's Icy Biosphere**
Christner, B. C.; Priscu, J. C.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Earth s biosphere is cold, with 14% being polar and 90% (by volume) cold ocean \h5 oC. More than 70% of Earth s freshwater occurs as ice and a large portion of the soil ecosystem (~20%) exists as permafrost.We propose that the Earth s cryosphere and associated sub-ice lakes should be included as biospheric components of our planet. Here, the cryosphere is defined as that portion of the Earth s surface where water is in a solid form as snow or ice, including solid forms such as sea ice, freshwater ice, snow, glaciers, and frozen ground. Examining permanently ice-covered habitats and microorganisms preserved for extended periods within ice is relevant to astrobiological discussions of past or present life on Mars, and the concept that planetary bodies may not be biologically isolated. Such remote and seemingly inconsequential frozen environments may harbor as yet undiscovered microbial ecosystems that could shed light on the natural history and evolution of life on a frozen Earth, as well as other icy planets and moons in the solar system.
Author
*Extraterrestrial Life; Mars (Planet); Earth Cryosphere*

**20040085763** Marine Biological Lab., Woods Hole, MA, USA
**Enzyme Amplified Detection of Microbial Cell Wall Components**
Wainwright, Norman R.; [2004]; 7 pp.; In English
Contract(s)/Grant(s): NAG9-1105; No Copyright; Avail: CASI; A02, Hardcopy

This proposal is MBL's portion of NASA's Johnson Space Center's Astrobiology Center led by Principal Investigator, Dr. David McKay, entitled: 'Institute for the Study of Biomarkers in Astromaterials.' Dr. Norman Wainwright is the principal investigator at MBL and is responsible for developing methods to detect trace quantities of microbial cell wall chemicals using the enzyme amplification system of Limulus polyphemus and other related methods.
Author
*Enzymes; Biomarkers; Microorganisms; Bioassay*

**20040085947** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Life in the Fast Lane for Protein Crystallization and X-Ray Crystallography**
Pusey, Marc L.; Liu, Zhi-Jie; Tempel, Wolfram; Praissman, Jeremy; Lin, Dawei; Wang, Bi-Cheng; Gavira, Jose A.; Ng, Joseph D.; [2004]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

The common goal for structural genomic centers and consortiums is to decipher as quickly as possible the three-dimensional structures for a multitude of recombinant proteins derived from known genomic sequences. Since X-ray crystallography is the foremost method to acquire atomic resolution for macromolecules, the limiting step is obtaining protein crystals that can be useful of structure determination. High-throughput methods have been developed in recent years to clone, express, purify, crystallize and determine the three-dimensional structure of a protein gene product rapidly using automated devices, commercialized kits and consolidated protocols. However, the average number of protein structures obtained for most structural genomic groups has been very low compared to the total number of proteins purified. As more entire genomic sequences are obtained for different organisms from the three kingdoms of life, only the proteins that can be crystallized and whose structures can be obtained easily are studied. Consequently, an astonishing number of genomic proteins remain unexamined. In the era of high-throughput processes, traditional methods in molecular biology, protein chemistry and crystallization are eclipsed by automation and pipeline practices. The necessity for high rate production of protein crystals and structures has prevented the usage of more intellectual strategies and creative approaches in experimental executions. Fundamental principles and personal experiences in protein chemistry and crystallization are minimally exploited only to obtain ″low-hanging fruit″ protein structures. We review the practical aspects of today s high-throughput manipulations and discuss the challenges in fast pace protein crystallization and tools for crystallography. Structural genomic pipelines can be improved with information gained from low-throughput tactics that may help us reach the higher-bearing fruits. Examples of recent developments in this area are reported from the efforts of the Southeast Collaboratory for Structural Genomics (SECSG).
Author
*Crystallography; Crystallization; X Rays; Protein Crystal Growth; Proteins*

## 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*.

**20040085532** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
**Performance Analysis of Parallel Supernodal Sparse LU Factorization**
Grigori, L.; Li, X. S.; 2004; 18 pp.; In English
Report No.(s): DE2004-822182; No Copyright; Avail: Department of Energy Information Bridge

We investigate performance characteristics for the LU factorization of large matrices with various sparsity patterns. We consider supernodal right-looking parallel factorization on a bi-dimensional grid of processors, making use of static pivoting. We develop a performance model and we validate it using the implementation in SuperLU-DIST, the real matrices and the IBM Power3 machine at NERSC. We use this model to obtain performance bounds on parallel computers, to perform scalability analysis and to identify performance bottlenecks. We also discuss the role of load balance and data distribution in this approach.
NTIS
*Factorization; Performance Tests; Parallel Processing (Computers)*

**20040085543** GEOMET Technologies, Inc., Germantown, MD, USA
**Integration of Real-Time Data into Building Automation Systems**
Stunder, M. J.; Sebastian, P.; Chube, B. A.; Koontz, M. D.; Jan. 2003; In English
Report No.(s): DE2003-809900; No Copyright; Avail: National Technical Information Service (NTIS)

The project goal was to investigate the possibility of using predictive real-time information from the Internet as an input to building management system algorithms. The objectives were to identify the types of information most valuable to commercial and residential building owners, managers, and system designers, to comprehensively investigate and document currently available electronic real-time information suitable for use in building management systems, verify the reliability of the information and recommend accreditation methods for data and providers, assess methodologies to automatically retrieve and utilize the information, characterize equipment required to implement automated integration, demonstrate the feasibility and benefits of using the information in building management systems, and identify evolutionary control strategies.
NTIS
*Automation; Real Time Operation; Automatic Control; Management Systems*

**20040085558** Lawrence Livermore National Lab., Livermore, CA
**Unclassified Computing Capability. User Responses to a Multiprogrammatic and Institutional Computing Questionnaire**
McCoy, M.; Kissel, L.; Jan. 29, 2002; In English
Report No.(s): DE2004-15005939; UCRL-ID-147450; No Copyright; Avail: National Technical Information Service (NTIS)

We are experimenting with a new computing model to be applied to a new computer dedicated to that model. Several LLNL science teams now have computational requirements, evidenced by the mature scientific applications that have been developed over the past five plus years, that far exceed the capability of the institution's computing resources. Thus, there is increased demand for dedicated, powerful parallel computational systems. Computation can, in the coming year, potentially field a capability system that is low cost because it will be based on a model that employs open source software and because it will use PC (IA32-P4) hardware. This incurs significant computer science risk regarding stability and system features but also presents great opportunity. We believe the risks can be managed, but the existence of risk cannot be ignored. In order to justify the budget for this system, we need to make the case that it serves science and, through serving science, serves the institution. That is the point of the meeting and the White Paper that we are proposing to prepare. The questions are listed and the responses received are in this report.
NTIS
*Computation; Computers; Parallel Processing (Computers)*

**20040085560** Lawrence Livermore National Lab., Livermore, CA
**Generalized B-Spline Subdivision-Surface Wavelets and Lossless Compression**
Bertram, M.; Duchaineau, M. A.; Hamann, B.; Joy, K. I.; Nov. 24, 1999; 36 pp.; In English
Report No.(s): DE2004-15006489; UCRL-JC-136574; No Copyright; Avail: Department of Energy Information Bridge

We present a new construction of wavelets on arbitrary two-manifold topology for geometry compression. The constructed wavelets generalize symmetric tensor product wavelets with associated B-spline scaling functions to irregular polygonal base mesh domains. The wavelets and scaling functions are tensor products almost everywhere, except in the neighborhoods of some extraordinary points (points of valence unequal four) in the base mesh that defines the topology. The compression of arbitrary polygonal meshes representing isosurfaces of scalar-valued trivariate functions is a primary application. The main contribution of this paper is the generalization of lifted symmetric tensor product B-spline wavelets to two-manifold geometries. Surfaces composed of B-spline patches can easily be converted to this scheme. We present a lossless compression method for geometries with or without associated functions like color, texture, or normals. The new wavelet transform is highly efficient and can represent surfaces at any level of resolution with high degrees of continuity, except at a finite number of extraordinary points in the base mesh. In the neighborhoods of these points detail can be added to the surface to approximate any degree of continuity.
NTIS
*Topology; Geometry; Spline Functions*

**20040085561** Lawrence Livermore National Lab., Livermore, CA
**Case Study of Isosurface Extraction Algortithm Performance**
Sutton, P. M.; Hansen, C. D.; Shen, H. W.; Schikore, D.; Dec. 14, 1999; 20 pp.; In English
Report No.(s): DE2004-15006491; UCRL-JC-136866; No Copyright; Avail: Department of Energy Information Bridge

Isosurface extraction is an important and useful visualization method. Over the past ten years, the field has seen numerous isosurface techniques published leaving the user in a quandary about which one should be used. Some papers have published complexity analysis of the techniques yet empirical evidence comparing different methods is lacking. This case study presents a comparative study of several representative isosurface extraction algorithms. It reports and analyzes empirical measurements of execution times and memory behavior for each algorithm. The results show that asymptotically optimal techniques may not be the best choice when implemented on modern computer architectures.
NTIS
*Architecture (Computers); Optimization*

**20040085690** Akron Univ., Akron, OH, USA
**Theory, Modeling, Software and Hardware Development for Analytical and Computational Materials Science**
Young, Gerald W.; Clemons, Curtis B.; [2004]; 16 pp.; In English
Contract(s)/Grant(s): NCC3-1094; No Copyright; Avail: CASI; A03, Hardcopy

The focus of this Cooperative Agreement between the Computational Materials Laboratory (CML) of the Processing Science and Technology Branch of the NASA Glenn Research Center (GRC) and the Department of Theoretical and Applied Mathematics at The University of Akron was in the areas of system development of the CML workstation environment, modeling of microgravity and earth-based material processing systems, and joint activities in laboratory projects. These efforts complement each other as the majority of the modeling work involves numerical computations to support laboratory investigations. Coordination and interaction between the modelers, system analysts, and laboratory personnel are essential toward providing the most effective simulations and communication of the simulation results. Toward these means, The University of Akron personnel involved in the agreement worked at the Applied Mathematics Research Laboratory (AMRL) in the Department of Theoretical and Applied Mathematics while maintaining a close relationship with the personnel of the Computational Materials Laboratory at GRC. Network communication between both sites has been established. A summary of the projects we undertook during the time period 9/1/03 - 6/30/04 is included.
Derived from text
*Mathematical Models; Materials Science; Software Engineering; Hardware; Research and Development*

**20040085738** NASA Langley Research Center, Hampton, VA, USA
**A Cubic Radial Basis Function in the MLPG Method for Beam Problems**
Raju, I. S.; Phillips, D. R.; [2002]; 6 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A non-compactly supported cubic radial basis function implementation of the MLPG method for beam problems is presented. The evaluation of the derivatives of the shape functions obtained from the radial basis function interpolation is much simpler than the evaluation of the moving least squares shape function derivatives. The radial basis MLPG yields results

as accurate or better than those obtained by the conventional MLPG method for problems with discontinuous and other complex loading conditions.
Author
*Derivation; Interpolation; Shape Functions*

**20040085772** NASA Langley Research Center, Hampton, VA, USA
**A Multifunctional Interface Method for Coupling Finite Element and Finite Difference Methods: Two-Dimensional Scalar-Field Problems**
Ransom, Jonathan B.; [2002]; 13 pp.; In English
Report No.(s): AIAA Paper 2002-1573; No Copyright; Avail: CASI; A03, Hardcopy

A multifunctional interface method with capabilities for variable-fidelity modeling and multiple method analysis is presented. The methodology provides an effective capability by which domains with diverse idealizations can be modeled independently to exploit the advantages of one approach over another. The multifunctional method is used to couple independently discretized subdomains, and it is used to couple the finite element and the finite difference methods. The method is based on a weighted residual variational method and is presented for two-dimensional scalar-field problems. A verification test problem and a benchmark application are presented, and the computational implications are discussed.
Author
*Finite Difference Theory; Finite Element Method; Two Dimensional Models; Methodology; Discretization (Mathematics)*

**20040085905** Lawrence Livermore National Lab., Livermore, CA
**Statistical Scalability Analysis of Communication Operations in Distributed Applications**
Vetter, J. S.; MCracken, M. O.; Feb. 27, 2001; In English
Report No.(s): DE2004-15006150; UCRL-JC-142611; No Copyright; Avail: National Technical Information Service (NTIS)

Current trends in high performance computing suggest that users will soon have widespread access to clusters of multiprocessors with hundreds, if not thousands, of processors. This unprecedented degree of parallelism will undoubtedly expose scalability limitations in existing applications, where scalability is the ability of a parallel algorithm on a parallel architecture to effectively utilize an increasing number of processors. Users will need precise and automated techniques for detecting the cause of limited scalability. This paper addresses this dilemma. First, we argue that users face numerous challenges in understanding application scalability: managing substantial amounts of experiment data, extracting useful trends from this data, and reconciling performance information with their application's design. Second, we propose a solution to automate this data analysis problem by applying fundamental statistical techniques to scalability experiment data. Finally, we evaluate our operational prototype on several applications, and show that statistical techniques offer an effective strategy for assessing application scalability. In particular, we find that non-parametric correlation of the number of tasks to the ratio of the time for individual communication operations to overall communication time provides a reliable measure for identifying communication operations that scale poorly.
NTIS
*Architecture (Computers); Arrays; Data Reduction; Statistical Analysis*

**20040085952** Environmental Protection Agency, Research Triangle Park, NC
**Finding a Common Data Representation and Interchange Approach for Multimedia Models**
Fine, S. S.; 2003; 12 pp.; In English
Report No.(s): PB2004-105257; No Copyright; Avail: CASI; A03, Hardcopy

As simulations of the environment become more comprehensive, there is growing need to share models and data sets among groups that previously operated independently. One of the largest obstacles to such sharing is that most groups use different approaches for representing and interchanging environmental data.
NTIS
*Multimedia; Simulation*

**20040086040** Institute for Employment Studies, Brighton, England, UK
**Data Protection Aspects within the Framework of Socio-Economic Research**
Rosier, K.; 2004; 94 pp.; In English
Report No.(s): PB2004-106883; IES-415; No Copyright; Avail: CASI; A05, Hardcopy

The aims of the project are to: Develop a voluntary code of practice for the conduct of socioeconomic research in the

information society; Contribute to the development of common European standards and benchmarks for socio-economic research; Contribute to the development of high standards in cross national and cross-disciplinary socio-economic research; Contribute to broader ethical and professional debates within the socio-economic research community; Help reduce barriers to the mobility of socio-economic researchers within the EU and Accession States; Provide succinct information on good practice in socioeconomic research for research users both inside and outside the IST community.
NTIS
*Research; Economics; Codes*

**20040086046** Air Force Logistics Command, Wright-Patterson AFB, OH, USA
**Stock Number User Directory (SNUD) Master File (Raw Data File on CD-ROM)**
Jun. 2004; In English
Report No.(s): PB2004-591150; No Copyright; Avail: National Technical Information Service (NTIS)

The stock number user directory (SNUD) file is a tailored product used primarily by Air Force activities as a research tool to assist in locating retail lateral support. SNUD consists of all stock numbers (SNs), for which participating activities have established user interest. The type of Stock Numbers available are National Stock Numbers (NSNs), Kit (K), Non-cataloged (NC) or Non-Designated (ND) numbers. Activities are identified by a Stock Record Account Number (SRAN) or an assigned user account.
NTIS
*Directories; Position (Location)*

**20040086095** NASA Langley Research Center, Hampton, VA, USA
**An Implicit LU/AF FDTD Method**
Beggs, John H.; Briley, W. Roger; [2001]; 4 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

There has been some recent work to develop two and three-dimensional alternating direction implicit (ADI) FDTD schemes. These ADI schemes are based upon the original ADI concept developed by Peaceman and Rachford and Douglas and Gunn, which is a popular solution method in Computational Fluid Dynamics (CFD). These ADI schemes work well and they require solution of a tridiagonal system of equations. A new approach proposed in this paper applies a LU/AF approximate factorization technique from CFD to Maxwell s equations in flux conservative form for one space dimension. The result is a scheme that will retain its unconditional stability in three space dimensions, but does not require the solution of tridiagonal systems. The theory for this new algorithm is outlined in a one-dimensional context for clarity. An extension to two and threedimensional cases is discussed. Results of Fourier analysis are discussed for both stability and dispersion/damping properties of the algorithm. Results are presented for a one-dimensional model problem, and the explicit FDTD algorithm is chosen as a convenient reference for comparison.
Derived from text
*Algorithms; Alternating Direction Implicit Methods; Computational Fluid Dynamics; Finite Difference Time Domain Method; Mathematical Models*

## 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*.

**20040086013** NASA Langley Research Center, Hampton, VA, USA
**Space Shuttle RTOS Bayesian Network**
Morris, A. Terry; Beling, Peter A.; [2001]; 12 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

With shrinking budgets and the requirements to increase reliability and operational life of the existing orbiter fleet, NASA has proposed various upgrades for the Space Shuttle that are consistent with national space policy. The cockpit avionics upgrade (CAU), a high priority item, has been selected as the next major upgrade. The primary functions of cockpit avionics include flight control, guidance and navigation, communication, and orbiter landing support. Secondary functions include the provision of operational services for non-avionics systems such as data handling for the payloads and caution and warning alerts to the crew. Recently, a process to selection the optimal commercial-off-the-shelf (COTS) real-time operating system (RTOS) for the CAU was conducted by United Space Alliance (USA) Corporation, which is a joint venture between Boeing and Lockheed Martin, the prime contractor for space shuttle operations. In order to independently assess the RTOS selection,

NASA has used the Bayesian network-based scoring methodology described in this paper. Our two-stage methodology addresses the issue of RTOS acceptability by incorporating functional, performance and non-functional software measures related to reliability, interoperability, certifiability, efficiency, correctness, business, legal, product history, cost and life cycle. The first stage of the methodology involves obtaining scores for the various measures using a Bayesian network. The Bayesian network incorporates the causal relationships between the various and often competing measures of interest while also assisting the inherently complex decision analysis process with its ability to reason under uncertainty. The structure and selection of prior probabilities for the network is extracted from experts in the field of real-time operating systems. Scores for the various measures are computed using Bayesian probability. In the second stage, multi-criteria trade-off analyses are performed between the scores. Using a prioritization of measures from the decision-maker, trade-offs between the scores are used to rank order the available set of RTOS candidates.
Author
*Bayes Theorem; Real Time Operation; Space Shuttles; Operating Systems (Computers); Avionics*

## 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.

**20040085701** NASA Langley Research Center, Hampton, VA, USA
**The Design of Fault Tolerant Quantum Dot Cellular Automata Based Logic**
Armstrong, C. Duane; Humphreys, William M.; Fijany, Amir; [2002]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

As transistor geometries are reduced, quantum effects begin to dominate device performance. At some point, transistors cease to have the properties that make them useful computational components. New computing elements must be developed in order to keep pace with Moore s Law. Quantum dot cellular automata (QCA) represent an alternative paradigm to transistor-based logic. QCA architectures that are robust to manufacturing tolerances and defects must be developed. We are developing software that allows the exploration of fault tolerant QCA gate architectures by automating the specification, simulation, analysis and documentation processes.
Author
*Transistor Logic; Automata Theory; Fault Tolerance; Computer Programs; Transistors*

**20040085716** NASA Langley Research Center, Hampton, VA, USA
**The Development of Design Tools for Fault Tolerant Quantum Dot Cellular Automata Based Logic**
Armstrong, Curtis D.; Humphreys, William M.; [2003]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

We are developing software to explore the fault tolerance of quantum dot cellular automata gate architectures in the presence of manufacturing variations and device defects. The Topology Optimization Methodology using Applied Statistics (TOMAS) framework extends the capabilities of the A Quantum Interconnected Network Array Simulator (AQUINAS) by adding front-end and back-end software and creating an environment that integrates all of these components. The front-end tools establish all simulation parameters, configure the simulation system, automate the Monte Carlo generation of simulation files, and execute the simulation of these files. The back-end tools perform automated data parsing, statistical analysis and report generation.
Author
*Automata Theory; Computer Programs; Design Optimization; Fault Tolerance*

**20040085780** NASA Langley Research Center, Hampton, VA, USA
**Control Law Design in a Computational Aeroelasticity Environment**
Newsom, Jerry R.; Robertshaw, Harry H.; Kapania, Rakesh K.; [2003]; 13 pp.; In English
Report No.(s): AIAA Paper 2003-1415; No Copyright; Avail: CASI; A03, Hardcopy

A methodology for designing active control laws in a computational aeroelasticity environment is given. The methodology involves employing a systems identification technique to develop an explicit state-space model for control law design from the output of a computational aeroelasticity code. The particular computational aeroelasticity code employed in this paper solves the transonic small disturbance aerodynamic equation using a time-accurate, finite-difference scheme. Linear structural dynamics equations are integrated simultaneously with the computational fluid dynamics equations to determine the

time responses of the structure. These structural responses are employed as the input to a modern systems identification technique that determines the Markov parameters of an ″equivalent linear system″. The Eigensystem Realization Algorithm is then employed to develop an explicit state-space model of the equivalent linear system. The Linear Quadratic Guassian control law design technique is employed to design a control law. The computational aeroelasticity code is modified to accept control laws and perform closed-loop simulations. Flutter control of a rectangular wing model is chosen to demonstrate the methodology. Various cases are used to illustrate the usefulness of the methodology as the nonlinearity of the aeroelastic system is increased through increased angle-of-attack changes.
Author
*Aeroelasticity; Computer Programs; Computational Fluid Dynamics; Active Control; Dynamic Structural Analysis*

**20040085781** NASA Langley Research Center, Hampton, VA, USA
**Optimization of Elastically Tailored Tow-Placed Plates with Holes**
Jegley, Dawn C.; Tatting, Brian F.; Guerdal, Zafer; [2003]; 14 pp.; In English
Report No.(s): AIAA Paper 2003-1420; Copyright; Avail: CASI; A03, Hardcopy

Elastic stiffness tailoring of laminated composite panels by allowing the fibers to curve within the plane of the laminate is a design concept that has been demonstrated to be both beneficial and practical. The objective of the present paper is to demonstrate the effectiveness of stiffness tailoring through the use of curvilinear fibers to reduce stress concentrations around the hole and improve the load carrying capability of panels. Preliminary panel designs that are to be manufactured and tested were determined through design studies for flat plates without holes under axial compression using an optimization program. These candidate designs were then analyzed with finite element models that accurately reflect the test conditions and geometries in order to decide upon the final designs for manufacture and testing. An advanced tow-placement machine is used to manufacture the test panels with varying fiber orientation angles. A total of six large panels measuring three feet by six feet, each of which is used to produce four specimens with or without holes, are fabricated. The panels were machined into specimens with holes and tested at NASA Langley Research Center. Buckling response and failure of panels without holes and with two different hole dimensions are presented. Buckling and failure loads of tow-steered specimens are significantly greater than the buckling and failure loads of traditional straight-fiber specimens.
Author
*Composite Structures; Stiffness; Flat Plates; Computer Programs*

**20040085931** NASA Langley Research Center, Hampton, VA, USA
**Rapid Prototyping of an Aircraft Model in an Object-Oriented Simulation**
Kenney, P. Sean; [2003]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

A team was created to participate in the Mars Scout Opportunity. Trade studies determined that an aircraft provided the best opportunity to complete the science objectives of the team. A high fidelity six degree of freedom flight simulation was required to provide credible evidence that the aircraft design fulfilled mission objectives and to support the aircraft design process by providing performance evaluations. The team created the simulation using the Langley Standard Real-Time Simulation in C++ (LaSRS++) application framework. A rapid prototyping approach was necessary because the team had only three months to both develop the aircraft simulation model and evaluate aircraft performance as the design and mission parameters matured. The design of LaSRS++ enabled rapid-prototyping in several ways. First, the framework allowed component models to be designed, implemented, unit-tested, and integrated quickly. Next, the framework provides a highly reusable infrastructure that allowed developers to maximize code reuse while concentrating on aircraft and mission specific features. Finally, the framework reduces risk by providing reusable components that allow developers to build a quality product with a compressed testing cycle that relies heavily on unit testing of new components.
Author
*Aircraft Models; Computerized Simulation; Object-Oriented Programming; Rapid Prototyping; Systems Engineering*

**20040085967** NASA Langley Research Center, Hampton, VA, USA
**Sensitivity Study of the Wall Interference Correction System (WICS) for Rectangular Tunnels**
Walker, Eric L.; Everhart, Joel L.; Iyer, Venkit; [2001]; 28 pp.; In English
Report No.(s): AIAA Paper 2001-0159; Copyright; Avail: CASI; A03, Hardcopy

An off-line wall version of the Wall Interference Correction System (WICS) has been implemented for the NASA Langley National Transonic Facility. The correction capability is currently restricted to corrections for solid wall interference in the model pitch plane for MAch numbers less than 0.45 due to limitation in tunnel calibration data. A study to assess output

sensitivity to measurement uncertainty was conducted to determine standard operational procedures and guidelines to ensure data quality during the testing process.
Author
*Aerodynamic Interference; Wall Flow*

**20040086012** NASA Langley Research Center, Hampton, VA, USA
**Integrated Component-based Data Acquisition Systems for Aerospace Test Facilities**
Ross, Richard W.; [2001]; 9 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The Multi-Instrument Integrated Data Acquisition System (MIIDAS), developed by the NASA Langley Research Center, uses commercial off the shelf (COTS) products, integrated with custom software, to provide a broad range of capabilities at a low cost throughout the system s entire life cycle. MIIDAS combines data acquisition capabilities with online and post-test data reduction computations. COTS products lower purchase and maintenance costs by reducing the level of effort required to meet system requirements. Object-oriented methods are used to enhance modularity, encourage reusability, and to promote adaptability, reducing software development costs. Using only COTS products and custom software supported on multiple platforms reduces the cost of porting the system to other platforms. The post-test data reduction capabilities of MIIDAS have been installed at four aerospace testing facilities at NASA Langley Research Center. The systems installed at these facilities provide a common user interface, reducing the training time required for personnel that work across multiple facilities. The techniques employed by MIIDAS enable NASA to build a system with a lower initial purchase price and reduced sustaining maintenance costs. With MIIDAS, NASA has built a highly flexible next generation data acquisition and reduction system for aerospace test facilities that meets customer expectations.
Author
*Data Acquisition; Test Facilities; Systems Integration; Aerospace Engineering*

**20040086014** NASA Langley Research Center, Hampton, VA, USA
**A Practical Approach to Modified Condition/Decision Coverage**
Hayhurst, Kelly J.; Veerhusem, Dan S.; [2001]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Testing of software intended for safety-critical applications in commercial transport aircraft must achieve modified condition/decision coverage (MC/DC) of the software structure. This requirement causes anxiety for many within the aviation software community. Results of a survey of the aviation software industry indicate that many developers believe that meeting the MC/DC requirement is difficult, and the cost is exorbitant. Some of the difficulties stem, no doubt, from the scant information available on the subject. This paper provides a practical 5-step approach for assessing MC/DC for aviation software products, and an analysis of some types of errors expected to be caught when MC/DC is achieved1.
Author
*Computer Programs; Errors; Safety*

**20040086518** Boeing Commercial Airplane Co., Seattle, WA, USA
**Computational Simulations for Stability and Control: BCA State-of-the-Art**
Yu, N. J.; Kao, T. J.; Bogue, D. R.; Lines, T. R.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 396-416; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

The presentation will show some of our recent work in using the NASA-built Navier-Stokes solvers for various applications including airplane control surface effectiveness study, Reynolds number scaling, and high lift configuration analysis.
Author
*Aerodynamic Configurations; Control Surfaces; Computation*

**20040086522** NASA Langley Research Center, Hampton, VA, USA
**TetrUSS Capabilities for S and C Applications**
Frink, Neal T.; Parikh, Paresh; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 378-395; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

TetrUSS is a suite of loosely coupled computational fluid dynamics software that is packaged into a complete flow analysis system. The system components consist of tools for geometry setup, grid generation, flow solution, visualization, and various utilities tools. Development began in 1990 and it has evolved into a proven and stable system for Euler and Navier-Stokes analysis and design of unconventional configurations. It is 1) well developed and validated, 2) has a broad base

of support, and 3) is presently is a workhorse code because of the level of confidence that has been established through wide use. The entire system can now run on linux or mac architectures. In the following slides, I will highlight more of the features of the VGRID and USM3D codes.
Derived from text
*Computational Fluid Dynamics; Flow Visualization; Computer Programs*

**20040086523** NASA Langley Research Center, Hampton, VA, USA
**Time-Accurate Computational Simulation**
Pao, S. Paul; Buning, Pieter G.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 417-432; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

Time accurate CFD may offer a faster approach to S&C aerodynamic database population than the conventional point by point steady state CFD. We would directly simulate -, -sweeps or other configuration movements typically of measurement sequence in wind tunnels. A second objective is to demonstrate potential applications to assessment of S&C dynamic derivatives by simulating vehicle motions such as free to roll, and nonlinearity such as the trends of aerodynamic forces near CL-max or flow hysteresis.
Author
*Computational Fluid Dynamics; Data Bases; Nonlinearity; Aerodynamic Forces*

## 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.

**20040086491** NASA Langley Research Center, Hampton, VA, USA
**Spaceflight Validation of Hzetrn Code**
Wilson, J. W.; Shinn, J. L.; Singleterry, R. C.; Badavi, F. F.; Badhwar, G. D.; Reitz, G.; Beaujean, R.; Cucinotta, F. A.; [1999]; 3 pp.; In English; Copyright; Avail: CASI; A01, Hardcopy

HZETRN is being developed as a fast deterministic radiation transport code applicable to neutrons, protons, and multiply charged ions in the space environment. It was recently applied to 50 hours of IMP8 data measured during the August 4, 1972 solar event to map the hourly exposures within the human body under several shield configurations. This calculation required only 18 hours on a VAX 4000 machine. A similar calculation using the Monte Carlo method would have required two years of dedicated computer time. The code has been benchmarked against well documented and tested Monte Carlo proton transport codes with good success. The code will allow important trade studies to be made with relative ease due to the computational speed and will be useful in assessing design alternatives in an integrated system software environment. Since there are no well tested Monte Carlo codes for HZE particles, we have been engaged in flight validation of the HZETRN results. To date we have made comparison with TEPC, CR-39, charge particle telescopes, and Bonner spheres. This broad range of detectors allows us to test a number of functions related to differing physical processes which add to the complicated radiation fields within a spacecraft or the human body, which functions can be calculated by the HZETRN code system. In the present report we will review these results.
Derived from text
*Space Flight; Radiation Transport; Computer Systems Programs; Program Verification (Computers)*

## 63
## CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also *54 Man/System Technology and Life Support*.

**20040085697** NASA Langley Research Center, Hampton, VA, USA
**Robotic Assembly of Truss Structures for Space Systems and Future Research Plans**
Doggett, William; [2002]; 10 pp.; In English
Report No.(s): IEEE-0-8703-7231-X/01; Copyright; Avail: CASI; A02, Hardcopy

Many initiatives under study by both the space science and earth science communities require large space systems, i.e.

with apertures greater than 15 m or dimensions greater than 20 m. This paper reviews the effort in NASA Langley Research Center's Automated Structural Assembly Laboratory which laid the foundations for robotic construction of these systems. In the Automated Structural Assembly Laboratory reliable autonomous assembly and disassembly of an 8 meter planar structure composed of 102 truss elements covered by 12 panels was demonstrated. The paper reviews the hardware and software design philosophy which led to reliable operation during weeks of near continuous testing. Special attention is given to highlight the features enhancing assembly reliability.
Author
*Robotics; Trusses; Aerospace Engineering; Research and Development; Assembly*

**20040085702** NASA Langley Research Center, Hampton, VA, USA
**Concept for a Micro Autonomous Ultrasonic Instrument (MAUI)**
Wilson, William C.; Atkinson, Gary M.; [2002]; 7 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

We investigate a concept for the construction a mobile Micro Optical ElectroMechanical Systems (MOEMS) based laser ultrasonic instrument to serve as a Micro Autonomous Ultrasonic Instrument (MAUI). The system will consist of a laser ultrasonic instrument fabricated using Micro Electro-Mechanical Systems (MEMS) technology, and a MEMS based walking platform like those developed by Pister et al. at Berkeley. This small system will allow for automated remote Non-Destructive Evaluation (NDE) of aerospace vehicles.
Author
*Autonomy; Ultrasonics; Microelectromechanical Systems; Fabrication; Robotics*

**20040085891** NASA Langley Research Center, Hampton, VA, USA
**A Design for Composing and Extending Vehicle Models**
Madden, Michael M.; Neuhaus, Jason R.; [2003]; 11 pp.; In English
Report No.(s): AIAA Paper 2003-5458; Copyright; Avail: CASI; A03, Hardcopy

The Systems Development Branch (SDB) at NASA Langley Research Center (LaRC) creates simulation software products for research. Each product consists of an aircraft model with experiment extensions. SDB treats its aircraft models as reusable components, upon which experiments can be built. SDB has evolved aircraft model design with the following goals: 1. Avoid polluting the aircraft model with experiment code. 2. Discourage the copy and tailor method of reuse. The current evolution of that architecture accomplishes these goals by reducing experiment creation to extend and compose. The architecture mechanizes the operational concerns of the model's subsystems and encapsulates them in an interface inherited by all subsystems. Generic operational code exercises the subsystems through the shared interface. An experiment is thus defined by the collection of subsystems that it creates (″compose″). Teams can modify the aircraft subsystems for the experiment using inheritance and polymorphism to create variants (″extend″).
Author
*Aircraft Models; Systems Engineering; Computer Systems Programs; Computerized Simulation*

## 64
## NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

**20040085764** NASA Langley Research Center, Hampton, VA, USA
**Aeroelastic System Development Using Proper Orthogonal Decomposition and Volterra Theory**
Lucia, David J.; Beran, Philip S.; Silva, Walter A.; [2003]; 12 pp.; In English
Contract(s)/Grant(s): AFOSR-99VA01COR; No Copyright; Avail: CASI; A03, Hardcopy

This research combines Volterra theory and proper orthogonal decomposition (POD) into a hybrid methodology for reduced-order modeling of aeroelastic systems. The out-come of the method is a set of linear ordinary differential equations (ODEs) describing the modal amplitudes associated with both the structural modes and the POD basis functions for the uid. For this research, the structural modes are sine waves of varying frequency, and the Volterra-POD approach is applied to the fluid dynamics equations. The structural modes are treated as forcing terms which are impulsed as part of the uid model realization. Using this approach, structural and uid operators are coupled into a single aeroelastic operator. This coupling converts a free boundary uid problem into an initial value problem, while preserving the parameter (or parameters) of interest for sensitivity analysis. The approach is applied to an elastic panel in supersonic cross ow. The hybrid Volterra-POD approach provides a low-order uid model in state-space form. The linear uid model is tightly coupled with a nonlinear panel model using

an implicit integration scheme. The resulting aeroelastic model provides correct limit-cycle oscillation prediction over a wide range of panel dynamic pressure values. Time integration of the reduced-order aeroelastic model is four orders of magnitude faster than the high-order solution procedure developed for this research using traditional uid and structural solvers.
Author
*Aeroelasticity; Sensitivity Analysis; Boundary Value Problems; Dynamic Pressure; Fluid Dynamics; Free Boundaries*

**20040085788** NASA Langley Research Center, Hampton, VA, USA
**Meshless Local Petrov-Galerkin Euler-Bernoulli Beam Problems: A Radial Basis Function Approach**
Raju, I. S.; Phillips, D. R.; Krishnamurthy, T.; [2003]; 14 pp.; In English
Report No.(s): AIAA Paper 2003-1674; No Copyright; Avail: CASI; A03, Hardcopy

A radial basis function implementation of the meshless local Petrov-Galerkin (MLPG) method is presented to study Euler-Bernoulli beam problems. Radial basis functions, rather than generalized moving least squares (GMLS) interpolations, are used to develop the trial functions. This choice yields a computationally simpler method as fewer matrix inversions and multiplications are required than when GMLS interpolations are used. Test functions are chosen as simple weight functions as in the conventional MLPG method. Compactly and noncompactly supported radial basis functions are considered. The non-compactly supported cubic radial basis function is found to perform very well. Results obtained from the radial basis MLPG method are comparable to those obtained using the conventional MLPG method for mixed boundary value problems and problems with discontinuous loading conditions.
Author
*Euler-Bernoulli Beams; Galerkin Method; Boundary Value Problems*

**20040086058** NASA Langley Research Center, Hampton, VA, USA
**Comparison of Nonlinear Random Response Using Equivalent Linearization and Numerical Simulation**
Rizzi, Stephen A.; Muravyov, Alexander A.; Structural Dynamics: Recent Advances, Proceedings of the 7th International Conference; 2000; Volume 2, pp. 833-846; In English; Structural Dynamics: Recent Advances, 2000; No Copyright; Avail: CASI; A03, Hardcopy

A recently developed finite-element-based equivalent linearization approach for the analysis of random vibrations of geometrically nonlinear multiple degree-of-freedom structures is validated. The validation is based on comparisons with results from a finite element based numerical simulation analysis using a numerical integration technique in physical coordinates. In particular, results for the case of a clamped-clamped beam are considered for an extensive load range to establish the limits of validity of the equivalent linearization approach.
Author
*Clamped Structures; Degrees of Freedom; Finite Element Method; Numerical Integration*

**20040086071** NASA Langley Research Center, Hampton, VA, USA
**An Inverse Interpolation Method Utilizing In-Flight Strain Measurements for Determining Loads and Structural Response of Aerospace Vehicles**
Shkarayev, S.; Krashantisa, R.; Tessler, A.; [2004]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

An important and challenging technology aimed at the next generation of aerospace vehicles is that of structural health monitoring. The key problem is to determine accurately, reliably, and in real time the applied loads, stresses, and displacements experienced in flight, with such data establishing an information database for structural health monitoring. The present effort is aimed at developing a finite element-based methodology involving an inverse formulation that employs measured surface strains to recover the applied loads, stresses, and displacements in an aerospace vehicle in real time. The computational procedure uses a standard finite element model (i.e., ″direct analysis″) of a given airframe, with the subsequent application of the inverse interpolation approach. The inverse interpolation formulation is based on a parametric approximation of the loading and is further constructed through a least-squares minimization of calculated and measured strains. This procedure results in the governing system of linear algebraic equations, providing the unknown coefficients that accurately define the load approximation. Numerical simulations are carried out for problems involving various levels of structural approximation. These include plate-loading examples and an aircraft wing box. Accuracy and computational efficiency of the proposed method are discussed in detail. The experimental validation of the methodology by way of structural testing of an aircraft wing is also discussed.
Author
*Interpolation; Loads (Forces); Strain Measurement; Structural Failure; Mathematical Models*

**20040086090** NASA Langley Research Center, Hampton, VA, USA

**A Hybrid Numerical Analysis Method for Structural Health Monitoring**

Forth, Scott C.; Staroselsky, Alexander; [2001]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

A new hybrid surface-integral-finite-element numerical scheme has been developed to model a three-dimensional crack propagating through a thin, multi-layered coating. The finite element method was used to model the physical state of the coating (far field), and the surface integral method was used to model the fatigue crack growth. The two formulations are coupled through the need to satisfy boundary conditions on the crack surface and the external boundary. The coupling is sufficiently weak that the surface integral mesh of the crack surface and the finite element mesh of the uncracked volume can be set up independently. Thus when modeling crack growth, the finite element mesh can remain fixed for the duration of the simulation as the crack mesh is advanced. This method was implemented to evaluate the feasibility of fabricating a structural health monitoring system for real-time detection of surface cracks propagating in engine components. In this work, the authors formulate the hybrid surface-integral-finite-element method and discuss the mechanical issues of implementing a structural health monitoring system in an aircraft engine environment.

Author

*Numerical Analysis; Fatigue (Materials); Finite Element Method; Crack Propagation; Three Dimensional Models*

**20040086092** NASA Langley Research Center, Hampton, VA, USA

**A Linear Bicharacteristic FDTD Method**

Beggs, John H.; [2001]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The linear bicharacteristic scheme (LBS) was originally developed to improve unsteady solutions in computational acoustics and aeroacoustics [1]-[7]. It is a classical leapfrog algorithm, but is combined with upwind bias in the spatial derivatives. This approach preserves the time-reversibility of the leapfrog algorithm, which results in no dissipation, and it permits more flexibility by the ability to adopt a characteristic based method. The use of characteristic variables allows the LBS to treat the outer computational boundaries naturally using the exact compatibility equations. The LBS offers a central storage approach with lower dispersion than the Yee algorithm, plus it generalizes much easier to nonuniform grids. It has previously been applied to two and three-dimensional freespace electromagnetic propagation and scattering problems [3], [6], [7]. This paper extends the LBS to model lossy dielectric and magnetic materials. Results are presented for several one-dimensional model problems, and the FDTD algorithm is chosen as a convenient reference for comparison.

Author

*Finite Difference Time Domain Method; Mathematical Models; Aeroacoustics; Algorithms*

**20040086472** NASA Langley Research Center, Hampton, VA, USA

**Grid Generation for Multidisciplinary Design and Optimization of an Aerospace Vehicle: Issues and Challenges**

Samareh, Jamshid A.; [2000]; 10 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

The purpose of this paper is to discuss grid generation issues and to challenge the grid generation community to develop tools suitable for automated multidisciplinary analysis and design optimization of aerospace vehicles. Special attention is given to the grid generation issues of computational fluid dynamics and computational structural mechanics disciplines.

Author

*Computational Fluid Dynamics; Grid Generation (Mathematics); Multidisciplinary Design Optimization*

**20040086513** NASA Langley Research Center, Hampton, VA, USA

**Determination of Nonlinear Stiffness Coefficients for Finite Element Models with Application to the Random Vibration Problem**

Muravyov, Alexander A.; [1999]; 14 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

In this paper, a method for obtaining nonlinear stiffness coefficients in modal coordinates for geometrically nonlinear finite-element models is developed. The method requires application of a finite-element program with a geometrically nonlinear static capability. The MSC/NASTRAN code is employed for this purpose. The equations of motion of a MDOF system are formulated in modal coordinates. A set of linear eigenvectors is used to approximate the solution of the nonlinear problem. The random vibration problem of the MDOF nonlinear system is then considered. The solutions obtained by application of two different versions of a stochastic linearization technique are compared with linear and exact (analytical) solutions in terms of root-mean-square (RMS) displacements and strains for a beam structure.

Author

*Nonlinear Systems; Stiffness; Coefficients; Finite Element Method; Vibration*

**20040086526** NASA Langley Research Center, Hampton, VA, USA
**Quantitative Prediction of Computational Quality (so the S and C Folks will Accept it)**
Hemsch, Michael J.; Luckring, James M.; Morrison, Joseph H.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 638-655; In English; See also 20040086515; No Copyright; Avail: CASI; A03, Hardcopy

Our choice of title may seem strange but we mean each word. In this talk, we are not going to be concerned with computations made ″after the fact″, i.e. those for which data are available and which are being conducted for explanation and insight. Here we are interested in preventing S&C design problems by finding them through computation before data are available. For such a computation to have any credibility with those who absorb the risk, it is necessary to quantitatively PREDICT the quality of the computational results.
Derived from text
*Quantitative Analysis; Computation; Design Analysis*

## 65
## STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

**20040085508** NASA Langley Research Center, Hampton, VA, USA
**Employing Sensitivity Derivatives to Estimate Uncertainty Propagation in CFD**
Putko, Michele M.; Newman, Perry A.; Taylor, Arthur C., III; [2004]; 6 pp.; In English; 9th ASCE EMD/SEI/GU/AD Joint Specialty Conference on Probabilistic Mechanics and Structural Reliability, 26-28 Jul. 2004, Albuquerque, NM, USA
Contract(s)/Grant(s): 23-762-45-G1; No Copyright; Avail: CASI; A02, Hardcopy

Two methods that exploit the availability of sensitivity derivatives are successfully employed to predict uncertainty propagation through Computational Fluid Dynamics (CFD) code for an inviscid airfoil problem. An approximate statistical second-moment method and a Sensitivity Derivative Enhanced Monte Carlo (SDEMC) method are successfully demonstrated on a two-dimensional problem. First- and second-order sensitivity derivatives of code output with respect to code input are obtained through an efficient incremental iterative approach. Given uncertainties in statistically independent, random, normally distributed flow parameters (input variables); these sensitivity derivatives enable one to formulate first- and second-order Taylor Series approximations for the mean and variance of CFD output quantities. Additionally, incorporation of the first-order sensitivity derivatives into the data reduction phase of a conventional Monte Carlo (MC) simulation allows for improved accuracy in determining the first moment of the CFD output. Both methods are compared to results generated using a conventional MC method. The methods that exploit the availability of sensitivity derivatives are found to be valid when considering small deviations from input mean values.
Author
*Computational Fluid Dynamics; Monte Carlo Method; Uncertain Systems; Statistical Analysis*

**20040086535** NASA Langley Research Center, Hampton, VA, USA
**A Most Probable Point-Based Method for Reliability Analysis, Sensitivity Analysis and Design Optimization**
Hou, Gene J.-W.; Gumbert, Clyde R.; Newman, Perry A.; May 26, 2004; 6 pp.; In English; 9th ASCE EMD/SEI/GI/AD Joint Specialty Conference on Probabilistic Mechanics and Structural Reliability, 26-28 Jul. 2004, Albuquerque, NM, USA
Contract(s)/Grant(s): 762-20-61
Report No.(s): PMC2004; Copyright; Avail: CASI; A02, Hardcopy

A major step in a most probable point (MPP)-based method for reliability analysis is to determine the MPP. This is usually accomplished by using an optimization search algorithm. The optimal solutions associated with the MPP provide measurements related to safety probability. This study focuses on two commonly used approximate probability integration methods; i.e., the Reliability Index Approach (RIA) and the Performance Measurement Approach (PMA). Their reliability sensitivity equations are first derived in this paper, based on the derivatives of their respective optimal solutions. Examples are then provided to demonstrate the use of these derivatives for better reliability analysis and Reliability-Based Design Optimization (RBDO).
Author
*Design Optimization; Probability Theory; Reliability Analysis; Sensitivity Analysis; Algorithms*

## 66
## SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

**20040085712** NASA Langley Research Center, Hampton, VA, USA
**The Strengths and Weaknesses of Logic Formalisms to Support Mishap Analysis**
Johnson, C. W.; Holloway, C. M.; [2002]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

The increasing complexity of many safety critical systems poses new problems for mishap analysis. Techniques developed in the sixties and seventies cannot easily scale-up to analyze incidents involving tightly integrated software and hardware components. Similarly, the realization that many failures have systemic causes has widened the scope of many mishap investigations. Organizations, including NASA and the NTSB, have responded by starting research and training initiatives to ensure that their personnel are well equipped to meet these challenges. One strand of research has identified a range of mathematically based techniques that can be used to reason about the causes of complex, adverse events. The proponents of these techniques have argued that they can be used to formally prove that certain events created the necessary and sufficient causes for a mishap to occur. Mathematical proofs can reduce the bias that is often perceived to effect the interpretation of adverse events. Others have opposed the introduction of these techniques by identifying social and political aspects to incident investigation that cannot easily be reconciled with a logic-based approach. Traditional theorem proving mechanisms cannot accurately capture the wealth of inductive, deductive and statistical forms of inference that investigators routinely use in their analysis of adverse events. This paper summarizes some of the benefits that logics provide, describes their weaknesses, and proposes a number of directions for future research.
Author
*Computer Programs; Computers; Systems Analysis; Organizations; Safety Factors*

**20040085885** NASA Ames Research Center, Moffett Field, CA, USA
**Beyond Mechanism Design**
Wolpert, David H.; Turner, Kagan; [2004]; 13 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The field of mechanism design is concerned with setting (incentives superimposed on) the utility functions of a group of players so as to induce desirable joint behavior of those players. It arose in the context of traditional equilibrium game theory applied to games involving human players. This has led it to have many implicit restrictions, which strongly limits its scope. In particular, it ignores many issues that are crucial for systems that are large (and therefore far off-equilibrium in general) and/or composed of non-human players (e.g., computer-based agents). This also means it has concentrated on issues that are often irrelevant in those broader domains (e.g., incentive compatibility). This paper illustrates these shortcomings by reviewing some of the recent theoretical work on the design of collectives, a body of work that constitutes a substantial broadening of mechanism design. It then presents computer experiments based on a recently suggested nanotechnology testbed that demonstrates the power of that extended version of mechanism design.
Author
*Game Theory; Decision Making*

## 70
## PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography*; for geophysics, astrophysics, or solar physics see *46 Geophysics, 90 Astrophysics*, or *92 Solar Physics*.

**20040085503** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**Particle Acceleration in SN1006 Shock Waves**
Sonneborn, George, Technical Monitor; Raymond, John C.; July 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-10352; No Copyright; Avail: CASI; A01, Hardcopy

The FUSE data have been reduced, and a paper on the results is in progress. The main results have been presented in a poster at the January 2004 AAS meeting and an ApJ paper in press. The primary result is that the widths of the 0 VI lines in the NW filament are a bit less than the width expected if the oxygen kinetic temperature is 16 times the proton temperature (mass proportional heating). This is at variance with measurements of shocks in the heliosphere, where preferential heating of oxygen and other heavy species is observed. The paper discusses the theoretical implications for collisionless shock wave

physics. A secondary result is that no O VI emission was observed from the NE filament. While the very different particle distribution in that region can partially account for the weakness of the O VI lines, the simplest interpretation is that the pre-shock density in the NE is less than 0.22 times the density in the NW.
Author
*Particle Acceleration; Shock Waves; Data Acquisition; Numerical Analysis*

**20040085533** Fermi National Accelerator Lab., Batavia, IL, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA
**Study of the Effects of High Temperatures during Quenches on the Performance of a Small Nb3Sn Racetrack Magnet**
Imbasciati, L.; Bauer, P.; Ambrosio, G.; Lamm, M.; Caspi, S.; 2003; 12 pp.; In English
Report No.(s): DE2004-822216; FERMILAB-CONF-03/464; No Copyright; Avail: Department of Energy Information Bridge
Several high field Nb(sub 3)Sn magnets of different design are under development for future particle accelerators. The high levels of stored energy in these magnets and the high current densities in the conductor can cause high peak temperatures during a quench. The thermal gradients generated in the epoxy-impregnated magnet coils during the fast temperature rise can result in high thermo-mechanical stresses. Considering the sensitivity of Nb(sub 3)Sn to strain and epoxy cracks, it is important to define a maximum acceptable temperature in the coils during a quench which does not cause degradation of the magnet performance. A program was launched at Fermilab to study the effects of thermo-mechanical stress in Nb(sub 3)Sn coils, supported by experiments and by analysis. In collaboration with LBNL, a sub-scaled magnet was built and instrumented to measure the effect of the thermo-mechanical shock during magnet quenches. The magnet consisted of two racetrack coils, assembled in a common coil configuration with a small gap in between. During the test, the magnet reached the maximum field of(approx) 11 T at the short sample current of 9100 A. Temperature excursions up to 400 K did not diminish the magnet quench performance; only after temperature excursions over 430 K, the magnet showed detraining effects, which reduced occasionally the quench current of about 6%. Signs of irreversible degradation (reducing the maximum current of about 3%) appeared only after temperature excursions over 550 K.
NTIS
*High Temperature; Quenching; Particle Accelerators; Niobium Stannides; Magnets*

**20040085534** Rutherford Appleton Lab., Oxford, UK
**Particle Physics Experiments Report 2003**
Mar. 2004; 346 pp.; In English
Report No.(s): PB2004-105587; RAL-TR-2004-010; Copyright; Avail: National Technical Information Service (NTIS)
This report describes work carried out in 2003 on experiments approved by the Particle Physics Experiments Selection Panel. The contents consist of unedited contributions from each experiment.
NTIS
*Elementary Particles; Nuclear Physics*

**20040085544** Stanford Linear Accelerator Center, Stanford, CA, USA, Lawrence Livermore National Lab., Livermore, CA
**Study of CP Violation in B Mesons Using the BaBar Detector**
Lange, D. J.; Apr. 2003; In English
Report No.(s): DE2003-813007; SLAC-PUB-9712; No Copyright; Avail: National Technical Information Service (NTIS)
We present results on time-dependent CP asymmetries in neutral B decays.The measurements use a data sample of about 88 million(Upsilon)(4S)(yields) B(bar B) decays collected between 1999 and 2002 with the BABAR detector at the PEP-II asymmetric-energy B Factory at SLAC. We study events in which one neutral B meson is fully reconstructed in a final state and the other B meson is determined to beeither a B(sup 0) or(bar B)(sup 0) from its decay products. Final statesconsidered include B(sup 0)(yields) J/(psi)K(sub S)(sup 0), B(sup 0)(yields) J/(psi)K(sub L)(sup 0), B(sup 0)(yields) J/(psi)(pi)(sup 0), B(sup 0)(yields) D*(sup+) D*(sup -), B(sup 0)(yields)(phi)K(sub S)(sup 0), B(sup 0)(yields)(pi)(sup+)(pi)(sup -), and B(sup 0)(yields)(rho) (sup(+-))(pi)(sup(-+)).
NTIS
*Asymmetry; Nuclides; Mesons*

**20040085552** Stanford Linear Accelerator Center, Stanford, CA, USA
**Experiments on Gradient Limits for Normal Conducting Accelerators**
Galayda, J. N.; Aug. 2002; In English
Report No.(s): DE2003-815258; SLAC-PUB-10115; No Copyright; Avail: National Technical Information Service (NTIS)

The accelerating gradient is one of the crucial parameters affecting the design, construction and cost of nextgeneration linear accelerators. For a specified final energy, the gradient sets the accelerator length, and for a given accelerating structure and pulse repetition rate, it determines power consumption. In this paper experimental results and problems related to breakdown damage, pulsed heating, application of new materials, as well as difference between standing wave (SW) and traveling wave (TW) structures will be discussed.
NTIS
*Linear Accelerators; Energy Consumption*

**20040085556** Rensselaer Polytechnic Inst., Troy, NY, USA, Thomas Jefferson National Accelerator Facility, Newport News, VA, USA
**Evidence for an Exotic Baryon State,(theta)(sup +)(1540), in Photoproduction Reactions from Protons and Deuterons with CLAS**
Kubarosky, V.; Stepanyan, S.; 2003; In English
Report No.(s): DE2003-816502; No Copyright; Avail: National Technical Information Service (NTIS)
CLAS photoproduction data on deuterium and hydrogen targets have been analyzed in a search for an exotic baryon state with strangeness S=+1, the(Theta)(sup+) (originally named the Z(sup+)). This resonance was predicted recently in theoretical work based on the chiral soliton modelas a lowest mass member of an anti-decuplet of 5-quark states. The reaction(gamma)d(yields) pK(sup -)K(sup+)n, which requires a final stateinteraction inside the deuteron, was used in the analysis of deuteron data. In the analysis of proton data, the reaction(gamma) p(yields)(pi)(sup+)K(sup -)K(sup+)n was studied. Evidencefor the(Theta)(sup+) state is found in both analyzes in the invariant mass distribution of the nK(sup+). Our results are consistent with previously reported results by LEPS/Spring-8 collaboration (Japan), and by the ITEP (Moscow) group.
NTIS
*Protons; Deuterons; Baryons*

**20040085559** Lawrence Livermore National Lab., Livermore, CA
**Study of Neutron Scattering in the NIF Chamber and Use of Neutron Activation as a Yield Diagnostic**
Tobin, M.; Song, P.; Sep. 05, 2003; In English
Report No.(s): DE2004-15006462; UCRL-JC-155366; No Copyright; Avail: National Technical Information Service (NTIS)
One of the planned core neutron diagnostics for NIF will use material activation to aid in determining information about target neutron yields. While this technique was routinely used on Nova and is in use today on Omega, the substantially larger chamber size and neutron yields for NIF raise several new issues for this technique. The effect of neutron scattering, due to the larger amount of entrant equipment inside the chamber, and more importantly, scattering inside the NIF target itself, is shown to be a significant effect. The appropriate location of the counting room to analyze activated samples that is sufficiently protected from neutron fluences is discussed. There are no significant safety issues related to sample handling when using In and Cu for short durations (minutes). We recommend placement and thickness of Cu samples based on neutron yield.
NTIS
*Neutron Scattering; Neutron Activation Analysis*

**20040085562** Lawrence Livermore National Lab., Livermore, CA
**600 eV Falcon-Linac Thomson X-ray Source**
Crane, J. K.; LeSage, G. P.; Ditmire, T.; Cross, R.; Wharton, K.; Dec. 15, 2000; In English
Report No.(s): DE2004-15006523; UCRL-ID-141613; No Copyright; Avail: National Technical Information Service (NTIS)
The advent of 3rd generation light sources such as the Advanced Light Source (ALS) at LBL, and the Advanced Photon Source at Argonne, have produced a revolution in x-ray probing of dense matter during the past decade. These machines use electron-synchrotrons in conjunction with undulator stages to produce 100 psec x-ray pulses with photon energies of several kiloelectronvolts (keV). The applications for x-ray probing of matter are numerous and diverse with experiments in medicine and biology, semiconductors and materials science, and plasma and solid state physics. In spite of the success of the 3rd generation light sources there is strong motivation to push the capabilities of x-ray probing into new realms, requiring shorter pulses, higher brightness and harder x-rays. A 4th generation light source, the Linac Coherent Light Source (LCLS), is being considered at the Stanford Linear Accelerator. The LCLS will produce multi-kilovolt x-rays of subpicosecond duration that are 10 orders of magnitude brighter than today's 3rd generation light sources. Although the LCLS will provide unprecedented capability for performing time-resolved x-ray probing of ultrafast phenomena at solid densities, this machine will not be

completed for many years. In the meantime there is a serious need for an ultrashort-pulse, high-brightness, hard x-ray source that is capable of probing deep into high-Z solid materials to measure dynamic effects that occur on picosecond time scales. Such an instrument would be ideal for probing the effects of shock propagation in solids using Bragg and Laue diffraction. These techniques can be used to look at phase transitions, melting and recrystallization, and the propagation of defects and dislocations well below the surface in solid materials. These types of dynamic phenomena undermine the mechanical properties of metals and are of general interest in solid state physics, materials science, metallurgy, and have specific relevance to stockpile stewardship. Another x-ray diagnostic technique, extended x-ray absorption fine structure (EXAFS) spectroscopy, can be used to measure small-scale structural changes to understand the underlying atomic physics associated with the formation of defects.
NTIS
*Light Sources; X Ray Sources; X Rays*

**20040085950** Chinese Inst. of Engineers, Taipei
**Journal of the Chinese Institue of Engineers, Volume 27, No. 1**
Chen, S. T.; Tsai, H. L.; Shiou, F. J.; Jan. 2004; In English
Report No.(s): PB2004-105312; No Copyright; Avail: National Technical Information Service (NTIS)
;Partial Contents: Using Context-Sensitive Neuro-Fuzzy Systems for Nonlinear System Identification; Simulations Tracking and Almost Disturbance Decoupling for Nonlinear Systems with Uncertainties; LMI Approach to Simultaneous Output-Feedback Stabilization for Discrete-Time Interval Systems; Right-Angled Triangle Property in Inversion of General Tridiagonal Matrices; Numerical Study of Spacing Effect on Unsteady Blade Aerodynamics in a Transonic Turbine State with Different Turbulence Models.
NTIS
*Engineers; Fuzzy Systems; Neural Nets; Nonlinear Systems*

**20040086026** Fermi National Accelerator Lab., Batavia, IL, USA, Technische Hochschule, Aachen, Germany
**New Charm(onium) Results from CDF**
Meyer, A.; 2003; In English
Report No.(s): DE2003-815765; FERMILAB-CONF-03/283-E; No Copyright; Avail: National Technical Information Service (NTIS)
After many upgrades to the CDF detector and to the accelerator complex, Run II began in April 2001. The new detector has improved capabilities for charm physics, and first results from the analysis of early Tevatron Run II data are reported here.
NTIS
*Particle Accelerators; Charm (Particle Physics)*

**20040086027** Fermi National Accelerator Lab., Batavia, IL, USA, California State Univ., Los Angeles, CA, USA, Oakland Univ., Rochester, MI, USA, Argonne National Lab., Idaho Falls, ID, USA
**Detector R and D for Future Neutrino Experiments with the NuMI Beamline**
Barenboim, G.; Bodek, A.; Bross, A.; Buckley-Geer, L.; Choudhary, B.; Oct. 2002; In English
Report No.(s): DE2003-815672; NUMI-PUB-GEN-0880; No Copyright; Avail: National Technical Information Service (NTIS)
This document is the result of a request from the Fermilab directorate to (i) investigate the detector technology issues relevant for future long baseline experiments and (ii) consider the associated detector R and D that would be needed to prepare the way for future neutrino oscillation experiments using the NuMI beamline. Because of the narrow energy spread provided by an off-axis beam and the resulting low intrinsic electron neutrino background, as well as the very favorable duty cycle of the NuMI beamline, a well-placed neutrino detector at the surface of the earth could take the next important steps in neutrino oscillation physics. The biggest outstanding issue in this field is whether or not the last unmeasured element of the leptonic mixing matrix, parameterized by the mixing angle(theta)(sub 13), is nonzero. Ifit is in fact non-zero, this opens the door to measurements of the neutrino mass hierarchy and, if the solar neutrino oscillations are described by the LMA solution, searches for CP violation in the lepton sector. In order to get to any of these measurements, an off-axis detector must be capable of measuring the(nu)(sub(mu)) ((bar(nu))(sub (mu)))(yields)(nu)(sub e)((bar(nu))(sub e)) transition probabilities as well as the(nu)(sub(mu)) ((bar(nu))(sub(mu))) survival probabilities, at the energies present in these off-axis beams, which could lie anywhere from 0.6 to 3 GeV. Optimal baselines and energies will depend on the physics goal of the experiment. For example, an optimization of the sensitivity for(nu)(sub e) appearance from a(nu)(sub(mu)) beam assuming(Delta)m(sub 32)(sup 2)= 3

x 10(sup -3) eV(sup 2) would lead to a baseline of(approx)700-900 km and an energy of(approx) 2.2 GeV.
NTIS
*Neutrinos; Probability Theory; Transition Probabilities*

**20040086030** Argonne National Lab., IL, Minnesota Univ., Minneapolis, MN, USA, Oxford Univ., Oxford, UK, Rutherford Appleton Lab., Chilton
**Observation of Atmospheric Neutrino Oscillations in Soudan 2**
Sanchez, M.; Allison, W. W. M.; Alner, G. J.; Ayres, D. S.; Barrett, W. L.; Jul. 2003; In English
Report No.(s): DE2003-815661; No Copyright; Avail: National Technical Information Service (NTIS)
The effects of oscillations of atmospheric(nu)(sub(mu)) are observed in the 5.90 fiducial kiloton-year exposure of the Soudan 2 detector. An unbinned maximum likelihood analysis of the neutrino L/E distribution has been carried out using the Feldman-Cousins prescription. The probability of the no oscillation hypothesis is 5.8 x 10(sup -4). The 90% confidence allowed region in the sin(sup 2) 2(theta),(Delta)m(sup 2) plane is presented.
NTIS
*Neutrinos; Oscillations; Maximum Likelihood Estimates*

**20040086031** Stanford Linear Accelerator Center, Stanford, CA, USA
**Considerations for Calorimetry at a Super B Factory**
Wisniewski, W.; 2003; In English
Report No.(s): DE2003-815659; SLAC-WP-039; No Copyright; Avail: National Technical Information Service (NTIS)
No abstract available
*Heat Measurement; Industrial Plants*

**20040086032** Mission Research Corp., Albuquerque, NM, USA, Sandia National Labs., Albuquerque, NM, California Univ., Berkeley, CA, USA, Lawrence Livermore National Lab., Livermore, CA
**Impact of Beam Transport Method on Chamber and Driver Design for Heavy Ion Inertial Fusion Energy**
Rose, D. V.; Welch, D. R.; Olson, C. L.; Yu, S. S.; Neff, S.; Dec. 30, 2002; In English
Report No.(s): DE2003-815528; No Copyright; Avail: National Technical Information Service (NTIS)
In heavy ion inertial fusion energy systems, intense beams of ions must be transported from the exit of the . nal focus magnet system through the target chamber to hit millimeter spot sizes on the target. In this paper, we examine three di.erent modes of beam propagation: neutralized ballistic transport, assisted pinched transport, and self-pinched transport. The status of our understanding of these three modes is summarized, and the constraints imposed by beam propagation upon the chamber environment, as well as their compatibility with various chamber and target concepts, are considered. We conclude that, on the basis of our present understanding, there is a reasonable range of parameter space where beams can propagate in thick-liquid wall, wetted-wall, and dry-wall chambers.
NTIS
*Ion Beams; Millimeter Waves; Impact*

**20040086033** Princeton Univ., NJ
**Soft X-ray Tangential Imaging of the NSTX Core Plasma by Means of a MPGD Pin-hole Camera**
Pacella, D.; Leigheb, M.; Bellazzini, R.; Brez, A.; 2003; In English
Report No.(s): DE2003-814725; PPL-3844; No Copyright; Avail: National Technical Information Service (NTIS)
A fast X-ray system based on a Micro Pattern Gas Detector has been used, for the first time, to investigate emission from the plasma core of the National Spherical Tokamak eXperiment (NSTX) at the Princeton Plasma Physics Laboratory. The results presented in this work demonstrate the capability of such a device to measure with a time resolution of the order of 1 ms the curvature and the elongation of the X-ray iso-emissivity contours, under various plasma conditions. Also, comparisons with the magnetic surface structure calculated by the EFIT code show good agreement between reconstructed flux surface and the soft X-ray emissions (SXR) for poloidal beta values up to 0.6. For greater values of beta, X-ray iso-emissivity contours become circular, while magnetic flux surface reconstructions yield elongation 1.5 less than k less than 2.2. The X-ray images have been acquired with a (statistical) signal to noise ratio (SNR) per pixel of about 30. Thanks to the direct and efficient X-ray conversion and its operation in a photon counting mode, this new diagnostic tool allows the routine

investigation of the plasma core with a sampling rate of 1 kHz and extremely high SNR under all experimental conditions in NSTX.
NTIS
*Curvature; Emissivity; Magnetic Field Configurations; Plasma Physics; X Ray Imagery*

**20040086052** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Magnetic and Langmuir Probe Measurements on the Plasmoid Thruster Experiment (PTX)**
Koelfgen, Syri J.; Eskridge, Richard; Fimognari, Peter; Hawk, Clark W.; Lee, Mike; Martin, Adam; [2004]; 1 pp.; In English; 40th AIAA Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

The Plasmoid Thruster Experiment (PTX) operates by inductively producing plasmoids in a conical theta-pinch coil and subsequently ejecting them at high velocity. An overview of PTX is described in a companion paper. The shape and magnetic field structure of the translating plasmoids will be measured with of an array of inductive magnetic field probes. Six sets of two B-dot probes (for a total of twelve probes) have been constructed for measuring B(sub z) and B(sub theta), the axial and azimuthal components of the magnetic field. The probes were calibrated with a Helmholtz coil, driven alternately by a high-voltage pulser or a signal generator. The probes are wound on a G-10 form, and have an average (calibrated) NA of 9.37 x 10(exp -5) square meters, where N is the number of turns and A is cross-sectional area. The frequency response of the probes was measured over the range from 1 kHz to 10 MHZ. The electron number density n(sub e), electron temperature T(sub e) and velocity v will be determined from measurements taken with a quadruple Langmuir probe, situated in the exhaust chamber. Three of the four probes on the quadruple probe sample the current-voltage characteristic, and from this yield measurements of T(sub e) and n(sub e). The fourth probe provides a measurement of plasma flow velocity. A 6-inch long alumina rod, hollowed with four holes to house the probe wires, is being used to construct the quadruple probe. A variety of propellants will be used, including hydrogen, nitrogen and argon. From the measurements of the plasmoid mass, density, temperature, and velocity, the basic propulsion characteristics of PTX will be evaluated.
Author
*Thrust; Magnetic Measurement; Plasmas (Physics); Electrostatic Probes*

**20040086054** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Progress on the Plasmoid Thruster Experiment (PTX)**
Martin, Adam; Eskridge, Richard; Fimognari, Peter; Koelfgen, Syri J.; Lee, Mike; [2004]; 1 pp.; In English; 40th AIAA Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; No Copyright; Avail: Other Sources; Abstract Only

A plasmoid is a compact plasma structure with an integral magnetic field, that may be categorized according to the relative strength of the poloidal and toroidal magnetic field (B(sub p) and B(sub t), respectively). An object with B(sub p)/B(sub t), much much more than 1 is called a Field Reverse Configuration (FRC); if B(sub p) approximately equal to B(sub t), it is called a Spheromak. The thruster operates by repetitively producing plasmoids that are accelerated and ejected at high velocity. As this process is inductive, there are no electrodes. Also, the magnetic structure of the plasmoid should suppress thermal and mass losses to the wall, and improve detachment of the plasma exhaust from the thruster. This concept should be capable of producing an Isp in the range of 5,000 - 10,000 s with thrust densities of order 10(exp 5) N per square meters. The current experiment is designed to produce jet powers in the range of 5-10 kW, although the concept should be scalable into the MW range. In PTX, the plasmoid is formed inside of a single turn conical theta-pinch coil (17.58 cone angle). The coil is driven by a 640 nF, 35 kV capacitor bank, which rings at a frequency of 500 kHz. Previous experiments on PTX were conducted with a static-fill of propellant gas (6% H2 in He), and demonstrated reliable ionization over a pressure range of 40 - 200 mTorr. We are now adding a fast gas-puff valve to load the propellant, and a ringing pre-ionization circuit (f = 5 Mhz) to better control the plasmoid formation. An alternate coil (8.58 cone angle) will also be used, so as to investigate the effect of coil shape on performance. In addition, a variety of propellants will be used, including hydrogen, nitrogen, and argon. The plasmoid mass and velocity will be measured with a variety of diagnostics, including external B-dot probes and flux loops, a high-speed framing camera, and a HeNe laser interferometer. Internal B-dot probes and a quadruple Langmuir probe will provide additional measurements of the plasmoid shape and structure, as well as density, and will be described in a companion paper. The experimental results will be compared to calculations made using a 0-D coil-gun model and also a 2-D time dependent MHD code.
Author
*Magnetic Fields; Toroidal Plasmas; Plasmas (Physics); Magnetic Field Configurations; Thrustors*

**20040086468** NASA Langley Research Center, Hampton, VA, USA

**Acoustic Emission Signals in Thin Plates Produced by Impact Damage**

Prosser, William H.; Gorman, Michael R.; Humes, Donald H.; Journal of Acoustic Emission; June 1999; Volume 17, No. 1-2, pp. 29-36; In English; Copyright; Avail: CASI; A03, Hardcopy

Acoustic emission (AE) signals created by impact sources in thin aluminum and graphite/epoxy composite plates were analyzed. Two different impact velocity regimes were studied. Low-velocity (less than 0.21 km/s) impacts were created with an airgun firing spherical steel projectiles (4.5 mm diameter). High-velocity (1.8 to 7 km/s) impacts were generated with a two-stage light-gas gun firing small cylindrical nylon projectiles (1.5 mm diameter). Both the impact velocity and impact angle were varied. The impacts did not penetrate the aluminum plates at either low or high velocities. For high-velocity impacts in composites, there were both impacts that fully penetrated the plate as well as impacts that did not. All impacts generated very large amplitude AE signals (1-5 V at the sensor), which propagated as plate (extensional and/or flexural) modes. In the low-velocity impact studies, the signal was dominated by a large flexural mode with only a small extensional mode component detected. As the impact velocity was increased within the low velocity regime, the overall amplitudes of both the extensional and flexural modes increased. In addition, a relative increase in the amplitude of high-frequency components of the flexural mode was also observed. Signals caused by high-velocity impacts that did not penetrate the plate contained both a large extensional and flexural mode component of comparable amplitudes. The signals also contained components of much higher frequency and were easily differentiated from those caused by low-velocity impacts. An interesting phenomenon was observed in that the large flexural mode component, seen in every other case, was absent from the signal when the impact particle fully penetrated through the composite plates.

Author

*Acoustic Emission; Thin Plates; Impact Damage; Aluminum; Impact Velocity*

**20040086490** NASA Langley Research Center, Hampton, VA, USA

**Shape Optimization of Cylindrical Shell for Interior Noise**

Robinson, Jay H.; [1999]; 8 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

In this paper an analytic method is used to solve for the cross spectral density of the interior acoustic response of a cylinder with nonuniform thickness subjected to turbulent boundary layer excitation. The cylinder is of honeycomb core construction with the thickness of the core material expressed as a cosine series in the circumferential direction. The coefficients of this series are used as the design variable in the optimization study. The objective function is the space and frequency averaged acoustic response. Results confirm the presence of multiple local minima as previously reported and demonstrate the potential for modest noise reduction.

Author

*Shape Optimization; Cylindrical Shells; Noise Reduction; Numerical Analysis*

**20040086510** NASA Langley Research Center, Hampton, VA, USA

**Effect of Alignment on Transport Properties of Carbon Nanotube/Metallic Junctions**

Wincheski, Buzz; Namkung, Min; Smits, Jan; Williams, Phillip; Harvey, Robert; [2003]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Ballistic and spin coherent transport in single walled carbon nanotubes (SWCNT) are predicted to enable high sensitivity single-nanotube devices for strain and magnetic field sensing. Based upon these phenomena, electron beam lithography procedures have been developed to study the transport properties of purified HiPCO single walled carbon nanotubes for development into sensory materials for nondestructive evaluation. Purified nanotubes are dispersed in solvent suspension and then deposited on the device substrate before metallic contacts are defined and deposited through electron beam lithography. This procedure produces randomly dispersed ropes, typically 2 - 20 nm in diameter, of single walled carbon nanotubes. Transport and scanning probe microscopy studies have shown a good correlation between the junction resistance and tube density, alignment, and contact quality. In order to improve transport properties of the junctions a technique has been developed to align and concentrate nanotubes at specific locations on the substrate surface. Lithographic techniques are used to define local areas where high frequency electric fields are to be concentrated. Application of the fields while the substrate is exposed to nanotube-containing solution results in nanotube arrays aligned with the electric field lines. A second electron beam lithography layer is then used to deposit metallic contacts across the aligned tubes. Experimental measurements are presented showing the increased tube alignment and improvement in the transport properties of the junctions.

Author

*Carbon Nanotubes; Magnetic Fields; Nanotubes; Electron Beams; Lithography*

# 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*.

**20040085485** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**The Effectiveness of the Sound Barrier at the Hojel Firing Range: Comparison Blast Measurement Conducted at 1:10 Scale Tests and During Firings with a 155 mm Howitzer**
Absil, L. H. J.; November 2003; 22 pp.; In Dutch
Contract(s)/Grant(s): A95/A/105; TNO Proj. 014.02214
Report No.(s): TD-2002-0232; PML-3003-A58; Copyright; Avail: Other Sources

On behalf of the Dutch MOD, TNO has investigated the influence of blast walls on the propagation of the muzzle blast of a 155 mm Howitzer. The research conducted consisted of an experimental investigation on a 1 : 10 scale model of the actual firing range, and blast measurements up to 100 m from the 5 m high blast wall on the actual firing range at the Artillery Firing Range (ASK) during exercises with a 155 mm Howitzer. The full scale and scale model tests show typical differences. In this report it is explained that these are probably caused by the bad representation of the Howitzer muzzle blast in the scale tests, by using a detonator placed in a metal tube. Part of the difference can also be explained by the directional effect caused by the gun silencer. Limited effect can be attributed to difference in weather conditions and the effect of the surface material. Author

*Effectiveness; Acoustic Velocity; Detonators; Scale Models; Walls*

**20040085509** NASA Langley Research Center, Hampton, VA, USA
**Improvements to the Two-Thickness Method for Deriving Acoustic Properties of Materials**
Palumbo, Daniel L.; Jones, Michael G.; Klos, Jacob; Park, Junhong; April 16, 2004; 9 pp.; In English; NOISE-CON 2004Summer Meeting and Exposition, 12-14 Jul. 2004, Baltimore, MD, USA
Contract(s)/Grant(s): 781-10-13; No Copyright; Avail: CASI; A02, Hardcopy

The characteristic impedance and other derivative acoustic properties of a material can be derived from impedance tube data using the specific impedance measured from samples with two different thicknesses. In practice, samples are chosen so that their respective thicknesses differ by a factor of 2. This simplifies the solution of the equations relating the properties of the two samples so that the computation of the characteristic impedance is straightforward. This approach has at least two drawbacks. One is that it is often difficult to acquire or produce samples with precisely a factor of 2 difference in thickness. A second drawback is that the phase information contained in the imaginary part of the propagation constant must be unwrapped before subsequent computations are performed. For well-behaved samples, this is not a problem. For ill behaved samples of unknown properties, the phase unwrapping process can be tedious and difficult to automate. Two alternative approaches have been evaluated which remove the factor-of-2 sample thickness requirement and directly compute unwrapped phase angles. One uses a Newton-Raphson approach to solve for the roots of the samples' simultaneous equations. The other produces a wave number space diagram in which the roots are clearly discernable and easily extracted. Results are presented which illustrate the flexibility of analysis provided by the new approaches and how this can be used to better understand the limitations of the impedance tube data.
Author

*Thickness; Acoustic Impedance; Newton-Raphson Method; Acoustic Properties; Impedance*

**20040085698** NASA Langley Research Center, Hampton, VA, USA
**A Two-Dimensional Linear Bicharacteristic FDTD Method**
Beggs, John H.; [2002]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The linear bicharacteristic scheme (LBS) was originally developed to improve unsteady solutions in computational acoustics and aeroacoustics. The LBS has previously been extended to treat lossy materials for one-dimensional problems. It is a classical leapfrog algorithm, but is combined with upwind bias in the spatial derivatives. This approach preserves the time-reversibility of the leapfrog algorithm, which results in no dissipation, and it permits more flexibility by the ability to adopt a characteristic based method. The use of characteristic variables allows the LBS to include the Perfectly Matched Layer boundary condition with no added storage or complexity. The LBS offers a central storage approach with lower dispersion than the Yee algorithm, plus it generalizes much easier to nonuniform grids. It has previously been applied to two and three-dimensional free-space electromagnetic propagation and scattering problems. This paper extends the LBS to the

two-dimensional case. Results are presented for point source radiation problems, and the FDTD algorithm is chosen as a convenient reference for comparison.
Author
*Aeroacoustics; Computation; Finite Difference Theory; Electromagnetic Wave Transmission; Linear Systems*

**20040085733** NASA Langley Research Center, Hampton, VA, USA
**Development of an Efficient Binaural Simulation for the Analysis of Structural Acoustic Data**
Johnson, Marty E.; Lalime, Aimee L.; Grosveld, Ferdinand W.; Rizzi, Stephen A.; Sullivan, Brenda M.; [2003]; 13 pp.; In English; 8th International Conference on Recent Advances in Structural Dynamics, 14-16 Jul. 2003, Southampton, UK
Contract(s)/Grant(s): NCC1-01029
Report No.(s): Paper 77; Copyright; Avail: CASI; A03, Hardcopy

Applying binaural simulation techniques to structural acoustic data can be very computationally intensive as the number of discrete noise sources can be very large. Typically, Head Related Transfer Functions (HRTFs) are used to individually filter the signals from each of the sources in the acoustic field. Therefore, creating a binaural simulation implies the use of potentially hundreds of real time filters. This paper details two methods of reducing the number of real-time computations required by: (i) using the singular value decomposition (SVD) to reduce the complexity of the HRTFs by breaking them into dominant singular values and vectors and (ii) by using equivalent source reduction (ESR) to reduce the number of sources to be analyzed in real-time by replacing sources on the scale of a structural wavelength with sources on the scale of an acoustic wavelength. The ESR and SVD reduction methods can be combined to provide an estimated computation time reduction of 99.4% for the structural acoustic data tested. In addition, preliminary tests have shown that there is a 97% correlation between the results of the combined reduction methods and the results found with the current binaural simulation techniques
Author
*Acoustics; Binaural Hearing; Computerized Simulation; Dynamic Structural Analysis; Data Processing*

**20040085736** NASA Langley Research Center, Hampton, VA, USA
**A Three-Dimensional Virtual Simulator for Aircraft Flyover Presentation**
Rizzi, Stephen A.; Sullivan, Brenda M.; Sandridge, Christopher A.; [2003]; 4 pp.; In English; 2003 International Conference on Auditory Display, 6-9 Jul. 2003, Boston, MA, USA; No Copyright; Avail: CASI; A01, Hardcopy

This paper presents a system developed at NASA Langley Research Center to render aircraft flyovers in a virtual reality environment. The present system uses monaural recordings of actual aircraft flyover noise and presents these binaurally using head tracking information. The three-dimensional audio is simultaneously rendered with a visual presentation using a head-mounted display (HMD). The final system will use flyover noise synthesized using data from various analytical and empirical modeling systems. This will permit presentation of flyover noise from candidate low-noise flight operations to subjects for psychoacoustical evaluation.
Author
*Binaural Hearing; Simulators; Virtual Reality; Psychoacoustics; Aeroacoustics; Three Dimensional Models*

**20040085743** NASA Langley Research Center, Hampton, VA, USA
**Some Analytic Results for the Study of Broadband Noise Radiation from Wings, Propellers and Jets in Uniform Motion**
Farassat, F.; Casper, J.; International Journal of Aeroacoustics; 2003; Volume 2, No. 3 - 4, pp. 335-350; In English; No Copyright; Avail: CASI; A03, Hardcopy

Alan Powell has made significant contributions to the understanding of many aeroacoustic problems, in particular, the problems of broadband noise from jets and boundary layers. In this paper, some analytic results are presented for the calculation of the correlation function of the broadband noise radiated from a wing, a propeller, and a jet in uniform forward motion. It is shown that, when the observer (or microphone) motion is suitably chosen, the geometric terms of the radiation formula become time independent. The time independence of these terms leads to a significant simplification of the statistical analysis of the radiated noise, even when the near field terms are included. For a wing in forward motion, if the observer is in the moving reference frame, then the correlation function of the near and far field noise can be related to a space-time cross-correlation function of the pressure on the wing surface. A similar result holds for a propeller in forward flight if the observer is in a reference frame that is attached to the propeller and rotates at the shaft speed. For a jet in motion, it is shown that the correlation function of the radiated noise can be related to the space-time crosscorrelation of the Lighthill stress tensor in the jet. Exact analytical results are derived for all three cases. For the cases under present consideration, the inclusion of

the near field terms does not introduce additional complexity, as compared to existing formulations that are limited to the far field.
Author
*Aeroacoustics; Broadband; Sound Waves; Wings; Propeller Blades; Jet Aircraft Noise*

**20040085745** NASA Langley Research Center, Hampton, VA, USA
**Modeling Aerodynamically Generated Sound of Helicopter Rotors**
Brentner, Kenneth S.; Farassat, F.; [2002]; 89 pp.; In English; Copyright; Avail: CASI; A05, Hardcopy

A great deal of progress has been made in the modeling of aerodynamically generated sound of rotors over the past decade. Although the modeling effort has focused on helicopter main rotors, the theory is generally valid for a wide range of rotor configurations. The Ffowcs Williams Hawkings (FW-H) equation has been the foundation for much of the development. The monopole and dipole source terms of the FW-H equation account for the thickness and loading noise, respectively. Bladevortex-interaction noise and broadband noise are important types of loading noise, hence much research has been directed toward the accurate modeling of these noise mechanisms. Both subsonic and supersonic quadrupole noise formulations have been developed for the prediction of high-speed impulsive noise. In an effort to eliminate the need to compute the quadrupole contribution, the FW-H equation has also been utilized on permeable surfaces surrounding all physical noise sources. Comparisons of the Kirchhoff formulation for moving surfaces with the FW-H equation have shown that the Kirchhoff formulation for moving surfaces can give erroneous results for aeroacoustic problems. Finally, significant progress has been made incorporating the rotor noise models into full vehicle noise prediction tools.
Author
*Aeroacoustics; Aerodynamic Noise; Rotor Aerodynamics; Helicopter Tail Rotors; Computational Fluid Dynamics; Mathematical Models*

**20040085747** NASA Langley Research Center, Hampton, VA, USA
**Reply by the Authors to C. K. W. Tam**
Morris, Philip J.; Farassat, F.; [2002]; 11 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The prediction of noise generation and radiation by turbulence has been the subject of continuous research for over fifty years. The essential problem is how to model the noise sources when one s knowledge of the detailed space-time properties of the turbulence is limited. We attempted to provide a comparison of models based on acoustic analogies and recent alternative models. Our goal was to demonstrate that the predictive capabilities of any model are based on the choice of the turbulence property that is modeled as a source of noise. Our general definition of an acoustic analogy is a rearrangement of the equations of motion into the form L(u) = Q, where L is a linear operator that reduces to an acoustic propagation operator outside a region upsilon; u is a variable that reduces to acoustic pressure (or a related linear acoustic variable) outside upsilon; and Q is a source term that can be meaningfully estimated without knowing u and tends to zero outside upsilon.
Derived from text
*Noise Generators; Acoustic Propagation; Sound Pressure*

**20040085760** NASA Langley Research Center, Hampton, VA, USA
**Interaction Metrics for Feedback Control of Sound Radiation from Stiffened Panels**
Cabell, Randolph H.; Cox, David E.; Gibbs, Gary P.; [2003]; 10 pp.; In English
Report No.(s): AIAA Paper 2003-1812; No Copyright; Avail: CASI; A02, Hardcopy

Interaction metrics developed for the process control industry are used to evaluate decentralized control of sound radiation from bays on an aircraft fuselage. The metrics are applied to experimentally measured frequency response data from a model of an aircraft fuselage. The purpose is to understand how coupling between multiple bays of the fuselage can destabilize or limit the performance of a decentralized active noise control system. The metrics quantitatively verify observations from a previous experiment, in which decentralized controllers performed worse than centralized controllers. The metrics do not appear to be useful for explaining control spillover which was observed in a previous experiment.
Author
*Feedback Control; Frequency Response; Noise Reduction; Panels; Stiffness*

**20040085969** NASA Langley Research Center, Hampton, VA, USA
**Hybrid Active/Passive Control of Sound Radiation from Panels with Constrained Layer Damping and Model Predictive Feedback Control**
Cabell, Randolph H.; Gibbs, Gary P.; [2000]; 6 pp.; In English; Noise-Con 2000, 3-5 Dec. 2000, Newport Beach, CA, USA; No Copyright; Avail: CASI; A02, Hardcopy

There has been considerable interest over the past several years in applying feedback control methods to problems of structural acoustics. One problem of particular interest is the control of sound radiation from aircraft panels excited on one side by a turbulent boundary layer (TBL). TBL excitation appears as many uncorrelated sources acting on the panel, which makes it difficult to find a single reference signal that is coherent with the excitation. Feedback methods have no need for a reference signal, and are thus suited to this problem. Some important considerations for the structural acoustics problem include the fact that the required controller bandwidth can easily extend to several hundred Hertz, so a digital controller would have to operate at a few kilohertz. In addition, aircraft panel structures have a reasonably high modal density over this frequency range. A model based controller must therefore handle the modally dense system, or have some way to reduce the bandwidth of the problem. Further complicating the problem is the fact that the stiffness and dynamic properties of an aircraft panel can vary considerably during flight due to altitude changes resulting in significant resonant frequency shifts. These considerations make the tradeoff between robustness to changes in the system being controlled and controller performance especially important. Recent papers concerning the design and implementation of robust controllers for structural acoustic problems highlight the need to consider both performance and robustness when designing the controller. While robust control methods such as H1 can be used to balance performance and robustness, their implementation is not easy and requires assumptions about the types of uncertainties in the plant being controlled. Achieving a useful controller design may require many tradeoff studies of different types of parametric uncertainties in the system. Another approach to achieving robustness to plant changes is to make the controller adaptive. For example, a mathematical model of the plant could be periodically updated as the plant changes, and the feedback gains recomputed from the updated model. To be practical, this approach requires a simple plant model that can be updated quickly with reasonable computational requirements. A recent paper by the authors discussed one way to simplify a feedback controller, by reducing the number of actuators and sensors needed for good performance. The work was done on a tensioned aircraft-style panel excited on one side by TBL flow in a low speed wind tunnel. Actuation was provided by a piezoelectric (PZT) actuator mounted on the center of the panel. For sensing, the responses of four accelerometers, positioned to approximate the response of the first radiation mode of the panel, were summed and fed back through the controller. This single input-single output topology was found to have nearly the same noise reduction performance as a controller with fifteen accelerometers and three PZT patches. This paper extends the previous results by looking at how constrained layer damping (CLD) on a panel can be used to enhance the performance of the feedback controller thus providing a more robust and efficient hybrid active/passive system. The eventual goal is to use the CLD to reduce sound radiation at high frequencies, then implement a very simple, reduced order, low sample rate adaptive controller to attenuate sound radiation at low frequencies. Additionally this added damping smoothes phase transitions over the bandwidth which promotes robustness to natural frequency shifts. Experiments were conducted in a transmission loss facility on a clamped-clamped aluminum panel driven on one side by a loudspeaker. A generalized predictive control (GPC) algorithm, which is suited to online adaptation of its parameters, was used in single input-single output and multiple input-single output configurations. Because this was a preliminary look at the potential constrained layer damping for adaptive control, static feedback control with no online adaptation was used. Two configurations of CLD in addition to a bare panel configuration were studied. For each CLD configuration, two sensor arrangements for the feedback controller were compared. The first arrangement used fifteen accelerometers on the panel to estimate the responses of the first six radiation modes of the panel. The second sensor arrangement was simpler, using the summed responses of only four accelerometers to approximate the response of the first radiation mode of the panel. In all cases a PZT patch was mounted at the center of the panel for control input. The performance of the controller was quantified using the responses of the fifteen accelerometers on the panel to estimate radiated sound power. The paper begins with a brief discussion of the GPC algorithm and the experimental setup. The experimental results are discussed next, comparing the CLD and sensor configurations, followed by discussion and conclusions.

Author

*Active Control; Sound Waves; Feedback Control; Acoustics; Noise Reduction*

**20040085972** NASA Langley Research Center, Hampton, VA, USA

**Investigating the Use of Ultrasound for Evaluating Aging Wiring Insulation**

Madaras, Eric I.; Anastasi, Robert F.; [2001]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper reviews our initial efforts to investigate the use of ultrasound to evaluate wire insulation. Our initial model was a solid conductor with heat shrink tubing applied. In this model, various wave modes were identified. Subsequently, several aviation classes of wires (MIL-W- 81381, MIL-W-22759/34, and MIL-W-22759/87) were measured. The wires represented polyimide and ethylene-tetraflouroethylene insulations, and combinations of polyimide and flouropolymer plastics. Wire gages of 12, 16, and 20 AWG sizes were measured. Finally, samples of these wires were subjected to high temperatures for short

periods of time to cause the insulation to degrade. Subsequent measurements indicated easily detectable changes.
Author
*Ultrasonics; Aging (Materials); Wiring; Insulation*

**20040086057** NASA Langley Research Center, Hampton, VA, USA
**Closed-Loop Control for Sonic Fatigue Testing Systems**
Rizzi, Stephen A.; Bossaert, Guido; Sound and Vibration; November 2001, pp. 1-5; In English; Copyright; Avail: CASI; A01, Hardcopy

This article documents recent improvements to the acoustic control system of the Thermal Acoustic Fatigue Apparatus (TAFA), a progressive wave tube test facility at the NASA Langley Research Center, Hampton, VA. A brief summary of past acoustic performance is first given to serve as a basis of comparison with the new performance data using a multiple-input, closed-loop, narrow-band controller. Performance data in the form of test section acoustic power spectral densities and coherence are presented for a variety of input spectra including uniform, band-limited random and an expendable launch vehicle payload bay environment.
Author
*Acoustic Fatigue; Fatigue Tests; Feedback Control; Thermal Environments; Systems Engineering*

**20040086101** NASA Langley Research Center, Hampton, VA, USA
**Acoustic Radiation From Rotating Blades: The Kirchhoff Method in Aeroacoustics**
Farassat, F.; July 03, 2000; 31 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

This paper reviews the current status of discrete frequency noise prediction for rotating blade machinery in the time domain. There are two major approaches both of which can be classified as the Kirchhoff method. These methods depend on the solution of two linear wave equations called the K and FW-H equations. The solutions of these equations for subsonic and supersonic surfaces are discussed and some important results of the research in the past years are presented. This paper is analytical in nature and emphasizes the work of the author and coworkers at NASA Langley Research Center.
Derived from text
*Aeroacoustics; Kirchhoff Law of Radiation; Noise Prediction; Mathematical Models*

**20040086493** NASA Langley Research Center, Hampton, VA, USA
**The Mean Curvature of the Influence Surface of Wave Equation With Sources on a Moving Surface**
Farassat, F.; Farris, Mark; Journal Mathematical Methods in the Applied Sciences; December 08, 1999; Volume 22, pp. 1485-1503; In English; Copyright; Avail: CASI; A03, Hardcopy

The mean curvature of the influence surface of the space-time point (x, t) appears in linear supersonic propeller noise theory and in the Kirchhoff formula for a supersonic surface. Both these problems are governed by the linear wave equation with sources on a moving surface. The influence surface is also called the Sigma - surface in the aeroacoustic literature. This surface is the locus, in a frame fixed to the quiescent medium, of all the points of a radiating surface f(x, t) = 0 whose acoustic signals arrive simultaneously to an observer at position x and at the time t. Mathematically, the Sigma- surface is produced by the intersection of the characteristic conoid of the space-time point (x, t) and the moving surface. In this paper, we derive the expression for the local mean curvature of the Sigma - space of the space-time point for a moving rigid or deformable surface f(x, t) = 0. This expression is a complicated function of the geometric and kinematic parameters of the surface f(x, t) = 0. Using the results of this paper, the solution of the governing wave equation of high speed propeller noise radiation as well as the Kirchhoff formula for a supersonic surface can be written as very compact analytic expression.
Author
*Curvature; Mean; Wave Equations; Surface Waves*

**20040086494** NASA Langley Research Center, Hampton, VA, USA
**Pseudo-Random Modulation of a Laser Diode for Generating Ultrasonic Longitudinal Waves**
Madaras, Eric I.; Anatasi, Robert F.; [2004]; 7 pp.; In English; No Copyright; Avail: CASI; A02, Hardcopy

Laser generated ultrasound systems have historically been more complicated and expensive than conventional piezoelectric based systems, and this fact has relegated the acceptance of laser based systems to niche applications for which piezoelectric based systems are less suitable. Lowering system costs, while improving throughput, increasing ultrasound signal levels, and improving signal-to-noise are goals which will help increase the general acceptance of laser based ultrasound. One current limitation with conventional laser generated ultrasound is a material s damage threshold limit. Increasing the optical

power to generate more signal eventually damages the material being tested due to rapid, high heating. Generation limitations for laser based ultrasound suggests the use of pulse modulation techniques as an alternate generation method. Pulse modulation techniques can spread the laser energy over time or space, thus reducing laser power densities and minimizing damage. Previous experiments by various organizations using spatial or temporal pulse modulation have been shown to generate detectable surface, plate, and bulk ultrasonic waves with narrow frequency bandwidths . Using narrow frequency bandwidths improved signal detectability, but required the use of expensive and powerful lasers and opto-electronic systems. The use of a laser diode to generate ultrasound is attractive because of its low cost, small size, light weight, simple optics and modulation capability. The use of pulse compression techniques should allow certain types of laser diodes to produce usable ultrasonic signals. The method also does not need to be limited to narrow frequency bandwidths. The method demonstrated here uses a low power laser diode (approximately 150 mW) that is modulated by controlling the diode s drive current and the resulting signal is recovered by cross correlation. A potential application for this system which is briefly demonstrated is in detecting signals in thick composite materials where attenuation is high and signal amplitude and bandwidth are at a premium. Derived from text

*Longitudinal Waves; Ultrasonics; Semiconductor Lasers; Pseudorandom Sequences; Pulse Modulation*

**20040086497** NASA Langley Research Center, Hampton, VA, USA

**Pulse Compression Techniques for Laser Generated Ultrasound**

Anastasi, R. F.; Madaras, E. I.; [1999]; 5 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

Laser generated ultrasound for nondestructive evaluation has an optical power density limit due to rapid high heating that causes material damage. This damage threshold limits the generated ultrasound amplitude, which impacts nondestructive evaluation inspection capability. To increase ultrasound signal levels and improve the ultrasound signal-to-noise ratio without exceeding laser power limitations, it is possible to use pulse compression techniques. The approach illustrated here uses a 150mW laser-diode modulated with a pseudo-random sequence and signal correlation. Results demonstrate the successful generation of ultrasonic bulk waves in aluminum and graphite-epoxy composite materials using a modulated low-power laser diode and illustrate ultrasound bandwidth control.

Author

*Pulse Compression; Laser Outputs; Sound Generators; Ultrasonics; Wave Propagation*

**20040086506** NASA Langley Research Center, Hampton, VA, USA

**Non-Localized Acoustic Receptivity and Subsequent Disturbance Growth in a Blasius Boundary Layer**

King, Rudolph A.; Breuer, Kenneth S.; [1999]; 6 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

Acoustic receptivity was experimentally examined for a Blasius bound- ary layer with receptivity sites in the form of 2-D waviness and oblique waviness. Linear receptivity coefficients obtained for all values of forcing combinations (epsilon = (Delta)h) are in good agreement with receptivity theory. The measured receptivity increased markedly with increasing wave obliqueness. Detuning was investigated by varying the streamwise wavenumber, alpha(sub w), of the 2-D and oblique wall waviness. Oblique transition was also investigated by exciting a pair of oblique Orr-Sommerfeld (O-S) modes (f/fo +/- beta/beta(subn w) = (1 +/- 1). For large values of epsilon = (Delta)nh, a secondary instability was observed that ultimately lead to laminar breakdown. This instability appears to be driven by large spanwise velocity gradients, absolute value of dU/d(zeta).

Author

*Boundary Layers; Velocity Distribution*

**20040086508** NASA Langley Research Center, Hampton, VA, USA

**Reflections of AE Waves in Finite Plates: Finite Element Modeling and Experimental Measurements**

Prosser, W. H.; Hamstad, M. A.; Gary, J.; OGallagher, A.; Journal of Acoustic Emission; June 1999; Volume 17, No. 1-2, pp. 37-47; In English; Copyright; Avail: CASI; A03, Hardcopy

The capability of a three-dimensional dynamic finite element method for predicting far-field acoustic emission signals in thin plates of finite lateral extent, including their reflections from the plate edges, was investigated. A lead break (Hsu-Neilsen) source to simulate AE was modeled and used in the experimental measurements. For the thin plate studied, the signals were primarily composed of the lowest order symmetric (S0) and antisymmetric (A0) Lamb modes. Experimental waveforms were detected with an absolutely calibrated, wideband, conical element transducer. The conditions of lead fractures both on the surface of the plate as well as on the edge of the plate were investigated. Surface lead breaks preferentially generate the A0 mode while edge lead breaks generate the S0 mode. Reflections of developed plate waves from both normal and oblique incidence angles were evaluated. Particularly interesting for the case of the lead break on the plate edge were S0 waves

produced by the interaction of a Rayleigh wave with the plate corner and by a bulk shear wave mode converting at the side edge. The Rayleigh wave, in this case, propagated along the specimen edge. For all cases considered, the experimental measurements were in good agreement with the predictions of the finite element model.
Author
*Mathematical Models; Three Dimensional Models; Acoustic Emission; Wave Propagation*

**20040086509** NASA Langley Research Center, Hampton, VA, USA
**The Application of a Boundary Integral Equation Method to the Prediction of Ducted Fan Engine Noise**
Dunn, M. H.; Tweed, J.; Farassat, F.; [1999]; 47 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

The prediction of ducted fan engine noise using a boundary integral equation method (BIEM) is considered. Governing equations for the BIEM are based on linearized acoustics and describe the scattering of incident sound by a thin, finite-length cylindrical duct in the presence of a uniform axial inflow. A classical boundary value problem (BVP) is derived that includes an axisymmetric, locally reacting liner on the duct interior. Using potential theory, the BVP is recast as a system of hypersingular boundary integral equations with subsidiary conditions. We describe the integral equation derivation and solution procedure in detail. The development of the computationally efficient ducted fan noise prediction program TBIEM3D, which implements the BIEM, and its utility in conducting parametric noise reduction studies are discussed. Unlike prediction methods based on spinning mode eigenfunction expansions, the BIEM does not require the decomposition of the interior acoustic field into its radial and axial components which, for the liner case, avoids the solution of a difficult complex eigenvalue problem. Numerical spectral studies are presented to illustrate the nexus between the eigenfunction expansion representation and BIEM results. We demonstrate BIEM liner capability by examining radiation patterns for several cases of practical interest.
Author
*Boundary Integral Method; Boundary Value Problems; Acoustic Scattering; Aerodynamic Noise; Fan Blades; Noise Reduction; Ducted Fan Engines*

**20040086533** NASA Glenn Research Center, Cleveland, OH, USA
**Modeling of Turbulence Generated Noise in Jets**
Khavaran, Abbas; Bridges, James; June 2004; 24 pp.; In English; Tenth Aeroacoustics Conference, 10-12 May 2004, Manchester, UK; Original contains color illustrations
Contract(s)/Grant(s): WBS 22-781-30-09
Report No.(s): NASA/TM-2004-213105; AIAA Paper 2004-2983; E-14580; No Copyright; Avail: CASI; A03, Hardcopy

A numerically calculated Green's function is used to predict jet noise spectrum and its far-field directivity. A linearized form of Lilley's equation governs the non-causal Green s function of interest, with the non-linear terms on the right hand side identified as the source. In this paper, contributions from the so-called self- and shear-noise source terms will be discussed. A Reynolds-averaged Navier-Stokes solution yields the required mean flow as well as time- and length scales of a noise-generating turbulent eddy. A non-compact source, with exponential temporal and spatial functions, is used to describe the turbulence velocity correlation tensors. It is shown that while an exact non-causal Green's function accurately predicts the observed shift in the location of the spectrum peak with angle as well as the angularity of sound at moderate Mach numbers, at high subsonic and supersonic acoustic Mach numbers the polar directivity of radiated sound is not entirely captured by this Green's function. Results presented for Mach 0.5 and 0.9 isothermal jets, as well as a Mach 0.8 hot jet conclude that near the peak radiation angle a different source/Green's function convolution integral may be required in order to capture the peak observed directivity of jet noise.
Author
*Jet Aircraft Noise; Mathematical Models; Jet Propulsion; Aeroacoustics; Turbulence*

**20040086540** NASA Langley Research Center, Hampton, VA, USA
**Aircraft Engine Noise Scattering by Fuselage and Wings: A Computational Approach**
Stanescu, D.; Hussaini, M. Y.; Farassat, F.; [2003]; 26 pp.; In English
Contract(s)/Grant(s): NAG1-01031; No Copyright; Avail: CASI; A03, Hardcopy

The paper presents a time-domain method for computation of sound radiation from aircraft engine sources to the far-field. The effects of nonuniform flow around the aircraft and scattering of sound by fuselage and wings are accounted for in the formulation. The approach is based on the discretization of the inviscid flow equations through a collocation form of the Discontinuous Galerkin spectral element method. An isoparametric representation of the underlying geometry is used in order

to take full advantage of the spectral accuracy of the method. Large-scale computations are made possible by a parallel implementation based on message passing. Results obtained for radiation from an axisymmetric nacelle alone are compared with those obtained when the same nacelle is installed in a generic configuration, with and without a wing.
Author
*Aircraft Engines; Fuselages; Wings; Aircraft Noise; Aeroacoustics; Computation; Acoustic Scattering*

## 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*.

**20040086478** Spectral Sciences, Inc., Burlington, MA, USA
**DSMC Simulations of Hyperthermal Oxygen Beam Exposures**
Cline, Jason A.; Braunstein, Matthew; Minton, Timothy K.; October 07, 2003; 1 pp.; In English; 37th AIAA Thermophysics Conference, 28 Jun. - 1 Jul. 2004, Portland, OR, USA
Contract(s)/Grant(s): NAS8-00201; No Copyright; Avail: Other Sources; Abstract Only

Pulsed sources of hyper-thermal O-atoms are now being extensively used to simulate low-earth orbit (LEO) surface exposure environments. The peak flux of these sources is many orders of magnitude larger than the corresponding LEO flux. Although it is desirable to accelerate the test by using higher fluxes than found in LEO, even commonly used fluxes are large enough to produce multi-collision effects by causing a build-up of gas at the sample surface. In this paper we characterize the physical consequences to the experiment using the direct simulation Monte Carlo (DSMC) method. DSMC allows us to extract the distributions of energy and impact angle for the O-atoms that reach the surface, and to record how strongly the gas build-up at the target assembly deflects flux from downstream instrumentation. By considering a range of source fluxes, we determine the onset conditions and severity of these multi-collision effects. We find that even at common experimental fluxes with a normally incident beam striking a flat surface sample, the energy distribution of incident O-atoms broadens and develops a significant low-energy tail. The angular distributions also broaden significantly. The number of O-atoms that reach downstream instrumentation is decreased by approximately 50%. These simulations will aid in the calibration of ground-based O-atom measurements, and provide a model for the energy and angular distributions of O-atoms that actually impinge on surface samples.
Author
*Monte Carlo Method; Oxygen Atoms; Exposure; Computerized Simulation*

## 73
## NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

**20040085538** Du Pont de Nemours (E. I.) and Co., Aiken, SC, USA
**Coefficients of Reactivity-Mark VII-A**
Oct. 1959; 22 pp.; In English
Report No.(s): DE2004-810368; DPSP 59-1564; No Copyright; Avail: Department of Energy Information Bridge

Tests were performed to determine the moderator temperature coefficient of reactivity, the prompt temperature coefficient of reactivity and the power coefficient of reactivity of Mark VII-A charges. This document summarizes the results of the tests and reports values of the coefficients that are commensurate with the test data.
NTIS
*Coefficients; Reactivity*

**20040085546** Academy of Sciences (Russia), Moscow, Russia, Department of Energy, Washington, DC, USA
**Variant 22: Spatially-Dependent Transient Processes in MOX Fueled Core**
Boshagin, S. N.; Pinegin, A. A.; Shishkov, L. K.; Shishkov, D. L.; Shumsky, B. E.; Sep. 2001; In English
Report No.(s): DE2003-814315; No Copyright; Avail: National Technical Information Service (NTIS)

In this document issued according to Work Release 02. P. 99-4a the reactor-kinetics benchmarks are presented for 30% MOX fueled core of VVER-1000. Both UOX and MOX cores are calculated for three types of accidents: Control rod ejection; Overcooling of the reactor core caused by steam line rupture and Boron dilution of coolant.
NTIS
*Fuels; Accidents; Kinetics; Fissionable Materials*

**20040085926** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The Electron Spectrum above 20 GeV Measured by ATIC**
Chang, J.; Schmidt, W. K. H.; Adams, J. H.; Ahn, H. S.; Bashindzhagyan, G.; Batkov, K. E.; Christl, M.; Fazely, A. R.; Ganel, O.; Gunasingha, R. M., et al.; [2004]; 1 pp.; In English; 35th COSPAR Scientific Assembly, 18-25 Jul. 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

The Advanced Thin Ionization Calorimeter (ATIC) Balloon Experiment has been flown from McMurdo, Antarctica in 2000-01 (test flight) and 2002-03 (science flight). ATIC is composed of a segmented BGO calorimeter following a carbon target with scintillator tracking layers and a Silicon matrix detector at the entrance. ATIC measures the composition and energy spectra of the nuclei plus electrons. We present the electron spectrum derived from the ATIC flights, from 20 GeV to 3 TeV, and compare it to existing very high energy measurements from emulsion chambers and to the results of galactic propagation calculations. The good energy resolution and high statistics in the ATIC data allow detailed astrophysical interpretation of the results.
Author
*Calorimeters; Ionization; Energy Spectra; Electron Spectroscopy*

## 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*.

**20040085476** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**Ultra-Wideband Optical Modulation Spectrometer (OMS) Development**
Gardner, Jonathan, Technical Monitor; Tolls, Volker; July 2004; 20 pp.; In English
Contract(s)/Grant(s): NAG5-10476; No Copyright; Avail: CASI; A03, Hardcopy

The optical modulation spectrometer (OMS) is a novel, highly efficient, low mass backend for heterodyne receiver systems. Current and future heterodyne receiver systems operating at frequencies up to a few THz require broadband spectrometer backends to achieve spectral resolutions of R approximately 10(exp 5) to 10(exp 6) to carry out many important astronomical investigations. Among these are observations of broad emission and absorption lines from extra-galactic objects at high redshifts, spectral line surveys, and observations of planetary atmospheres. Many of these lines are pressure or velocity broadened with either large half-widths or line wings extending over several GHz. Current backend systems can cover the needed bandwidth only by combining the output of several spectrometers, each with typically up to 1 GHz bandwidth, or by combining several frequency-shifted spectra taken with a single spectrometer. An ultra-wideband optical modulation spectrometer with 10 - 40 GHz bandwidth will enable broadband ob- servations without the limitations and disadvantages of hybrid spectrometers. Spectrometers like the OMS will be important for both ground-based observatories and future space missions like the Single Aperture Far-Infrared Telescope (SAFIR) which might carry IR/submm array heterodyne receiver systems requiring a spectrometer for each array pixel. Small size, low mass and small power consumption are extremely important for space missions. This report summarizes the specifications developed for the OMS and lists already identified commercial parts. The report starts with a review of the principle of operation, then describes the most important components and their specifications which were derived from theory, and finishes with a conclusion and outlook.
Derived from text
*Light Modulation; Spectrometers; Broadband; Electro-Optics*

**20040085550** Princeton Univ., NJ
**Generation of Ultra-high Intensity Laser Pulses**
Fisch, N. J.; Malkin, V. M.; Jun. 2003; In English
Report No.(s): DE2003-814677; PPPL-3821; No Copyright; Avail: National Technical Information Service (NTIS)

Mainly due to the method of chirped pulse amplification, laser intensities have grown remarkably during recent years.

However, the attaining of very much higher powers is limited by the material properties of gratings. These limitations might be overcome through the use of plasma, which is an ideal medium for processing very high power and very high total energy. A plasma can be irradiated by a long pump laser pulse, carrying significant energy, which is then quickly depleted in the plasma by a short counterpropagating pulse. This counterpropagating wave effect has already been employed in Raman amplifiers using gases or plasmas at low laser power. Of particular interest here are the new effects which enter in high power regimes. These new effects can be employed so that one high-energy optical system can be used like a flashlamp in what amounts to pumping the plasma, and a second low-power optical system can be used to extract quickly the energy from the plasma and focus it precisely.
NTIS
*Laser Outputs; Pulsed Lasers; Gratings (Spectra)*

**20040085557** Lawrence Livermore National Lab., Livermore, CA
**Multiple Film Plane Diagnostic for Shocked Lattice Measurements**
Kalanta, D. H.; Bringa, E.; Caturla, M.; Colvin, J.; Lorenz, K. T.; Jul. 02, 2002; 30 pp.; In English
Report No.(s): DE2004-15002014; UCRL-JC-147825; No Copyright; Avail: Department of Energy Information Bridge
Laser-based shock experiments have been conducted in thin Si and Cu crystals at pressures above the Hugoniot Elastic Limit (HEL). In these experiments, static film and x-ray streak cameras recorded x-rays diffracted from lattice planes both parallel and perpendicular to the shock direction. This data showed uniaxial compression of Si (100) along the shock direction and 3-D compression of Cu (100). In the case of the Si diffraction, there was a multiple wave structure observed, which may be due to a 1-D phase transition or a time variation in the shock pressure. A new film-based detector has been developed for these in-situ dynamic diffraction experiments.
NTIS
*Streak Cameras; Phase Transformations*

**20040086070** NASA Langley Research Center, Hampton, VA, USA
**Fiber Optic Sensors for Cure/Health Monitoring of Composite Materials**
Wood, K. H.; Brown, T. L.; Wu, M. C.; Gause, C. B.; [2004]; 10 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy
The objective of the current program is to develop techniques for using optical fibers to monitor the cure of composite materials in real time during manufacture and to monitor the in-service structural health of composite structures. Single and multimode optical fibers containing Bragg gratings have been used to perform Near Infrared (NIR) spectroscopy on high refractive index resins and show promise as embedded sensors. In order for chemical spectroscopy to be possible, intimate contact must be achieved between the fiber core and the composite resin. This contact is often achieved by stripping the cladding off of a portion of the fiber, thus making it brittle and easily broken in the composite processing environment. To avoid weakening the fiber to this extent, high refractive index fibers have been fabricated that use a low refractive index acrylate coating which serves as the cladding. This is ideal, as the coating is easily solvent stripped and intimate contact with the glass core can be achieved. Real time resin and composite chemical spectra have been obtained, with possible multifunctional capability using Bragg gratings to assess physical properties such as strain, modulus and other parameters of interest.
Derived from text
*Fiber Optics; Bragg Gratings; Composite Materials; Near Infrared Radiation; Sensors; Resins*

**20040086481** Boeing Electron Dynamic Devices, Inc., Torrance, CA, USA
**Fabrication and Vibration Results of 30-cm Pyrolytic Graphite Ion Optics**
DePano, Michael K.; Hart, Stephen L.; Hanna, Andrew A.; Schneider, Analyn C.; [2004]; 9 pp.; In English; 2004 Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-02131; No Copyright; Avail: CASI; A02, Hardcopy
Boeing Electron Dynamic Devices, Inc. is currently developing pyrolytic graphite (PG) grids designed to operate on 30-cm NSTAR-type thrusters for the Carbon Based Ion Optics (CBIO) program. The PG technology effort of the CBIO program aims to research PG as a flightworthy material for use in dished ion optics by designing, fabricating, and performance testing 30-cm PG grids. As such, PG grid fabrication results will be discussed as will PG design considerations and how they must differ from the NSTAR molybdenum grid design. Surface characteristics and surface processing of PG will be explored relative to effects on voltage breakdown. Part of the CBIO program objectives is to understand the erosion of PG due to Xenon ion bombardment. Discussion of PG and CC sputter yields will be presented relative to molybdenum. These sputter yields will

be utilized in the life modeling of carbon-based grids. Finally, vibration results of 30-cm PG grids will be presented and compared to a first-order model generated at Boeing EDD. Performance testing results of the PG grids will not be discussed in this paper as it has yet to be completed.
Author
*Pyrolytic Graphite; Vibration Tests; Xenon; Ion Irradiation; Lenses*

## 75
## PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**20040085506** Prins Maurits Lab. TNO, Rijswijk, Netherlands
**Analysis of the Applicability of a Laser for the Neutralization of Munitions**
Meuken, B.; Vliegenthart, W.; November 2003; 38 pp.; In Dutch
Contract(s)/Grant(s): A03/KL/4KT; TNO Proj. 014.12972
Report No.(s): TD-2002-0259; PML-2003-A85; Copyright; Avail: Other Sources

In this analysis several aspects of laser neutralization of munitions are studied in detail. Within the Ministry of Defense exists a need for a procedure to neutralize unexploded ordnance (UXO) from a safe distance. It covers the applications in which the laser can be of use, other components required in addition to the laser system, additional research which is needed to test en verify the results and the type of laser which is most suitable for the task. The work is carried out in cooperation with TNO TPD under contract from LBBKL/Munitiebedrijf. The fiber laser of IPG Photonics seems to be the most suitable for this application. Some optics need to be added to create a focus distance of several meters. Discussed here are also the laser-material interactions, safety issues and the project steps required to a evaluation system.
Author
*Laser Materials; Fiber Lasers; Safety*

**20040085551** Princeton Univ., NJ
**Shape Optimization for DIII-D Advanced Tokamak Plasmas**
Kessel, C. E.; Ferron, J. R.; Greenfield, C. M.; Menard, J. E.; Taylor, T. S.; Jul. 2003; In English
Report No.(s): DE2003-814731; PPPL-3848; No Copyright; Avail: National Technical Information Service (NTIS)

The advanced tokamak program on DIII-D is targeting the full integration of high-beta and high-bootstrap/noninductive current fraction for long-pulse lengths and the high confinement consistent with these features. Central to achieving these simultaneously is access to the highest ideal beta limits possible to maximize the headroom for experimental operation with RWM control. A study of the ideal-MHD stability is done for plasmas modeled after DIII-D advanced tokamak plasmas, varying the plasma elongation, triangularity, and outboard squareness. The highest beta(sub)N limits reach 6-7 for the n=1 kink mode for all elongation, outer squareness values, and plasma triangularity equals 0.8.
NTIS
*Shape Optimization; Magnetohydrodynamic Stability; Confinement*

**20040085726** NASA Langley Research Center, Hampton, VA, USA
**Volumetric Near-Field Microwave Plasma Generation**
Exton, R. J.; Balla, R. Jeffrey; Herring, G. C.; Popovic, S.; Vuskovic, L.; [2003]; 12 pp.; In English
Report No.(s): AIAA Paper 2003-4181; Copyright; Avail: CASI; A03, Hardcopy

A periodic series of microwave-induced plasmoids is generated using the outgoing wave from a microwave horn and the reflected wave from a nearby on-axis concave reflector. The plasmoids are spaced at half-wavelength separations according to a standing-wave pattern. The plasmoids are enhanced by an effective focusing in the near field of the horn (Fresnel region) as a result of a diffractive narrowing. Optical imaging, electron density, and rotational temperature measurements characterize the near field plasma region. Volumetric microwave discharges may have application to combustion ignition in scramjet engines.
Author
*Microwaves; Near Fields; Plasma Generators; Plasmas (Physics)*

**20040086001** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Radio Frequency (RF) Trap for Confinement of Antimatter Plasmas Using Rotating Wall Electric Fields**

Sims, William Herbert, III; Pearson, J. Boise; [2004]; 5 pp.; In English; 6th NASA/DOD Conference on Evolvable Hardware, 24-26 Jun. 2004, Seattle, WA, USA; No Copyright; Avail: CASI; A01, Hardcopy

Perturbations associated with a rotating wall electric field enable the confinement of ions for periods approaching weeks. This steady state confinement is a result of a radio frequency manipulation of the ions. Using state-of-the-art techniques it is shown that radio frequency energy can produce useable manipulation of the ion cloud (matter or antimatter) for use in containment experiments. The current research focuses on the improvement of confinement systems capable of containing and transporting antimatter.

Author

*Antimatter; Electric Fields; Radio Frequencies; Plasma Control; Hydrogen Ions; Rotation*

**20040086050** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Stormtime Particle Energization with High Temporal Resolution AMIE Potentials**

Khazanov, George V.; Liemohn, Michael W.; Fok, Mei-Ching; Newman, Timothy S.; Ridley, Aaron J.; Journal of Geophysical Research; January 2004; ISSN 0148-0227; Volume 109, pp. 1-17; In English

Contract(s)/Grant(s): NAG5-5030; NAG5-10297; NAG5-10850; NSF ATM-00-90165; Copyright; Avail: Other Sources

Simulations were conducted to investigate the influence of rapid electric field fluctuations on electron energization in the inner magnetosphere based on the assimilative mapping of ionospheric electrodynamics (AMIE) technique. Simulations for four different magnetic storms were run, namely those that occurred on 15 May 1997, 4 May 1998, 25 September 1998, and 19 October 1998. Here we have examined the formation of high- energy (100-500 keV) electrons in the inner magnetosphere during these storm events with our recently developed relativistic radiation belt transport code. The point of this numerical experiment is to show that a simulation of a real event must have the high time resolution electric field input files in order to produce the seed population for the radiation belts, which are often observed to increase in the days following a magnetic storm. Specifically, a cadence of the global electric field pattern of 5 min or less produces inner magnetospheric fluxes that are larger (by up to several orders of magnitude) than fluxes produced with a longer cadence. Differences were particularly large relative to simulation results with a 3-hour time cadence, analogous to a Kpdriven electric field model.

Author

*Space Plasmas; Charged Particles; Particle Acceleration; Particle Motion; Magnetospheric Instability; Ring Currents*

## 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*.

**20040085529** Iowa State Univ. of Science and Technology, Ames, IA

**Optically Detected Magnetic Resonance and Thermal Activation Spectroscopy Study of Organic Semiconductors**

Kim, C. H.; 2003; 210 pp.; In English

Report No.(s): DE2004-822055; No Copyright; Avail: Department of Energy Information Bridge

Organic electronic materials are a new class of emerging materials. Organic light emitting devices (OLEDs) are the most promising candidates for future flat panel display technologies. The photophysical characterization is the basic research step one must follow to understand this new class of materials and devices. The light emission properties are closely related to the transport properties of these materials. The objective of this dissertation is to probe the relation between transport and photophysical properties of organic semiconductors. The transport characteristics were evaluated by using thermally stimulated current and thermally stimulated luminescence techniques. The photoluminescence detected magnetic resonance and photoluminescence quantum yield studies provide valuable photophysical information on this class of materials. OLEDs are already in the market. However, detailed studies on the degradation mechanisms are still lacking. Since both optically detected magnetic resonance and thermal activation spectroscopy probe long-lived defect-related states in organic semiconductors, the combined study generates new insight on the OLED operation and degradation mechanisms.

NTIS

*Light Emission; Magnetic Resonance; Organic Semiconductors; Spectroscopy; Photoluminescence*

**20040085530** Iowa State Univ. of Science and Technology, Ames, IA
**Electromagnetic Wave Propagation in Two-Dimensional Photonic Crystals**
Foteinopoulou, S.; 2003; 228 pp.; In English
Report No.(s): DE2004-822058; No Copyright; Avail: Department of Energy Information Bridge

In this dissertation, they have undertaken the challenge to understand the unusual propagation properties of the photonic crystal (PC). The photonic crystal is a medium where the dielectric function is periodically modulated. These types of structures are characterized by bands and gaps. In other words, they are characterized by frequency regions where propagation is prohibited (gaps) and regions where propagation is allowed (bands). In this study they focus on two-dimensional photonic crystals, i.e., structures with periodic dielectric patterns on a plane and translational symmetry in the perpendicular direction. They start by studying a two-dimensional photonic crystal system for frequencies inside the band gap. The inclusion of a line defect introduces allowed states in the otherwise prohibited frequency spectrum. The dependence of the defect resonance state on different parameters such as size of the structure, profile of incoming source, etc., is investigated in detail. For this study, they used two popular computational methods in photonic crystal research, the Finite Difference Time Domain method (FDTD) and the Transfer Matrix Method (TMM). The results for the one-dimensional defect system are analyzed, and the two methods, FDTD and TMM, are compared. Then, they shift their attention only to periodic two-dimensional crystals, concentrate on their band properties, and study their unusual refractive behavior.
NTIS
*Crystals; Electromagnetic Wave Transmission; Photonics; Wave Propagation; Electromagnetic Radiation*

**20040085898** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Diffraction and Imaging Study of Imperfections of Protein Crystals with Coherent X-rays**
Hu, Z. W.; Thomas, B. R.; Chernov, A. A.; Chu, Y. S.; Lai, B.; [2004]; 1 pp.; In English; American Crystallographic Association Annual Meeting, 17-22 Jul. 2004, Chicago, IL, USA
Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

High angular-resolution x-ray diffraction and phase contrast x-ray imaging were combined to study defects and perfection of protein crystals. Imperfections including line defects, inclusions and other microdefects were observed in the diffraction images of a uniformly grown lysozyme crystal. The observed line defects carry distinct dislocation features running approximately along the \h110\g growth front and have been found to originate mostly in a central growth area and occasionally in outer growth regions. Slow dehydration led to the broadening of a fairly symmetric 4 4 0 rocking curve by a factor of approximately 2.6, which was primarily attributed to the dehydration-induced microscopic effects that are clearly shown in diffraction images. X-ray imaging and diffraction characterization of the quality of apoferritin crystals will also be discussed in the presentation.
Author
*Protein Crystal Growth; Imaging Techniques; Coherent Radiation; X Ray Diffraction; Crystal Defects*

**20040085916** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Containerless Processing of a Lithium Disilicate Glass**
Ranasinghe, Kisa; Ray, Chandra S.; Day, Delbert E.; Rogers, Jan R.; Hyers, Robert W.; Rathz, Thomas; [2004]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

Glasses of Li2O.2SiO2 (LS2), and LS2 doped with 0.001wt% platinum (LS2 + 0.001 wt% Pt) compositions were melted, cooled and reheated at controlled rates while levitated (containerless) inside an Electrostatic Levitator (ESL) furnace at the NASA Marshall Space Flight Center, Huntsville, AL. The experiments were conducted in vacuum (approximately 10(exp -5) Pa) using spherical, 2.5 to 3 millimeter diameter, glass samples. The measured critical cooling rate for glass formation, R(sub c), for the LS2 and LS2+0.001 wt% Pt glasses processed at ESL were 14 plus or minus 2 Celsius per minute and 130 plus or minus 5 Celsius per minute, respectively. The values of R(sub c), for the same LS2 and LS2 + 0.001 wt% Pt glasses processed in a container were 62 plus or minus 3 Celsius per minute and 162 plus or minus 5 Celsius per minute, respectively. The effective activation energy for crystallization, E, for this LS2 glass processed without a container at ESL, 392 plus or minus 15 kiloJoules per mole, was higher than that, 270 plus or minus 15 kiloJoules per mole, for an identical glass processed in a container. These results suggest that the glass formation tendency for a containerless LS2 melt is significantly increased compared to an identical melt in contact with a container. The absence of heterogeneous nucleation sites that are inherently present in all melts held in containers, and or a change in the surface composition due to evaporation of Li2O during processing at ESL are likely reasons for the increased glass forming tendency of this containerless LS2 melt.
Author
*Glass; Lithium Oxides; Silicates; Doped Crystals; Containerless Melts*

**20040085933** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Step and Kink Dynamics in Inorganic and Protein Crystallization**
Chernov, A. A.; Rashkovich, L. N.; Vekilov, P. G.; DeYoreo, J. J.; [2004]; 1 pp.; In English
Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

Behavior of low-kink-density steps in solution growth and consequences for general understanding of spiral crystal growth processes will be overviewed. Also, influence of turbulence on step bunching and possibility to diminish this bunching will be presented.
Author
*Protein Crystal Growth; Crystallization; Dynamic Control; Inorganic Chemistry*

**20040086060** NASA Langley Research Center, Hampton, VA, USA
**Evaluation of New Actuators in a Buffet Loads Environment**
Moses, Robert W.; Wieseman, Carol D.; Bent, Aaron A.; Pizzochero, Alessandro E.; [2001]; 12 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

Ongoing research in buffet loads alleviation has provided an application for recently developed piezoelectric actuators capable of higher force output than previously existing actuators could provide and that can be embedded within the vehicle s structure. These new actuators, having interdigitated electrodes, promise increased performance over previous piezoelectric actuators that were tested on the fin of an F/A-18 aircraft. Two new actuators being considered by the USA Air Force to reduce buffet loads on high performance aircraft were embedded into the fins of an F/A-18 wind-tunnel model and tested in the Transonic Dynamics Tunnel at the NASA Langley Research Center. The purpose of this test program, called ENABLE (Evaluation of New Actuators in a Buffet Loads Environment), was to examine the performance of the new actuators in alleviating fin buffeting, leading to a systems -level study of a fin buffet loads alleviation system architecture being considered by the USAF, Boeing, and NASA for implementation on high performance aircraft. During this windtunnel test, the two actuators performed superbly in alleviating fin buffeting. Peak values of the power spectral density functions for tip acceleration were reduced by as much as 85%. RMS values of tip acceleration were reduced by as much as 40% while using less than 50% of the actuators capacity. Details of the wind-tunnel model and results of the wind-tunnel test are provided herein.
Derived from text
*Actuators; Buffeting; Transonic Wind Tunnels; Aerodynamic Loads; Spectra; Supersonic Aircraft; Piezoelectric Actuators*

## 80
## 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*.

**20040085512** Parker-Hannifin Corp., Dublin, GA, USA
**Are Four Year Universities Better than Two-Year Colleges at Preparing Students to Pass the FAA Aircraft Mechanic Certification Written Examinations?**
Summey, Jeffrey Bruce; Schultz, Marian C.; Schultz, James T.; Journal of Air Transportation, Volume 9, No. 1; 2004, pp. 3-20; In English; See also 20040085511; Copyright; Avail: CASI; A03, Hardcopy

This study evaluates differences between two-year and four-year schools offering a Federal Aviation Administration (FAA) Part 147 aviation maintenance technician program. The actual average test scores were analyzed to determine whether students from four-year university programs were better prepared for the test than students from two-year college or technical school programs. Test scores can be viewed as a direct indication of the quality of the aviation maintenance programs at these schools. The study found that there was no statistically significant difference in the test scores between two-year college and four-year university students taking the FAA examinations. These results support previous studies that found the learning outcomes of two-year and four-year students on general subjects to be comparable.
Author
*Aircraft Maintenance; Students; Universities; Training Evaluation; Education*

**20040085515** University of Southern Illinois, Carbondale, IL, USA
**Perceptions of Communication Training Among Collegiate Flight Educators**
Ruiz, Lorelei; Journal of Air Transportation, Volume 9, No. 1; 2004, pp. 36-57; In English; See also 20040085511; Copyright; Avail: CASI; A03, Hardcopy

This paper reports on the opinions of educators regarding communication training in University Aviation Association (UAA) member collegiate aviation flight programs. Educators representing 37 UAA member flight programs indicated their levels of agreement with a battery of statements regarding communication training on a five-point Likert scale. Chi square and Mann-Whitney analysis of responses indicates that these educators agree on the importance of communication skills, the purpose of written assignments, and their institution's preparation of students to communicate effectively in industry. Opinions are more varied regarding the integration of more communication assignments and the willingness of institutions to compensate those instructors who choose to incorporate such assignments.
Author
*Education; Universities; Instructors; Pilot Training; Verbal Communication*

## 81
## ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**20040085516** Purdue Univ., West Lafayette, IN, USA
**Ethics Education in University Aviation Management Programs in the U.S., Part 3, Qualitative Analysis and Recommendations**
Oderman, Dale B.; Journal of Air Transportation, Volume 9, No. 1; 2004, pp. 58-85; In English; See also 20040085511; Copyright; Avail: CASI; A03, Hardcopy

This three-part study examined how four-year U.S. universities with baccalaureate programs in aviation management include ethics instruction in their curricula. Part One justified the need for ethics education and developed hypotheses to evaluate the status of ethics instruction. Statistical tests in Parts Two A and Two B established that ethics is not widely included in aviation curricula. Part Three continues by probing for deeper understanding of current practice. It was found that little is being done to increase ethics instruction, as no sense of urgency exists to bring about change. Recommendations to improve ethics coverage include proactive involvement of those currently interested in the subject, cooperative relationships between academia and the aviation industry, and a phased program to increase the level of ethics inclusion in aviation curricula. Ideas for future study are suggested.
Author
*Ethics; Aerospace Industry; Education; Industrial Management*

**20040085714** NASA Stennis Space Center, Bay Saint Louis, MS, USA
**NASA Scientific Data Purchase**
Davis, Bruce; Policelli, Fritz; Zanoni, Vicki; Frisbie, Troy; March 19, 2002; 31 pp.; In English; JACIE High Spatial Resolution Commercial Imagery Workshop, 25-27 Mar. 2002, Reston, VA, USA
Report No.(s): SE-2002-03-00026-SSC; No Copyright; Avail: CASI; A03, Hardcopy

The paper discusses the following: 1. 50 Million ,Appropriation - Acquire science data from commercial sources. 2. Demonstration Project - Test new way of doing business. Tap new sources of data. Support Earth science research. Support commercial remote sensing industry. 3. Phase I - Review simulated/prototypical datasets (10 companies). 4. Phase II - 3-year purchase/distribution of select data (5 companies). 5. FY01 $20M Appropriation - Commercial Imagery Office Proposed continuation and new contracts.
Derived from text
*Appropriations; Space Commercialization; Earth Sciences*

**20040085986** NASA Langley Research Center, Hampton, VA, USA
**Risk-Based Prioritization of Research for Aviation Security Using Logic-Evolved Decision Analysis**
Eisenhawer, S. W.; Bott, T. F.; Sorokach, M. R.; Jones, F. P.; Foggia, J. R.; [2004]; 10 pp.; In English; 22 International System Safety Conference, 2-6 Aug. 2004, Providence, RI, USA
Contract(s)/Grant(s): 23-728-06-03; No Copyright; Avail: CASI; A02, Hardcopy

The National Aeronautics and Space Administration is developing advanced technologies to reduce terrorist risk for the

air transportation system. Decision support tools are needed to help allocate assets to the most promising research. An approach to rank ordering technologies (using logic-evolved decision analysis), with risk reduction as the metric, is presented. The development of a spanning set of scenarios using a logic-gate tree is described. Baseline risk for these scenarios is evaluated with an approximate reasoning model. Illustrative risk and risk reduction results are presented.
Author
*Decision Theory; Risk; Security*

**20040086473** NASA Langley Research Center, Hampton, VA, USA
**First-Order Frameworks for Managing Models in Engineering Optimization**
Alexandrov, Natlia M.; Lewis, Robert Michael; [2000]; 16 pp.; In English; 1st International Workshop on Surrogate Modelling and Space Mapping for Engineering Opt., 16-19 Nov. 2000, Denmark
Contract(s)/Grant(s): NAS1-97046; No Copyright; Avail: CASI; A03, Hardcopy

Approximation/model management optimization (AMMO) is a rigorous methodology for attaining solutions of high-fidelity optimization problems with minimal expense in high- fidelity function and derivative evaluation. First-order AMMO frameworks allow for a wide variety of models and underlying optimization algorithms. Recent demonstrations with aerodynamic optimization achieved three-fold savings in terms of high- fidelity function and derivative evaluation in the case of variable-resolution models and five-fold savings in the case of variable-fidelity physics models. The savings are problem dependent but certain trends are beginning to emerge. We give an overview of the first-order frameworks, current computational results, and an idea of the scope of the first-order framework applicability.
Author
*Models; Engineering Management; Methodology*

**20040086532** Boeing Commercial Airplane Co., Renton, WA, USA
**COMSAC Feedback: Boeing Commercial Airplanes**
Ball, Douglas N.; COMSAC: Computational Methods for Stability and Control, Part 2; April 2004, pp. 730-732; In English; See also 20040086515; No Copyright; Avail: CASI; A01, Hardcopy

This viewgraph presentation lists areas of concern and steps for moving forward, with an emphasis on metrics, plans, and a 'black program' work environment.
Author
*Boeing Aircraft; Commercial Aircraft*

## 82
## DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer program documentation see *61 Computer Programming and Software*.

**20040085535** General Accounting Office, Washington, DC
**Defense Acquisitions: The Global Information Grid and Challenges Facing Its Implementation**
Jul. 2004; 42 pp.; In English
Report No.(s): PB2004-106202; GAO-04-858; No Copyright; Avail: CASI; A03, Hardcopy

The Department of Defense (DOD) is in the midst of transforming military capabilities. The transformation relies in part on the Global Information Grid (GIG), which is focused on building a new Internet-like network capability that DOD envisions will enable weapons and other systems and people to share information quickly, allowing warfighters to identify threats more effectively and to respond with greater precision and lethality. DOD plans to spend at least $21 billion through 2010 to build a core GIG capability. GAO was asked (1) to describe the GIG, including the concept, key acquisitions, and implementation and (2) to identify significant challenges facing DOD in implementing the GIG.
NTIS
*Defense Program; Grid Computing (Computer Networks)*

**20040085691** NASA Langley Research Center, Hampton, VA, USA
**NASA Patent Abstracts Bibliography: A Continuing Bibliography, Supplement 64**
August 2004; 56 pp.; In English
Report No.(s): NASA/SP-2004-7039/SUPPL64; No Copyright; Avail: CASI; A04, Hardcopy

Several thousand inventions result each year from research supported by the National Aeronautics and Space Administration. NASA seeks patent protection on inventions to which it has title if the invention has important use in government programs or significant commercial potential. These inventions cover a broad range of technologies and include many that have useful and valuable commercial application. NASA inventions best serve the interests of the USA when their benefits are available to the public. In many instances, the granting of nonexclusive or exclusive licenses for the practice of these inventions may assist in the accomplishment of this objective. This bibliography is published as a service to companies, firms, and individuals seeking new, licensable products for the commercial market. The NASA Patent Abstracts Bibliography is a semiannual NASA publication containing comprehensive abstracts of NASA-owned inventions covered by U.S. patents. The citations included were originally published in NASA's Scientific and Technical Aerospace Reports (STAR) and cover STAR announcements made since May 1969. The citations published in this issue cover the period September 2003 through June 2004. The range of subjects covered includes the NASA Scope and Subject Category Guides 10 broad subject divisions separated further into 76 specific categories. However, not all categories have citations during the dates covered for this issue, therefore the Table of Contents does not include all divisions and categories. This scheme was devised in 1975 and revised in 1987 and 2000 in lieu of the 34 category divisions which were utilized in supplements (01) through (06) covering STAR abstracts from May 1969 through January 1974. Each entry consists of a citation accompanied by an abstract and, when appropriate, a key illustration taken from the patent or application for patent. Entries are arranged by subject category in ascending order.
Derived from text
*Bibliographies; Patent Policy; NASA Programs; Technology Utilization*

**20040086044** Chemonics International, Inc., Washington, DC, USA
**Achievement of Market-Friendly Initiatives and Results Program (AMIR 2.0 Program). Intelligence and Information Management in Jordan Customs**
Dec. 2003; 64 pp.; In English
Report No.(s): PB2004-106910; PN-ACX-227; No Copyright; Avail: CASI; A04, Hardcopy

The objective of the consultancy was to develop intelligence capability while integrating intelligence into planning and operational practices in Jordan Customs, specifically in the Risk Management and Border management areas. After extensive information management and intelligence capability research, Jordan Customs executives accepted all the recommendations of the consultant in late 2002 and granted subsequent planning approval in early 2003 for the creation of a Jordan Customs Intelligence function. The consultant formulated intelligence competencies and designed analyst training programs that he delivered to the Customs Intelligence Unit and other analysts in July 2003. The consultant also designed and delivered further intelligence planning and training programs to staff in the Aqaba Special Economic Zone (not part of this scope of work) in August 2003 to complement the integrated national approach to information management principles in Jordan.
NTIS
*Economics; Information Management; Intelligence; Procedures*

**20040086458** University of Southern California, Marina del Rey, CA
**Scalable Coordination Architectures for Deeply Distributed Systems (SCADDS)**
Estrin, Deborah; Heidemarm, John; Govindan, Ramesh; Jul. 8, 2004; 23 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DABT63-99-1-0011
Report No.(s): AD-A424528; No Copyright; Avail: CASI; A03, Hardcopy

The SCADDS project explored and demonstrated scalable coordination mechanisms for deeply distributed and dynamic systems. Nodes in these systems were heterogeneous, having a range of sensing, actuation and communication capabilities. These systems raised many challenges for distributed system and network design. The first was a shift from node-centric, to data-centric network architecture. Both scalability and long lifetime called for extensive processing of data within and among the nodes of the sensor network. Rather than streaming all sensor readings back to a central site for processing, nodes autonomously exchanged data, filtered out uninteresting events, and identified patterns of interest. The second challenge was to build systems that were truly self-configuring; able to adapt efficiently to ad hoc deployment and both environmental and network dynamics. This paradigm shift required new network architecture.
DTIC
*Coordination*

**20040086501** Old Dominion Univ., Norfolk, VA, USA
**Structured Course Objects in a Digital Library**
Maly, K.; Zubair, M.; Liu, X.; Nelson, M.; Zeil, S.; [1999]; 8 pp.; In English; Copyright; Avail: CASI; A02, Hardcopy

We are developing an Undergraduate Digital Library Framework (UDLF) that will support creation/archiving of courses and reuse of existing course material to evolve courses. UDLF supports the publication of course materials for later instantiation for a specific offering and allows the addition of time-dependent and student-specific information and structures. Instructors and, depending on permissions, students can access the general course materials or the materials for a specific offering. We are building a reference implementation based on NCSTRL+, a digital library derived from NCSTRL. Digital objects in NCSTRL+ are called buckets, self-contained entities that carry their own methods for access and display. Current bucket implementations have a two level structure of packages and elements. This is not a rich enough structure for course objects in UDLF. Typically, courses can only be modeled as a multilevel hierarchy and among different courses, both the syntax and semantics of terms may vary. Therefore, we need a mechanism to define, within a particular library, course models, their constituent objects, and the associated semantics in a flexible, extensible way. In this paper, we describe our approach to define and implement these multilayered course objects. We use XML technology to emulate complex data structures within the NCSTRL+ buckets. We have developed authoring and browsing tools to manipulate these course objects. In our current implementation a user downloading an XML based course bucket also downloads the XML-aware tools: an applet that enables the user to edit or browse the bucket. We claim that XML provides an effective means to represent multi-level structure of a course bucket.
Author
*Data Structures; Document Markup Languages; Libraries; Training Devices*

## 83
## ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

**20040085514** Colorado Univ., Denver, CO, USA
**Assessing Perceived Risk of Consumers in Internet Airline Reservations Services**
Cunningham, Lawrence F.; Gerlach, James; Harper, Michael D.; Journal of Air Transportation, Volume 9, No. 1; 2004, pp. 21-35; In English; See also 20040085511; Copyright; Avail: CASI; A03, Hardcopy

This research investigates the premise that the use of Internet airline reservation systems is perceived to be riskier than traditional airline reservation systems. Unlike previous studies on perceived risk that typically focused on the relationship of perceived risk and information search, this study examines the dynamics of perceived risk throughout the various stages of the consumer buying process. A survey of 159 respondents reveals that perceived risk for both traditional and Internet airline reservation services follows a systematic pattern throughout the consumer buying process. Perceived risk for both traditional and Internet airline reservation systems falls during information search but recovers and rapidly increases as consumers approach the moment of purchase. When viewed as a dynamic process, perceived risk for Internet airline reservation services shows more radical changes in risk levels than the traditional service. Another major finding of this study is the discovery of a risk premium for Internet airline reservation services that permeates all stages of the consumer buying process.
Author
*Airline Operations; Consumers; Risk; Electronic Commerce; Internets*

## 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.

**20040086017** NASA Goddard Space Flight Center, Greenbelt, MD, USA
**NASA/NOAA Electronic Theater: 90 Minutes of Spectacular Visualization**
Hasler, A. F.; [2004]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The NASA/NOAA Electronic Theater presents Earth science observations and visualizations from space in a historical perspective. Fly in from outer space to Ashville and the Conference Auditorium. Zoom through the Cosmos to SLC and site of the 2002 Winter Olympics using 1 m IKONOS 'Spy Satellite' data. Contrast the 1972 Apollo 17 'Blue Marble' image of the Earth with the latest US and International global satellite images that allow us to view our Planet from any vantage point. See the latest spectacular images from NASA/NOAA remote sensing missions like Terra, GOES, TRMM, SeaWiFS, &

Landsat 7, of storms & fires like Hurricane Isabel and the LA/San Diego Fire Storms of 2003. See how High Definition Television (HDTV) is revolutionizing the way we do science communication. Take the pulse of the planet on a daily, annual and 30-year time scale. See daily thunderstorms, the annual blooming of the northern hemisphere land masses and oceans, fires in Africa, dust storms in Iraq, and carbon monoxide exhaust from global burning. See visualizations featured on Newsweek, TIME, National Geographic, Popular Science covers & National & International Network TV. Spectacular new global visualizations of the observed and simulated atmosphere and Oceans are shown. See the currents and vortexes in the Oceans that bring up the nutrients blooms in response to El Nino/La Nina climate changes. The Etheater will be presented using the latest High Definition TV (HDTV) and video projection technology on a large screen. See the global city lights, and the great NE US blackout of August 2003 observed by the 'night-vision' DMSP satellite.
Author
*Satellite Imagery; Scientific Visualization; Educational Television; Earth Observations (From Space); High Definition Television*

## 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*.

**20040086474** NASA Langley Research Center, Hampton, VA, USA
**Aeroassist Technology Planning for Exploration**
Munk, Michelle M.; Powell, Richard W.; [2000]; 11 pp.; In English
Report No.(s): AAS-00-169; No Copyright; Avail: CASI; A03, Hardcopy

Now that the International Space Station is undergoing assembly, NASA is strategizing about the next logical exploration strategy for robotic missions and the next destination for humans. NASA's current efforts are in developing technologies that will both aid the robotic exploration strategy and make human flight to other celestial bodies both safe and affordable. One of these enabling technologies for future robotic and human exploration missions is aeroassist. This paper will (1) define aeroassist, (2) explain the benefits and uses of aeroassist, and (3) describe a method, currently used by the NASA Aeroassist Working Group, by which widely geographically distributed teams can assemble, present, use, and archive technology information.
Author
*Aeroassist; International Space Station; NASA Space Programs; Space Exploration; Technological Forecasting*

## 89
## ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

**20040085480** Johns Hopkins Univ., Baltimore, MD, USA
**The Physical Properties of Intracluster Gas at z \g 1**
Rosati, Piero; Ford, Holland C.; July 06, 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-10176; No Copyright; Avail: CASI; A01, Hardcopy

We have used XMM-Newton, Chandra and HST/ACS data on one of the most distant clusters known to date, RDCS1252-29 at z= 1.24, to measure the mass of its baryonic and dark components for the first time at these large redshifts. By comparing physical properties of cluster galaxies and of the X-ray emitting intra-cluster medium (including the iron abundance) with those in low-redshift clusters, we have found that little evolution has taken place over 60% of the lifetime of the Universe. This suggests that most of the stars formed at z\gapprox.3 and metal enrichment processes took place early in the evolutionary history of galaxy clusters. These findings have a strong bearing on galaxy and cluster evolution models.
Author
*Galactic Clusters; Intergalactic Media; Red Shift; Cosmic Gases; Galaxies; Iron*

**20040085488** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**X Persei: The X-Ray Halo and Spectrum of a High-Latitude X-Ray Binary**
Mushotzky, Richard, Technical Monitor; Smith, Randall; July 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-13180; No Copyright; Avail: CASI; A01, Hardcopy

The observations were completed on February 25,2003. Although the source was in the FOV for 31.4 ksec, only 18.2 ksec of data were usable due to a strong flare in the first part of the observations. We have extracted the X-ray halo from the good portion of the data, and were then faced with the problem of calibrating the far-off-axis point spread function, which is needed only for X-ray halo analysis; the same problem affected Chandra halo observations. We used data from 3C273, MCG 6-30-15, LMC X-1, and Her X-1 to measure the PSF, and found that it is reasonably well fit with a power law of the form PSF(theta) = A theta^-G, where A = 0.0034 arcmin^-2, and G = 3.05 for energies between 1-4 keV. This suggests there are fewer large dust grains along the When fitting the spectrum of X Persei, we found NH = 3e21 cm^-2, as expected. However, the X-ray halo (using a Mathis, Rumpl, Nordsieck 1977 dust model) required at most a column density of 1.4+/-0.1 e21 cm^-2; other models required sightline to X Per than would have been expected. In addition, a smoothly distributed dust model fit the observations better than a single cloud model, also against our expectations. We are in the process of writing a paper to be submitted to ApJ with these results, and will also present them at the 2004 HEAD meeting in New Orleans.
Author
*X Ray Binaries; Atmospheric Models; Halos; O Stars; Calibrating; Clouds (Meteorology)*

**20040085500** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**The Mass of the Classical Cepheid S Mus**
Sonneborn, George, Technical Monitor; Evans, Nancy, Technical Monitor; August 2004; 6 pp.; In English
Contract(s)/Grant(s): NAG5-11946; No Copyright; Avail: CASI; A02, Hardcopy

A FUSE spectrum of the hot companion of the Cepheid S Mus has been obtained, reduced and analysed. Since the determination of the temperature of S Mus B is the prime goal of this program, we have identified two regions in the spectrum which are temperature sensitive in the temperature range of the companion, but which are not overly affected by molecular hydrogen absorption. From comparison of the spectrum with spectra of stars of known temperature, we have determined the temperature of the companion to be 17,000 K. From this a mass has been inferred. Combining this mass with the orbital velocity ratio of the Cepheid and the companion (from the ground-based Cepheid orbit, and HST GHRS echelle observations), the mass of the Cepheid is determined to be 6.0 =/- 0.4 solar masses. The results have been presented at a conference (conference proceedings in press--see attachment).
Author
*Stellar Spectra; Molecular Gases; Maximum Usable Frequency; Hydrogen; Stellar Mass*

**20040085799** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The Sun and the Heliosphere as an Integrated System**
Poletto, Giannina; Suess, Steven T.; January 2004; 1 pp.; In English; Copyright; Avail: Other Sources

This book, for the first time, ties together physical processes across the full scale of the heliosphere. It is about the natural connections that exist between various parts of the system. Therefore, it is mainly cast in terms of those mechanisms and phenomena rather than individual missions in space. However, to give credit, this has only been possible because of the existence of a fleet of deep space missions such as Ulysses, SOHO, and the Voyagers. It is only with them working in concert that a real understanding of the physics can be, and has been achieved. There are fourteen chapters in the book, written by top scientists from around the world. The level of presentation is very high but the authors were given enough space to present understandable introductions, physical discussions, and extensive bibliographies. The book can be of use to average scientists and academicians as well as to specialists.
Derived from text
*Heliosphere; Sun; Systems Integration*

**20040085900** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Evidence for Hot Plasma after CME events from Remote and In Situ Observations**
Poletto, G.; Suess, S. T.; Bemporad, A.; Schwadron, N.; Elliott, H. A.; Zurbuchen, T.; Ko, Y.; [2004]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

We present here evidence for highly ionized Fe observed both in the corona, in the aftermath of a CME, and, after propagation, {\it in situ}. The apparent source temperature is $\g$6 MK. To our knowledge, this is the first time that such an

unambiguous identification has been made. This detection complements studies correlating other properties of plasma observed {\it in situ} to the same properties of the same plasma remotely observed at its source in the corona.
Author
*High Temperature Plasmas; Coronas*

**20040085924** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Unraveling the Cooling Trend of the Soft Gamma Repeater SGR 1627-41**
Kouveliotou, C.; Eichler, D.; Woods, P. M.; Lyubarsky, Y.; Patel, S. K.; Gogus, E.; vanderKlis, M.; Tennant, A.; Wachter, S.; Hurley, K.; The Astrophysical Journal; October 10, 2003; Volume 596, pp. L79-L82; In English
Contract(s)/Grant(s): NAG5-9350; SAO-GO1-2066X; Copyright; Avail: Other Sources

SGR 1627-41 was discovered in 1998 after a single active episode that lasted approximately 6 weeks. We report here our monitoring results of the decay trend of the persistent X-ray luminosity of the source during the last 5 years. We find an initial temporal power-law decay with index 0.47, reaching a plateau that is followed by a sharp (factor of 10) flux decline approximately 800 days after the source activation. The source spectrum is best described during the entire period by a single power law with high absorption [N(sub H) = 9.0(7) x 10(exp 22) per square centimeter]; the spectral index, however, varies dramatically between 2.2 and 3.8 spanning the entire range for all known soft gamma repeater sources. We discuss the cooling behavior of the neutron star assuming a deep crustal heating initiated by the burst activity of the source during 1998.
Author
*Cooling; Soft Gamma Repeaters; Gamma Ray Astronomy; Stellar Luminosity*

**20040085925** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Probing a GRB Progenitor at a Redshift of z=2: A Comprehensive Observing Campaign of the Afterglow of GRB 030226l**
Klose, S.; Greiner, J.; Rau, A.; Henden, A. A.; Hartmann, D. H.; Zeh, A.; Ries, C.; Masetti, N.; Malesani, D.; Guenther, E., et al.; [2004]; 3 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

We report results from a comprehensive optical/near-infrared follow-up observing campaign of the afterglow of GRB 030226, including VLT spectroscopy and polarimetry, supplemented by Chandra X-ray and BOOTES-1 rapid response observations. First observations at ESO started 0.2 days after the burst when the afterglow was at a magnitude of R approx. 19. The multi-color light curve of the afterglow, with a break around 1 day after the burst, is achromatic within the observational uncertainties even during episodes of short-term fluctuations. Close to the break time the degree of linear polarization of the afterglow light was less than 1.1%, consistent with low intrinsic polarization observed in other afterglows. VLT spectra show a foreground absorber of Mg II at a redshift z=1.042 and two absorption line systems at redshifts z=1.962+/-0.001 and at z=1.986+/-0.001, placing the lower limit for the redshift of the GRB close to 2. The kinematics and the composition of the absorbing clouds is very similar to those observed in the afterglow of GRB 021004, supporting the view that at least some GRBs are physically related to the explosion of a Wolf-Rayet star.
Author
*Gamma Rays; Wolf-Rayet Stars; Gamma Ray Bursts; A Stars; Near Infrared Radiation; Red Shift; Line Spectra; Linear Polarization*

**20040086049** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The Energy Spectra of Proton and Helium Measured from the ATIC Experiment**
Ahn, H. S.; Seo, E. S.; Adams, J. H.; Bashindzhagyan, G. L.; Batkov, K. E.; Chang, J.; Christl, M.; Fazely, A. R.; Ganel, O.; Gunasingha, R. M., et al.; [2004]; 1 pp.; In English; 35th COSPAR Scientific Assembly, 18-25 Jul. 2004, Paris, France; Copyright; Avail: Other Sources; Abstract Only

The Advanced Thin Ionization Calorimeter (ATIC) balloon experiment is designed to investigate the composition and energy spectra of cosmic rays at the highest energies currently accessible from direct measurements, the region up to 100 TeV. The instrument consists of a silicon matrix for charge measurement, a graphite target (0.75 nuclear interaction length) to induce hadronic fragmentation, 3 scintillator strip hodoscopes for triggering and helping reconstruct trajectory, and a BGO calorimeter (18 radiation lengths) to measure the energy of incident particles. ATIC had two successful Long Duration Balloon (LDB) flights from McMurdo, Antarctica: from 12/28/00 to 01/13/01 and from 12/29/02 to 01/18/03. We present the energy spectra of proton and helium extracted from the ATIC flights, over the energy range from 100 GeV to 100 TeV, and compare

them with the results from other experiments at both the lower and higher energy ends.
Author
*Calorimeters; Energy Spectra; Helium; Ionization; Protons*

**20040086434** Space Telescope Science Inst., Baltimore, MD, USA
**Simultaneous FUSE, HST, and Chandra Observations or Intrinsic Absorbers in NGC 7469 and MRK 279**
Sonneborn, George, Technical Monitor; Kriss, Gerard A.; August 12, 2004; 3 pp.; In English
Contract(s)/Grant(s): NAG5-12147; STScI Proj. J0381; No Copyright; Avail: CASI; A01, Hardcopy

We obtained FUSE observations of NGC 7469 on 2002 Dec 13 & 14. The two exposures totaled only 7 ks. The observations only have good data in one channel, LiF1, due to channel alignment problems. These observations were obtained simultaneously with high-quality HST/STIS and Chandra HETG spectra. The previously known O VI absorption lines in the FUSE spectrum are detected at good signal to noise ratio, and a wide array of other intrinsic absorption lines are visible in the X-ray spectrum and in the STIS spectrum. Compared to prior FUSE observations, the continuum flux for this observation was 50% lower. We see the effects of this in the lowest-velocity O VI absorber, which we associate with the X-ray absorbing gas also detected in this object. This O VI absorber has only a 50% covering fraction, consistent with its covering only the continuum in this source, and its strength and inferred column density increased as the continuum flux of NGC 7469 decreased. This is consistent with the recombination expected from photoionization models of the highly ionized gas. We obtained FUSE observations of Mrk 279 on 2002 May 18. As for NGC 7469, channel alignment problems led to good data being present only in LiFl. While we obtained a much longer integration on the target than planned (47.4 ks vs. 31 ks requested), the UV flux was down a factor of 10 or more from previous HST and FUSE observations, and our wavelength coverage was restricted due to the channel alignment problems. These data still cover the important O VI emission line and absorption lines in Mrk 279. The FUSE flux also agrees well with the simultaneous HST STIS data, which have good signal to noise. We have also analyzed FUSE observations made at three earlier epochs. We detect the Fe K-alpha emission line in the Chandra spectrum, and its flux is consistent with the low X-ray continuum flux level of Mrk 279 at the time of the observation. Because of low signal-to-noise ratios (S/N) in the Chandra spectrum, no O VII or O VIII absorption features are observable in the Chandra data, but the UV spectra reveal strong and complex absorption from H I and high-ionization species such as O VI, N V, and C IV, as well as from low-ionization species such as C III, N III, C II, and N II in some velocity components. The far-UV spectral coverage of the FUSE data provides information on high-order Lyman series absorption, which we use to calculate the optical depths and line and continuum covering fractions in the intrinsic H I absorbing gas in a self-consistent fashion. Based on the velocities, profile shapes, covering fractions and variability of the UV absorption, we conclude that some of the absorption components, particularly those showing prominent low-ionization lines, are likely associated with the host galaxy of Mrk 279, and possibly with its interaction with a close companion galaxy, while the remainder arises in a nuclear outflow.
Author
*X Ray Astrophysics Facility; Hubble Space Telescope; Far UV Spectroscopic Explorer; Absorbers; Seyfert Galaxies*

**20040086477** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Observations of X-ray Afterglows**
Kouveliotou, Chryssa; [2004]; 1 pp.; In English; Workshop on Gamma-Ray Bursts and Supernovae Connection, 5-7 Jul. 2004, Seattle, WA, USA; No Copyright; Avail: Other Sources; Abstract Only

Discussion of X-ray studies of the environs of Gamma Ray Burst (GRB) associated Supernovae using the Chandra and XMM X-Ray Observatories, in particular the long term evolution of their X-ray afterglow lightcurves. For SN 1998bw, we have combined all available observations and derived a smooth X-ray light curve spanning -1300 days, assuming that GRB 980425 and SN 1998bw were coincident at 35.6 Mpc. Perform comparison of this X-ray light curve with those of the X-ray afterglows of ordinary GRBs, X-ray Flashes, and ordinary supernovae, and discuss the emerging evidence for at least two classes of lightcurves, perhaps bounding a continuum. By three to ten years, all these phenomena seem to converge on a common X-ray luminosity, possibly indicative of the supernova underlying them all. One possible explanation for the two classes is a (nearly) standard GRB observed at different angles. If this interpretation is correct, X-ray afterglows with intermediate luminosities should eventually be discovered; GRB 03 1203 maybe just such a case.
Author
*Afterglows; Gamma Ray Bursts; Supernovae; X Ray Astronomy*

## 90
## ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

**20040085475** Colorado Univ., Colorado Springs, CO, USA
**FUSE Cycle 3 Program CO22: Chromospheric Activity in Population II Giants**
Harper, Graham M.; August 1, 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-12210
Report No.(s): CU-1535515; No Copyright; Avail: CASI; A01, Hardcopy

One of the mysteries of Population II giants is that they still show chromospheric emission despite their great age. The global dynamo which was active during their main-sequence lifetimes is expected to become extremely weak through magnetic rotational braking. The nature of the observed emission is not understood; although acoustic shock waves might provide the heating, acoustic waves are not predicted to drive the observed mass loss - which in turn requires the dissipation of magneto-hydrodynamic waves. This program was designed to search for the faint stellar H Ly(beta) emission wings and the fluorescent Fe II and H2 emission from one of the brightest, metal poor, Population II stars. These FUSE diagnostics, when combined with existing UV and optical spectra, help determine the major radiative cooling channels for the chromosphere. This observation was to complement that previously planned for the mildly metal deficient giant alpha Boo (K2 III). However, a Boo has yet to be observed with FUSE.
Derived from text
*Emission Spectra; Hydrogen; Fluorescence*

**20040085477** Clemson Univ., SC, USA
**History of the Nuclei Important for Cosmochemistry**
Meyer, Bradley S.; [2004]; 7 pp.; In English
Contract(s)/Grant(s): NAG5-10454; No Copyright; Avail: CASI; A02, Hardcopy

An essential aspect of studying the nuclei important for cosmochemistry is their production in stars. Over the grant period, we have further developed the Clemson/American University of Beirut stellar evolution code. Through use of a biconjugate-gradient matrix solver, we now routinely solve l0(exp 6) x l0(exp 6) sparse matrices on our desktop computers. This has allowed us to couple nucleosynthesis and convection fully in the 1-D star, which, in turn, provides better estimates of nuclear yields when the mixing and nuclear burning timescales are comparable. We also have incorporated radiation transport into our 1-D supernova explosion code. We used the stellar evolution and explosion codes to compute iron abundances in a 25 Solar mass star and compared the results to data from RIMS.
Derived from text
*Cosmochemistry; Nuclear Fusion; Stellar Mass; Stellar Evolution*

**20040085479** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**An Evolving Trio of Hybrid Stars: C 111**
Oliversen, Ronald, Technical Monitor; Dupree, Andrea K.; July 2004; 5 pp.; In English
Contract(s)/Grant(s): NAG5-12478; No Copyright; Avail: CASI; A01, Hardcopy

Our goal is to understand the behavior of the outer atmosphere in this intermediate stage to create a comprehensive picture of atmospheric evolution. In the hybrid phase, the large-scale magnetic dynamo activity decays and hydrodynamic processes assume importance. Some hot plasma is still confined close to the star by magnetic loops, yet the confining field is breaking open, the atmosphere can escape through these open field lines, and the diffuse corona may be warm. There may well be a more extended and variable transition process. It remains for FUSE to identify the controlling parameters of the hybrid stars. It shows the positions of our 3 targets in the color-magnitude diagram where it is seen that they are at the extreme end of the hybrid region. Originally we had been awarded the hybrid star Iota Aur, but due to newly imposed pointing constraints of FUSE, that target was not accessible. And so we substituted Iota Dra, a giant of mass similar to our other targets but less evolved. In addition, Iota Dra was recently found to harbor a sub-stellar objects, possibly a planet, and so it could reveal the stellar environment of the planet. This substitution was accepted.
Derived from text
*Magnetic Variations; Solar Magnetic Field; High Temperature Plasmas; Atmospheric Chemistry; Evolution (Development)*

**20040085481** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**Coronal Structures in Cool Stars**
Oliversen, Ronald, Technical Monitor; Dupree, Andrea K.; July 2004; 4 pp.; In English
Contract(s)/Grant(s): NAG5-11093
Report No.(s): SAO-16613385; No Copyright; Avail: CASI; A01, Hardcopy

Many papers have been published that further elucidate the structure of coronas in cool stars as determined from EUVE, HST, FUSE, Chandra, and XMM-Newton observations. In addition we are exploring the effects of coronas on the He I 1083081 transition that is observed in the infrared. Highlights of these are summarized below including publications during this reporting period and presentations. Ground-based magnetic Doppler imaging of cool stars suggests that active stars have active regions located at high latitudes on their surface. We have performed similar imaging in X-ray to locate the sites of enhanced activity using Chandra spectra. Chandra HETG observations of the bright eclipsing contact binary 44i Boo and Chandra LETG observations for the eclipsing binary VW Cep show X-ray line profiles that are Doppler-shifted by orbital motion. After careful analysis of the spectrum of each binary, a composite line-profile is constructed by adding the individual spectral lines. This high signal-to-noise ratio composite line-profile yields orbital velocities for these binaries that are accurate to 30 km/sec and allows their orbital motion to be studied at higher time resolutions. In conjunction with X-ray lightcurves, the phase-binned composite line-profiles constrain coronal structures to be small and located at high latitudes. These observations and techniques show the power of the Doppler Imaging Technique applied to X-ray line emission.
Derived from text
*Cool Stars; Coronas; Helium Isotopes; Imaging Techniques; Infrared Radiation*

**20040085504** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**Environmental Effects on the Metallicities of Early-Type Galaxies**
Jones, Christine; Oliversen, Ronald, Technical Monitor; July 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-9096; No Copyright; Avail: CASI; A01, Hardcopy

We completed and published two papers in the Astrophysical Journal based on research from grant. In the first paper we analyzed nine X-ray-bright Virgo early-type galaxies observed by both ASCA and ROSAT. Through spatially resolved spectroscopy, we determined the radial temperature profiles and abundances of Mg, Si, and Fe for six galaxies. The temperature profiles are consistent with isothermal temperatures outside of cooler regions at the galaxies' centers. We present new evidence for iron abundance gradients in NGC 4472 and NGC 4649 and confirm the previous results on NGC 4636. Mg and Si abundance gradients on average are flatter than those of iron and correspond to an underabundance of process elements at high Fe values, while at low iron the element ratios favor enrichment by Type II supernovae (SNe). We explain the observed trend using the metallicity dependence of SN Ia metal production and present constraints on the available theoretical modeling for low-metallicity inhibition of SNe Ia. In the second paper We analyzed nine X-ray-bright Virgo early-type galaxies observed by both ASCA and ROSAT. Through spatially resolved spectroscopy, we determined the radial temperature profiles and abundances of Mg, Si, and Fe for six galaxies. The temperature profiles are consistent with isothermal temperatures outside of cooler regions at the galaxies' centers. We present new evidence for iron abundance gradients in NGC 4472 and NGC 4649 and confirm the previous results on NGC 4636. Mg and Si abundance gradients on average are flatter than those of iron and correspond to an underabundance of process elements at high Fe values, while at low iron the element ratios favor enrichment by Type I1 supernovae (SNe). We explain the observed trend using the metallicity dependence of SN Ia metal production and present constraints on the available theoretical modeling for low-metallicity inhibition of SNe Ia.
Author
*Galactic Winds; X Rays; Temperature Profiles; Environment Effects*

**20040085798** NASA Marshall Space Flight Center, Huntsville, AL, USA
**An Overview of the Performance of the Chandra X-ray Observatory**
Weisskopf, M. C.; Aldcroft, T. L.; Bautz, M.; Cameron, R. A.; Dewey, D.; Drake, J. J.; Grant, C. E.; Marshall, H. L.; Murray, S. S.; [2004]; 2 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

The Chandra X-ray Observatory is the X-ray component of NASA's Great Observatory Program which includes the recently launched Spitzer Infrared Telescope, the Hubble Space Telescope (HST) for observations in the visible, and the Compton Gamma-Ray Observatory (CGRO) which, after providing years of useful data has reentered the atmosphere. All these facilities provide, or provided, scientific data to the international astronomical community in response to peer-reviewed proposals for their use. The Chandra X-ray Observatory was the result of the efforts of many academic, commercial, and government organizations primarily in the USA but also in Europe. NASA s Marshall Space Flight Center (MSFC) manages the Project and provides Project Science; Northrop Grumman Space Technology (NGST - formerly TRW) served as prime

contractor responsible for providing the spacecraft, the telescope, and assembling and testing the Observatory; and the Smithsonian Astrophysical Observatory (SAO) provides technical support and is responsible for ground operations including the Chandra X-ray Center (CXC). Telescope and instrument teams at SAO, the Massachusetts Institute of Technology (MIT), the Pennsylvania State University (PSU), the Space Research Institute of the Netherlands (SRON), the Max-Planck Institut fur extraterrestrische Physik (MPE), and the University of Kiel support also provide technical support to the Chandra Project. We present here a detailed description of the hardware, its on-orbit performance, and a brief overview of some of the remarkable discoveries that illustrate that performance.
Author
*X Ray Astrophysics Facility; General Overviews; Astronomical Observatories; NASA Programs*

**20040085913** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Chandra Observations of Microquasars**
Weisskopf, Maetin C.; [2004]; 1 pp.; In English; Fifth Microquasor Workshop, 7-11 Jun. 2004, Beijing, China; No Copyright; Avail: Other Sources; Abstract Only

We present an overview of the Chandra X-Ray Observatory, its instrumentation and status and observations of microquasars made during the almost five years of observation.
Author
*Quasars; X Ray Astrophysics Facility; Observation; General Overviews*

**20040086009** Smithsonian Astrophysical Observatory, Cambridge, MA, USA
**Molecular Hydrogen in the Quiescent Disk of SW UMa**
Raymond, John C.; July 2004; 2 pp.; In English
Contract(s)/Grant(s): NAG5-10353; No Copyright; Avail: CASI; A01, Hardcopy

The FUSE observation has been reduced and a paper has been submitted to ApJ. The analysis has been slow because of the very noisy quality of the data, but we have derived line profile information for O VI and limits to the continuum brightness which place an interesting limit on the white dwarf temperature. The primary results are that a narrow O VI emission component seems to arise from the accretion flow onto the white dwarf itself, in agreement with cooling flow models for the X-ray spectra of low accretion rate dwarf novae. The broad component of the O VI lines is weaker than the observed C IV emission, suggesting that the UV line emission from the disk comes from photoionized plasma. A secondary result is that there is no H-2 fluorescent emission. The upper limits indicate that if molecular gas is present in the disk, it is shielded from Ly alpha photons by a layer of atomic hydrogen on the disk surface. We also derive an upper limit to the continuum level is below that observed by IUE. The limits are compatible with the lower end of the WD temperature range derived from IUE measurements, and they appear to agree with unpublished analysis of HST spectra. The grant has provided partial support for a data aide (Matt Povich) and a postdoc (Alex Lobel). It purchased a computer for M. Menou.
Author
*Molecular Gases; Hydrogen; Dwarf Novae; Accretion Disks; X Ray Astronomy*

**20040086065** NASA Marshall Space Flight Center, Huntsville, AL, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA
**FUSE Observations of Galactic and Intrinsic Absorption in the Spectrum of the Seyfert 1 Galaxy 2MASX J21362313-6224008**
Bonamente, Massimiliano; Dixon, W. Van Dyke; The Astrophysical Journal; July 10, 2004; Volume 609, pp. 597-602; In English
Contract(s)/Grant(s): NAS5-32985; Copyright; Avail: Other Sources

We present the far-ultraviolet spectrum of the Seyfert 1 galaxy 2MASX J21362313-6224008 obtained with the Far Ultraviolet Spectroscopic Explorer (FUSE). The spectrum features absorption from Galactic O VI at two velocities and redshifted H I Ly beta and gamma, C II, CIII, and O VI. The redshifted absorption features represent a single kinematic component blueshifted by approx. 310 km/s relative to the active galactic nucleus. We use photoionization models to derive constraints on the physical parameters of the absorbing gas. An alternative interpretation for the absorption lines is also proposed, wherein the absorbing gas is associated with an intervening galaxy cluster.
Author
*Seyfert Galaxies; Ultraviolet Astronomy; Ultraviolet Spectra; Absorption Spectra*

**20040086480** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Laboratory Experiments on Rotation of Micron Size Cosmic Dust Grains with Radiation**

Abbas, M. M.; Craven, P. D.; Spann, J. F.; Tankosic, D.; LeClair, A.; Gallagher, D. L.; West, E.; Weingartner, J.; Witherow, W. K.; [2004]; 1 pp.; In English; 35th COSPAR Scientific Assembly, 18-25 Jul 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

The processes and mechanisms involved in the rotation and alignment of interstellar dust grains have been of great interest in astrophysics ever since the surprising discovery of the polarization of starlight more than half a century ago. Numerous theories, detailed mathematical models and numerical studies of grain rotation and alignment along the Galactic magnetic field have been presented in the literature. In particular, the subject of grain rotation and alignment by radiative torques has been shown to be of particular interest in recent years. However, despite many investigations, a satisfactory theoretical understanding of the processes involved in grain rotation and alignment has not been achieved. As there appears to be no experimental data available on this subject, we have carried out some unique experiments to illuminate the processes involved in rotation of dust grains in the interstellar medium. In this paper we present the results of some preliminary laboratory experiments on the rotation of individual micron/submicron size nonspherical dust grains levitated in an electrodynamic balance evacuated to pressures of approx. 10(exp -3) to 10(exp -5) torr. The particles are illuminated by laser light at 5320 A, and the grain rotation rates are obtained by analyzing the low frequency (approx. 0-100 kHz) signal of the scattered light detected by a photodiode detector. The rotation rates are compared with simple theoretical models to retrieve some basic rotational parameters. The results are examined in the light of the current theories of alignment.

Author

*Cosmic Dust; Rotation*

## 91
## LUNAR AND PLANETARY SCIENCE AND EXPLORATION

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

**20040085564** Lunar and Planetary Inst., Houston, TX, USA

**Third International Conference on Mars Polar Science and Exploration**

2003; ISSN 0161-5297; In English; Third International Conference on Mars Polar Science and Exploration, 13-17 Oct. 2003, Alberta, Canada; See also 20040085565 - 20040085689; Original contains color and black and white illustrations

Contract(s)/Grant(s): NCC5-679

Report No.(s): LPI-Contrib-1184; Copyright; Avail: CASI; C01, CD-ROM

The Third International Conference on Mars Polar Science and Exploration presented reports pertaining to image analysis of the polar regions of Mars, studies of Mars atmosphere and atmospheric models, as well as microbiological studies regarding habitat and analogies posed from anatartic regions on Earth to Mars.

CASI

*Mars Surface; Mars Atmosphere; Polar Caps*

**20040085566** Centre National de la Recherche Scientifique, Paris, France

**Simulations of the Seasonal Variations of the Mars South Polar Cap: Preliminary Results**

Dassas, K.; Forget, F.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Every martian year, as much as 30% of the CO2 atmosphere of Mars condenses in the polar caps of each hemisphere during their respective polar nights. During the spring and summer seasons in a given hemisphere, the seasonal CO2 cap sublimates back into atmosphere. While the north polar cap remains roughly circular and centered on the geographic pole during its recession, the south polar cap becomes asymmetric with strong variations with space and time. In particular, the preservation of a permanent CO2 deposit all year long near the south pole raises important issues such as the potential ability of these deposits to buffer the atmosphere. The TES observations of the south polar region during its recession have also confirmed that two regions have different behavior than the rest of the cap in terms of albedo and CO2 budget. These are the Mountains of Mitchel, a high albedo area where the frost is left behind after the rest of the polar cap recedes each spring, and the Cryptic region, an extended low albedo area which sublimates earlier than the rest of the cap. As of today, the existence and location of the residual cap, the mountains of Mitchel, and the Cryptic region remain poorly understood. No obvious

correlations have been found between these areas of interest and topography, geology, thermal inertia or ground albedo.
Author
*Annual Variations; Carbon Dioxide; Mars Atmosphere; Polar Caps*

**20040085567** Brown Univ., Providence, RI, USA
**Polar Wander in the Geological History of Mars: Constraints from Topography Statistics**
Kreslavsky, M. A.; Head, J. W.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

True polar wander (that is change of position of the spin axis of a planet relative to the crust) has been hypothesized for Mars long ago. The general idea is the formation of Tharsis rise should shift any initial spin axis position so that the rise is centered at the equator. Our recent studies showed pronounced latitudinal zonality of the statistical characteristics of the kilometer-scale topography of Mars. Here we analyze constraints that our findings put on the hypotheses of past true polar wander.
Author
*Mars (Planet); Magnetic Poles; Crusts; Mars Surface; Polar Wandering (Geology)*

**20040085568** NASA Ames Research Center, Moffett Field, CA, USA
**Describing the Components of the Water Transport in the Martian Atmosphere**
Montmessin, F.; Haberle, R. M.; forget, F.; Rannou, P.; Cabane, M.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In this paper, we examine the meteorological components driving water transport in the Martian atmosphere. A particular emphasis is given to the role of residual mean circulation and water ice clouds in determining the geographical partitioning of water vapor and frost.
Author
*Mars Atmosphere; Water; Atmospheric Models*

**20040085569** California Inst. of Tech., Pasadena, CA, USA
**The Sublimation and Relaxation of Troughs and Scarps Within the Martian North Polar Layered Deposits**
Pathare, A. V.; Paige, D. A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The kilometer-scale topography of the North Polar Layered Deposits (NPLD) is dominated by troughs and scarps: Both (a) the ubiquity of troughs throughout the NPLD, and (b) the enhanced steepness of scarps at the margins of the NPLD (e.g., along the inner wall of the channel-like reentrant, Chasma Boreale) are shown. Although the surface slopes and total depths of NPLD troughs and scarps are widely presumed to result from surface ablational processes, here we propose that an alternative mechanism, viscous relaxation of subsurface water ice, governs the morphological evolution of NPLD troughs and scarps.
Derived from text
*Mars Surface; Planetary Geology; Polar Regions; Sublimation; Troughs; Mineral Deposits; Escarpments*

**20040085570** Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany
**Model for Formation of Spider Patterns in the Cryptic Region**
Portyankina, G.; Markiewicz, W. J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The cryptic region is one of the most dominant albedo features in data from Thermal Emission Spectrometer (TES) onboard of the Mars Global Surveyor (MGS). It is situated between latitudes 73 deg.S and 81deg.S and longitudes 175 deg.W and 225 deg.W. Its main characteristic is that it remains cold well after it attains an albedo similar to the Martian soil. This low albedo is in contradiction with the low temperature that is close to that of CO2 ice. One possibility to resolve this paradox is to assume that a large fraction of the solar flux passes through a surface layer of CO2 ice and is absorbed by the dust underneath it. This is possible if the ice is slab CO2 ice. Within this cryptic region Mars Orbiter Camera also onboard of MGS

has taken images of radially converging dendritic patterns example of which is shown.
Derived from text
*Albedo; Carbon Dioxide; Mars Surface; Surface Layers*

**20040085571** Arizona Univ., Tucson, AZ, USA
**The Phoenix Scout Mission**
Smith, P. H.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In December 2002, four Scout missions to Mars, proposed in response to a NASA Announcement of Opportunity (AO), were selected to proceed to Phase A. Phoenix was one of the missions selected. All missions were required to launch in 2007 and meet a cost cap of $325M (FY03$) that encompasses all mission costs including the launch vehicle and a healthy reserve. A Concept Study report was submitted May 15 after a 5-month Phase A study; it completely describes the technical approach and management plan. The cost plan with reserves ensures that the mission can meet all its science goals within the cost cap. This abstract is being submitted prior to the selection announcement in August 2003. The strategy and goals for exploring subsurface ice layers in the northern plains will still be valid in spite of any negative decision that delays the mission.
Author
*Costs; Ice; Mars Missions; Mars Surface*

**20040085573** International Research School of Planetary Sciences, Pescara, Italy
**Testing the SHARAD Experiment of Mars Reconnaissance Orbiter with a Flight Balloon over Polar Regions**
Ori, G. G.; Flamini, E.; Seu, R.; Marinangeli, L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

SHARAD is a subsurface penetrating radar that will be onboard the Mars Reconnaissance Orbiter (MRO) NASA mission. SHARAD is a facility instrument provided by Agenzia Spaziale Italiana for a NASA mission and the PI is R. Seu (INFOCOM Dept., Univ. Roma ″La Sapienza). SHARAD is the direct evolution of MARSIS the subsurface penetrating radar on board the European mission Mars Express. MARSIS has a strong penetration power (a few kilometers) and lower vertical resolution, whereas SHARAD will penetrate only several 100s meters but its data will have high-resolution range. This is achieved with the use of different hardware and different frequencies. One of the goals of MARSIS and SHARAD data is to understand the nature of the signal and compare it with the geological nature of the subsurface. The two instruments have been not tested yet in flying conditions on Earth. The Agenzia Spaziale Italiana has set up a test campaign in order to evaluate and validate the operation and data of the SHARAD experiment. The Agenzia Spaziale Italiana is planning a test programme in order to evaluate and validate the operation and data of the SHARAD experiment. Possibly, two experiments are envisaged one in Antarctica and the other in the Artic. At present, only one flight will be performed. According to the results of the first test a decision to carry out another test will be taken. The first experiment is scheduled in 2004.
Author
*Ground Penetrating Radar; Radar Geology; Mars (Planet)*

**20040085574** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Comparison Between North and South Near Polar Regions of Mars from HEND/Odyssey Data**
Litvak, M. L.; Mitrofanov, I. G.; Kozyrev, A. S.; Sanin, A. B.; Tretyakov, V.; Boynton, W. V.; Hamara, D. K.; Shinohara, C.; Saunders, R. S.; Drake, D.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

It is known that North and South near polar regions are affected by global redistribution of atmospheric CO2. The maximal thickness of CO2 snow depth may be as high as 1 m at latitudes close to martian poles. It explains why neutron flux above martian poles significantly varies from summer to winter seasons. It occurs because CO2 frost hides upper surface layer from the orbit observations. This fact was used to estimate thickness of CO2 deposit at different latitudes. Here we suggest to make comparison between martian near polar regions in both ways as in terms of subsurface regolith structure as in terms of distribution of CO2 deposits.
Derived from text
*Mars Surface; Seasons; Carbon Dioxide Concentration*

**20040085575** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Ability to Probe the Martian Polar Subsurface Via Ground-penetrating Radar**

Farrell, W. M.; Mahaffy, P. R.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Ground-penetrating radar (GPR) offers the exciting possibility of remote sensing below the Martian surface for trapped aquifers. A GPR is currently heading to Mars onboard Mars Express (MEX) and a GPR is in consideration to be onboard Mars Reconnaissance Orbiter (MRO) in 2005. While such orbital systems offer great potential for polar stratigraphy studies, their ability to penetrate deep into the Martian polar ice is a function of both the intervening ionospheric density and the overlying ground ice conductivity. The influence of both signal-altering layers will be discussed. Polar Ice and Water: Clifford1,2 has suggested

Author

*Ground Penetrating Radar; Mars Surface; Stratigraphy*

**20040085576** Moscow State Univ., Russia

**Properties of Disperse Frost Rock in the Range of Low Negative Temperatures**

Komarov, I. A.; Issaev, V. S.; Melchakova, L. V.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

This paper presents experimental data for thermophysical properties of disperse terrestrial soils in the wide range of negative temperatures from 0 to -120 C. We represent results of comparison with data of thermal lag of Marthian surface.

Author

*Frost; Low Temperature; Rocks; Thermophysical Properties*

**20040085577** NASA Ames Research Center, Moffett Field, CA, USA

**Interannual Atmospheric Variability Simulated by a Mars GCM: Impacts on the Polar Regions**

Bridger, Alison F. C.; Haberle, R. M.; Hollingsworth, J. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

It is often assumed that in the absence of year-to-year dust variations, Mars weather and climate are very repeatable, at least on decadal scales. Recent multi-annual simulations of a Mars GCM reveal however that significant interannual variations may occur with constant dust conditions. In particular, interannual variability (IAV) appears to be associated with the spectrum of atmospheric disturbances that arise due to baroclinic instability. One quantity that shows significant IAV is the poleward heat flux associated with these waves. These variations and their impacts on the polar heat balance will be examined here.

Author

*Annual Variations; Polar Regions; Simulation; Mars Atmosphere; Atmospheric General Circulation Models*

**20040085578** York Univ., Toronto, Ontario, Canada

**Hubble Space Telescope Search for Localized Outgassing on Mars**

Ouvarova, T.; Caldwell, J.; Atreya, S.; Wong, A.; Renno, N.; James, P.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Evidence of recent groundwater seepage and surface runoff (at mid and high latitudes) may suggest that current outgassing from small, localized sources on Mars is possible. Further, formaldehyde (CH2O) has been tentatively detected in the equatorial region of Mars. If this detection is confirmed with future observations, it would give more evidence to support the possibility of present-day localized outgassing occurring on Mars. Photochemical models, based on terrestrial analogues, have identified methane (CH4), sulfur dioxide (SO2), and hydrogen sulfide (H2S) as plausible outgassing products on Mars. Two of these gases have strong bands in the UV (SO2) and near IR (CH4) in the range of Hubble Space Telescope's (HST) detectors, however H2S does not. HST has obtained spectra of Mars from the UV (with its STIS Space Telescope Imaging Spectrograph instrument) to the near IR (by NICMOS Near Infrared Camera and Multi-Object Spectrometer) in 1997 and 2001. We will analyze the archived data to search for evidence of these outgassing products.

Derived from text

*Hubble Space Telescope; Mars Surface; Outgassing; Imaging Techniques; Detection*

**20040085579** Grenoble-1 Univ., France

**The Formation and Detectability of CO2 Clathrate Hydrate on Mars**

Schmitt, B.; Mulato, L.; Doute, S.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

CO2 clathrate hydrate is suspected to be present near the surface of the south polar cap of Mars, and covered by seasonal CO2 frost during winter. After sublimation of this frost during summer times, it may be locally present at the surface where it may eventually decompose . However there are currently no direct proof of its existence. Very limited laboratory spectral data are available in the mid-infrared and none in the near-infrared. Thermodynamical data on the formation, stability and decomposition rates are also sparse. Kinetic experiments have been performed on the formation of CO2 clathrate by direct interaction of CO2 gas with water ice grains at low temperature (195-213 K) . We show the effects of several gas and solid phase parameters on the clathrate hydrate formation rates: temperature, pressure difference with dissociation pressure, specific surface area and surface stability of water ice. The stability of the CO2 clathrate and its decomposition kinetics have been also studied. Microphysical mechanisms for both formation and decomposition processes are proposed. CO2 clathrate on Mars. The conditions for CO2 clathrate formation and stability in the atmosphere and at the surface of Mars are discussed and the formation rates are estimated from the extrapolation of our laboratory data to the relevant Mars conditions.

Derived from text

*Clathrates; Mars Surface; Polar Caps*

**20040085580** Helsinki Univ., Helsinki, Finland

**An Investigation of Aerosol Dynamics in the Atmosphere of Mars**

Maatanen, A.; Korhonen, H.; Lehtinen, K. E. J.; Vehkamaki, H.; Kulmala, M.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Atmospheric models are developed and used for several purposes. The research of climate change is a hot topic at the moment, and global climate models produce results about past and future climates. Numerical weather prediction models are well known in the sense that they are used to produce the everyday weather predictions for e.g. television. Both model types can be converted to other planetary atmospheres as well, to describe their weather and climate. Aerosol models have recently been incorporated as components in atmospheric models; detailed microphysical models describe microscale aerosol size distribution and processes in the atmosphere. When used together with or inside an atmospheric model, e.g. cloud and rain particle formation are de ned and described in great detail. Aerosol particles affect radiative transfer in the models because they absorb and scatter radiation thus influencing the net radiative forcing of the atmosphere. In the Martian atmosphere dust and other types of aerosol particles (most importantly carbon dioxide and water ices) scatter and absorb both short and longwave radiation. This affects the thermal structure of the atmosphere and flow fields therein. Flow patterns affect the aerosol particle distribution by lifting dust from the surface and advecting dust and ice particles in the atmosphere. This feedback between aerosols and flow patterns may, for example, have a great influence in the onset of global (and also local) dust storms. In the polar areas atmospheric temperatures are lowenough for extensive ice nucleation to occur, since e.g. clouds are regularly observed. Aerosol processes may also have some in uence in the formation of the polar layered deposits; the mixture of ice and dust is probable also in the atmosphere (via heterogeneous nucleation) from where it can sedimentate to the surface. Our goal is to build a microphysical aerosol model for the Martian atmosphere. So far we have studied homogeneous and heterogeneous nucleation of carbon dioxide based on the work by Wood (1999). Homogeneous nucleation of CO heterogeneous nucleation seems very probable in temperatures below 178 K. Model simulations have been conducted in average atmospheric near surface conditions for a 100% CO2 atmosphere (the Martian atmosphere is 93.5% CO2). Unary nucleation of H2O will also be studies in the same way. The binary nucleation of carbon dioxide and water will also be investigated.

Derived from text

*Atmospheric Models; Mars Atmosphere; Aerosols; Climatology*

**20040085582** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Observations of the Seasonal Polar Icecaps of Mars at 1064 nm**

Zuber, Maria T.; Smith, David E.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Mars Orbiter Laser Altimeter (MOLA) is routinely making radiometric observations of Mars at a wavelength of 1064

nm. Although the altimeter function is no longer operational, the MOLA detector continues to measure the reflectivity of the surface. Observations have been obtained almost continuously since the beginning of the Mars Global Surveyor (MGS) mapping mission in February 1999, and are providing measurements relevant to understanding the seasonal cycling of CO2 surface frost.
Author
*Mars Global Surveyor; Frost; Cycles; Altimeters; Ice*

**20040085583** Toledo Univ., OH, USA
**Effects of Atmospheric and Surface Dust on the Sublimation Rates of CO2 on Mars**
Bonev, B. P.; James, P. B.; Bjorkman, J. E.; Hansen, G. B.; Wolff, M. J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations
Contract(s)/Grant(s): NSF AST-98-19928; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

We present an overview of our modeling work dedicated to study the effects of atmospheric dust on the sublimation of CO2 on Mars. The purpose of this study is to better understand the extent to which dust storm activity can be a root cause for interannual variability in the planetary CO2 seasonal cycle, through modifying the springtime regression rates of the south polar cap. We obtain calculations of the sublimation fluxes for various types of polar surfaces and different amounts of atmospheric dust. These calculations have been compared qualitatively with the regression patterns observed by Mars Global Surveyor (MGS) in both visible and infrared wavelengths, for two years of very different dust histories (1999, and 2001).
Author
*Dust Storms; Carbon Dioxide; Sublimation; Mars Atmosphere*

**20040085584** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**The Most Recent Section of the South Polar Layered Deposits**
Byrne, S.; Ivanov, A. B.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The polar layered deposits of both hemispheres contain a record of Martian environmental conditions. In this study we will assemble a fully three dimensional stratigraphic sequence for the topmost section of the southern layered deposits. A prominent layer sticks out as a bench part-way down the section. We will correlate other layers relative to this one in exposures on opposite ends of the section. In this way we hope to learn how this part of the overall southern layered deposits is organized in three dimensions. The necessary datasets which will be utilized will be hires topographic grids from the Mars Orbiter Laser Altimeter (MOLA) provided by the MOLA team and high resolution Mars Orbiter Camera (MOC) images with spatial resolutions of 1.4 to 12 m/px. Due to continuous repeat coverage of the polar orbiting Mars Global Surveyor and Mars Odyssey (MGS & MO) spacecraft this area has very high coverage. MOC frames almost totally cover the entire exposure which makes it ideal for this kind of study.
Derived from text
*Deposits; Mars Environment; Mars Surface; Stratigraphy; Topography; Three Dimensional Models*

**20040085585** Search for Extraterrestrial Intelligence Inst., Moffett Field, CA, USA
**Challenges and Solutions for the Human Exploration of the Martian Poles**
Cockell, Charles; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Martian poles present special challenges for human scientific expeditions that bear similarities to operations in terrestrial polar regions. These challenges include mobility on snows and ices, the problem of accommodation in the deep field, methods for the use of local resources and problems of station maintenance. Because the polar regions are dynamic, substantial volatile sinks, the exploration of the polar regions by humans is a potentially high priority exploration goal. Furthermore, the high astrobiological potential of these regions makes them attractive targets for human exploration. The exploration of the Martian poles might begin in the earliest stages of a human presence on the planet or missions of exploration might be launched from lower-latitude stations that would avoid the 9-month 24 hr darkness of polar winter, which imposes substantial long-term safety problems.
Author
*Mars (Planet); Polar Regions; Expeditions*

**20040085586** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Albedo Variations on the Martian Northern Polar Cap as Seen by MGS**

Hale, A. S.; Bass, D. S.; Tamppan, L. K.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Viking Orbiters determined that the surface of Mars northern residual cap is water ice. Many researchers have related observed atmospheric water vapor abundances to seasonal exchange between reservoirs such as the polar caps, but the extent to which the exchange between the surface and the atmosphere remains uncertain. Early studies of the ice coverage and albedo of the northern residual Martian polar cap using Mariner 9 and Viking images reported that there were substantial internannual differences in ice deposition on the polar cap, a result that suggested a highly variable Martian climate. However, some of the data used in these studies were obtained at differing values of heliocentric solar longitude (Ls). Reevaluation of this dataset in indicated that the residual cap undergoes seasonal brightening throughout the summer, and indicated that this process repeats from year to year. In this study we continue this work with data acquired with Mars Global Surveyor s Mars Orbiter Camera (MOC) and Thermal Emission Spectrometer (TES) instruments. We use MOC Wide Angel (WA) red filter images Derived from text

*Albedo; Atmospheric Moisture; Deposition; Ice; Mars Environment; Polar Caps*

**20040085587** NASA Johnson Space Center, Houston, TX, USA

**Prospecting for Martian Ice from Orbit**

Kanner, L. C.; Bell, M. S.; Allen, C. C.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent data from the Gamma-Ray Spectrometer (GRS) on Mars Odyssey indicate the presence of a hydrogen-rich layer tens of centimeters thick in high latitudes on Mars. This hydrogen-rich layer correlates to previously determined regions of ice stability. It has been suggested that the subsurface hydrogen is ice and constitutes 35 plus or minus 15% by weight near the north and south polar regions. This study constrains the location of subsurface ice deposits on the scale of kilometers or smaller by combining GRS data with surface features indicative of subsurface ice. The most recognizable terrestrial geomorphic indicators of subsurface ice, formed in permafrost and periglacial environments, include thermokarst pits, pingos, pseudocraters and patterned ground. Patterned ground features have geometric forms such as circles, polygons, stripes and nets. This study focuses on the polygonal form of patterned ground, selected for its discernable shape and subsurface implications. Polygonal features are typically demarcated by troughs, beneath which grow vertical ice-wedges. Ice-wedges form in thermal contraction cracks in ice-rich soil and grow with annual freezing and thawing events repeated over tens of years. Ice wedges exist below the depth of seasonal freeze-thaw. Terrestrial ice wedges can be several meters deep and polygons can be tens of meters apart, and, on rare occasions, up to 1 km. The crack spacing of terrestrial polygons is typically 3 to 10 times the crack depth.

Derived from text

*Ice; Mars Surface; Planetary Geology; Geomorphology; Planetary Orbits*

**20040085588** Moscow State Univ., Russia

**Intercrystalline Swelling of Stratified Silicates Exposed to Negative Temperatures**

Komarov, I. A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Theoretical calculations based on a thermodynamic model together with experimental results based on differential scanning calorimetry are used to test whether intercrystalline swelling occurs in montmorillonite under negative temperatures. Author

*Silicates; Swelling; Crystallinity; Strata; Thermodynamics; Montmorillonite; Mathematical Models; Cryogenic Temperature*

**20040085589** Warsaw Univ., Warsaw, Poland

**Seasonal Melting of Surface Water Ice Condensing in Martian Gullies**

Kossacki, K. J.; Markiewicz, W. J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In this work we consider when and how much liquid water during present climate is possible within the gullies observed on the surface of Mars. We analyze the conditions for melting of H2O ice, which seasonally condenses within the troughs of the gullies. The model includes both an approximate topography of the gullies as well as the inclination of the slope where the gullies appear. We have found, that water ice condensed in winter on the walls of gully-like troughs can undergo transition to the liquid phase after complete sublimation of CO2 ice. The amount of liquid eater obtained in this way, depends n several parameters but is most likely to be very small.
Author
*Ice; Mars Surface; Melting; Surface Water; Liquids; Annual Variations*

**20040085590** Washington Univ., Seattle, WA, USA
**Surface Features of the South Polar Layered Deposits of Mars and Possible Terrestrial Analogues**
Koutnik, M. R.; Byrne, S.; Murray, B. C.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Data from the Mars Orbiter Camera (MOC) and the Mars Orbiter Laser Altimeter (MOLA) aboard the Mars Global Surveyor (MGS) mission have provided important new clues to the past history of the South Polar Layered Deposits (SPLD). There are distinct features presented here that have been observed almost exclusively with these data sets and are unique to the south polar region of Mars. Although we do not conclusively know the origin of these features and don t rule out other interpretations, we consider here the possibility that relatively recent subglacial volcanism and possibly the influence of ice flow may have been active in their formation. Regional Description: We focus primarily on one
Derived from text
*Planetary Geology; Mineral Deposits; Mars Surface; Polar Regions; Analogs; Strata*

**20040085592** Brown Univ., Providence, RI, USA
**Extensive Hesperian-aged South Circumpolar Ice Sheet on Mars: Dorsa Argentea Formation Synthesis**
Head, James W.; Ghatan, Gil J.; Marchant, David; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The nature of the climate in early Mars history, and whether pluvial conditions prevailed during the Noachian Period (approximately 4.6-3.7 Ga), or if an ocean existed then and/or during the Hesperian Period (approximately 3.7- 3.0 Ga), are matters of major debate and investigation. The Dorsa Argentea Formation (DAF) is a south circumplolar deposit of Hesperian age and thus may record the aftermath of Noachian-aged climate and volatile evolution. Here we outline a synthesis of the characteristics of the DAF, and show that these are consistent with the presence of a major water-ice-rich circumpolar deposit during the Hesperian, and its partial melting, sublimation and retreat. We outline interpretations for the source and fate of these volatiles and their significance to polar and hydrological processes and history.
Derived from text
*Ice Formation; Mars Environment; Mars Surface; Geochronology*

**20040085593** Cornell Univ., Ithaca, NY, USA
**The South Polar Residual Cap of Mars: Layers, Erosion, and Stratigraphy**
Thomas, P. C.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The south polar residual cap (sprc) of Mars is a group of thin layers degraded into unique topography resting on the flatter portions of the main polar layered deposits. This is a summary of the characteristics of these layers and their degredation that impacts the interpretation of the history of the martian polar environment..
Derived from text
*Erosion; Mars Surface; Polar Caps; Stratigraphy; Topography; Strata*

**20040085594** California Inst. of Tech., Pasadena, CA, USA
**Climactic History from South Polar Residual Cap Geomorphology**
Byrne, S.; Ingersoll, A. P.; Pathare, A. V.; Jiron, F. S.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The southern residual CO2 cap is a small (88,000 square kilometers) high-albedo feature which sits atop the much thicker and more extensive southern layered deposits. It persists throughout the year in contrast to the thinner seasonal CO2 frost which appears and disappears each year. The solid CO2 which lasts throughout the year both controls circulation patterns regionally and buffers the atmospheric pressure globally. In turn this residual CO2 deposit is affected by changes in environmental conditions wrought by external forces such as dust storm activity. This solid CO2 reservoir has been theorized and observed for decades. Mars Global Surveyor data have revealed this CO2 residual deposit to contain a rich variety of geomorphic features. One of the most ubiquitous classes of features on the residual cap are the flat-floored quasi-circular pits with steep walls, dubbed Swiss-cheese features.
Derived from text
*Geomorphology; Polar Caps; Carbon Dioxide; Paleontology; Mars Surface*

**20040085595** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany
**Chasma Australe, Mars: Formation by Successive Headward Thermo-Erosional Collapses**
vanGasselt, S.; Jaumann, R.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The development of the south polar Chasma Australe reentrant has been discussed for several years and a variety of theories including eolian, aquatic, subglacial and tectonic mechanisms have been proposed for its formation. Morphological observations and studies of recent imagery support the idea of successive headward erosion and removal of volatile rich sub surface material combined with collapse and eolian blow out processes.
Author
*Mars Surface; Image Analysis*

**20040085596** Massachusetts Inst. of Tech., Cambridge, MA, USA
**Albedo Feedback in the Patterning Mechanisms of Martian Polar Caps**
Ng, Felix S. L.; Zuber, Maria T.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Both the north and south polar caps on Mars display conspicuous patterns of spiraling troughs on the surface , and their origin is largely unexplained. Here we examine the hypothesis that such morphology could be the result of a spatial instability. By modeling the interaction of polar ice with the Martian atmosphere, we show that an albedo feedback (associated with dust) can lead to relaxation oscillations in the coupling between surface mass exchange, radiative heat balance and air moisture regulation. Under favourable conditions, this temporal behaviour is manifest on the surface of the residual ice caps as alternating domains of sublimation and condensation, whose evolved forms mimic the observed (dark) troughs and their adjacent (light) smooth terrains; their expected orientation and topography are broadly consistent with the actual pattern. The mechanism finds observational support from stratigraphic relationships in the cap deposits and recently inferred wind patterns, and may offer useful insights for developing more complex models.
Derived from text
*Mars Surface; Polar Caps; Air Land Interactions*

**20040085597** Smithsonian Institution, Washington, DC, USA
**Preliminary Results from a Survey of Candidate Permafrost and Periglacial Features on Mars**
Leverington, D. W.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Several studies have noted that high-resolution images acquired by the Mars Observer Camera (MOC) may be used to identify candidate Martian permafrost and periglacial features at scales more consistent with their terrestrial counterparts. In the present research, a comprehensive survey of Martian candidate features is being conducted.
Author
*Mars Surface; Permafrost; Terrain Analysis*

**20040085598** Lamont-Doherty Geological Observatory, Palisades, NY, USA

**Some Applications of CO2-H2O Phase Equilibria to the Composition and Evolution of the Martian Polar Ice Caps**

Longhi, J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Preferential melting of CO2 ice and clathrate layers within polar ice caps during periods of low obliquity may lead to sequestration of liquid CO2 in the Martian crust.

Author

*Carbon Dioxide; Clathrates; Mars Surface; Polar Caps; Water*

**20040085599** Swiss Federal Inst. for Snow and Avalanche Research, Dorf, Switzerland

**Combining Micro-Penetrometer and Near-Infrared Photography to Measure Physical Properties in Snow Profiles**

Matzl, M.; Schneebeli, M.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The description of layered snow profiles bases mostly on morphological methods. Physical properties are then correlated to the morphology and density of the snow. Different layers and horizons in the snowprofile are classified according to a set of features, most of them by manual and visual inspection. Basic physical parameters, as density, are measured within the layer, assuming no spatial variability within the classified layer. Planar vertical sections allow for higher resolution, but are only feasible for small areas (up to 0.07 m vertical extension). This type of snowprofile has several drawbacks: the features (e.g. hand hardness, grain size, snow type) are measured at discrete locations, the description is one-dimensional and the level of discrimination of layers is subjective. A notable exception is the translucent profile, which is used sometimes for illustration. A quantitative analysis of this type of profile is difficult because transmittance of light is not only dependent on density, but also on grain size. The correlation of physical properties of the snow to density and grain type is incomplete, as is shown by the extensive field measurements of thermal conductivity by Sturm et al. We developed two new methods, which measure directly with high spatial resolution physical and mechanical properties of a snowpack. The micro-penetrometer measures the strength of bonds between structural elements (″grains″). Near infrared photography maps the distribution of the specific surface area of a snow profile with a resolution of about 4 x 10(exp -6) square meters. Here we try to combine the signals of these complementary methods.

Derived from text

*Near Infrared Radiation; Penetrometers; Physical Properties; Mechanical Properties; Snow Cover; Infrared Photography*

**20040085600** Rome Univ., Rome, Italy

**Electromagnetic Propagation Modelling for GPR Exploration of Martian Subsoil**

Pettinelli, E.; Burghignoli, P.; Galli, A.; Pisani, A. R.; Ticconi, F.; DelVento, D.; Cereti, A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The use of GPR for Mars exploration has been suggested by several authors in the past ten years. Some of the instruments proposed in the late 90s were designed to investigate the subsurface at great depth (thousands of meters) and therefore implemented a measurement technique quite different from traditional GPR. The interest toward a detailed investigation of the first few meters of Mars subsurface, linked to the exploration of past or present life on the planet, requires, however, the use of such a traditional technique, which is well established and has been widely applied on the Earth. It is well known that GPR performance is maximized when it is applied in a very resistive environment, like that expected in a cold and dry planet. Very little is known on the electromagnetic properties (permittivity, permeability, and conductivity) of the Martian soil, but the absence of liquid water on surface and in the shallow subsurface should in principle assure a good penetration of the signal. Both Viking and Pathfinder missions have shown, however, that strongly magnetic mineral phases are present in the Martian dust and therefore highly magnetic phases are also expected in the soil. Moreover, measurements from the Gamma Ray Spectrometer (GRS) experiment onboard the Mars Odyssey spacecraft support the existence of significant quantities of shallow subsurface water ice in certain parts of the planet. The highest concentrations occur pole-ward from about 60 N and 60 S, as interpreted on the basis of the specific patterns of detected neutrons and spatial correlations with regions where ground ice has been predicted to be stable. The presence of both icy soil and magnetic materials may significantly affect the attenuation values and thus the achievable GPR penetration depth. The main scope of the present work is to predict GPR propagation and attenuation features at 225 MHz and 900 MHz in Martian-like materials on the basis of the electromagnetic

parameters measured in the laboratory, and also to evaluate the effect of volumetric scattering for possible in homogeneities (intrusions) in the planetary subsurface.
Derived from text
*Electromagnetic Wave Transmission; Soils; Mars Surface; Mathematical Models; Wave Propagation*

**20040085601** Finnish Meteorological Inst., Helsinki, Finland
**Sublimation and Condensation Flows in Chasma Borealis: A Sensitivity Study Using a 2-D Ensemble Mesoscale Circulation Model**
Siili, T.; Maattanen, A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564
Contract(s)/Grant(s): SA Proj. 51441; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The University of Helsinki s 2D Mesoscale Circulation Model (MCM) has been adapted for Martian conditions in early 1990s to create the University of Helsinki (UH), Division of Atmospheric Sciences (ATM) 2DMars MCM (MMCM). The model has since been used and developed at both UH/ATM and Finnish Meteorological Institute (FMI), Geophysical Research (GEO) to study a number of martian mesoscale circulations, especially so called surface-induced phenomena. Among the forcing and circulation types are : slope winds; (CO2 and H2O) ice edge winds; and, winds driven by horizontal variations in albedo, thermal inertia and horizontal dust optical thickness. The model also incorporates a basic H2O transport scheme, but no dust transport as of yet.
Author
*Mars Atmosphere; Mars Surface; Atmospheric Models*

**20040085602** Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Berlin, Germany
**Distribution and Morphology of Polygons, South Polar Region, Mars**
vanGasselt, S.; Reiss, D.; Jaumann, R.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In this work we present a mapping of polygonal patterns at the south pole of Mars between 80 -90 S on the basis of all MOC narrow angle images (up to the current release of E18). We found 750 (out of 6000) MOC narrow angle images showing a variety of polygonal patterns resmebling terrestrial ice wedge polygons. They occur predominately inside circular depressions of the polar layered deposits, circum polar troughs and re entrants or below slopes.
Author
*Mars Surface; Topography; Image Analysis*

**20040085603** Arizona Univ., Tucson, AZ, USA
**Life in Perennially Ice Covered Lakes on Mars: An Antarctic Analogue**
Wilson, Alex T.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

As a past member of the New Zealand Antarctic Program, the author spent many summers studying the perennially ice covered lakes in the cold and arid regions of the Antarctic. This presentation will review what is known about such lakes and conclude that versions of them may exist on Mars. If indeed this proves to be the case, they would be prime sites to look for life. They might also be suitable sites for the construction of a research base, since they would provide a good landing site, water and building material.
Author
*Antarctic Regions; Arid Lands; Ice; Lakes; Low Temperature Environments; Mars*

**20040085604** Guigne International Ltd., Paradise, Newfoundland, Canada
**Ice Keel Scour Marks and Ice Floe Grounding Structures in Kasei Valles and Echus Chasma**
Woodworth-Lynas, Christopher; Guigne, Jacques Yves; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

We present further new observations from analyses of Mars Global Surveyor Mars Orbiter Camera images of surficial

features interpreted to be the result of interactions between the keels of floating ice masses on submerged sediment. The surface morphology of scour marks typically comprises a curvilinear trough from which seabed material has been ploughed to the sides by the entrenched, moving ice keel, to form two co-linear berms of excavated material.
Author
*Ice Floes; Mars Surface; Troughs; Keels*

**20040085605** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Volatile-rich Crater Interior Deposits in the Polar Regions of Mars: Evidence for Ice Cap Advance and Retreat**
Russell, Patrick S.; Head, James W.; Hecht, Michael H.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Many craters on Mars are partially filled by distinctive material emplaced by post-impact processes. This crater fill material is an interior mound which is generally separated from the walls of the crater by a trough that may be continuous along the crater circumference (i.e. a ring-shaped trough), or which may only partially contact the crater walls (i.e. a crescent-shaped trough). The fill deposit is frequently offset from the crater center and may be asymmetric in plan view. Populations of such craters include those in the circum-south polar cap region, in Arabia Terra, associated with the Medusae Fossae Formation, and in the northern lowlands proximal to the north polar cap. We focus on those craters in circumpolar regions and assess their relationship to polar cap advance and retreat, especially the possibility that fill material represents remnants of a formerly larger contiguous cap. Volatile-rich deposits have the property of being modifiable by the local stability of the solid volatile, which is governed by local energy balance. Here we test the hypothesis that asymmetries in volatile fill shape, profile, and center-location within a crater result from asymmetries in local energy balance within the crater, due mainly to variation of solar insolation and radiative effects of the crater walls over the crater interior. Model profiles of crater fill are compared with MOLA topographic profiles to assess this hypothesis. If asymmetry in morphology and location of crater fill are consistent with radiative-dominated asymmetries in energy budget within the crater, then 1) the volatile-rich composition of the fill is supported (this process should not be effective at shaping volcanic or sedimentary deposits), and 2) the dominant factor determining the observed shape of volatile-rich crater fill is the local radiative energy budget (and erosive processes such as eolian deflation are secondary or unnecessary). We also use a geographic and energy model approach to specifically test the idea that material in partially filled craters around the south pole may once have been contiguous to the cap and may have been sustained and modified by radiative processes specific to the crater environment (as opposed to the surrounding plains) as the cap retreated.
Author (revised)
*Mars Craters; Polar Caps; Paleoclimatology; Morphology; Planetary Cryospheres*

**20040085606** Geological Survey, Flagstaff, AZ, USA
**Martian Polar Ice Sheets and Mid-Latitude Debris-rich Glaciers, and Terrestrial Analogs**
Kargel, J. S.; Molnia, B.; Tanaka, K. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Glaciers are commonly defined as perennial masses of ice and snow that exhibit morphologic indications of significant flow down-slope under its own weight (under the influence of gravity). This definition does not imply a particular origin or flow mechanism, and in the broadest sense it does not even require that the ice is H2O. Thus, terrestrial rock glaciers are a type of glacier by this definition, as are Earth's snow-fed alpine glaciers, ice caps, and polar ice sheets; Martian lobate debris aprons, lineated valley deposits of the fretted terrain, and the south polar cap are also glaciers. Martian glaciers apparently include both H2O-dominated and CO2-rich icy flows; the ones being rich in CO2-rich are restricted to the south polar cap. Debris-covered snow-fed glaciers and periglacial rock glaciers provide the closest terrestrial analogs to lobate debris aprons and lineated valley deposits of the fretted terrain.
Author
*Mars (Planet); Polar Caps; Glaciers; Earth Analogs*

**20040085607** Brown Univ., Providence, RI, USA
**Tropical Mountain Glaciers on Mars: Evidence for Amazonian Climate Change**
Head, James W.; Shean, David E.; Milkovich, Sarah; Marchant, David; Third International Conference on Mars Polar Science

and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Polar deposits on Mars represent one of the most significant current volatile reservoirs on the planet and these, together with high-latitude surface and near-surface ground ice, the global cryosphere, possible groundwater, and small amounts of atmospheric water vapor, represent components of the hydrological cycle. Recent Odyssey data have been interpreted to signify the presence of significant amounts of near-surface ice at mid-to high latitudes in both hemispheres. These deposits, together with other topography and morphology data, have been interpreted to mean that volatile-rich deposits have been emplaced from about 30 deg north and south latitude to the poles during obliquity excursions on the order of \h 35 deg, perhaps relatively recently, in agreement with predictions from climate models. In this contribution, we outline evidence for the accumulation of ice deposits below 30 deg north and south latitude during the Amazonian Period. These near-equatorial ice accumulations take the form of tropical glacier deposits that extended outward from the flanks of the Tharsis Montes and Olympus Mons.

Author

*Mars (Planet); Glaciers; Mars Volcanoes*

**20040085608** Lawrence Livermore National Lab., Livermore, CA, USA

**The Rheology of CO2 Clathrate Hydrate and Other Candidate Ices in the Martian Polar Caps**

Durham, W. B.; Kirby, S. H.; Stern, L. A.; Circone, S. C.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Modeling the evolution of the Martian polar ice caps requires, among other things, knowledge of the rheologies of their component phases. We review here the known flow laws for water ice and solid CO2, which are, respectively, the major icy phase, and major CO2-bearing phase, if conventional wisdom is to be believed. We also present first measurements on the flow of CO2 clathrate hydrate, whose presence in the south polar cap has been suggested. Earlier measurements of methane clathrate, which is structurally analogous to CO2 hydrate and which is dramatically harder than water ice suggested that the presence of important volumes of clathrates in the south polar cap were unlikely, owing to the exceedingly high strength of the material. The new measurements show that CO2 hydrate is significantly weaker than CH4 clathrate, but still much stronger than water ice. Thus, the rheological basis for dismissing CO2 hydrate is somewhat weakened, but relaxation models for the south polar cap are still inconsistent with the strength of CO2 clathrate. Concerning the water ice phase in the polar caps, it is important to consider the balance between grain-size-sensitive (GSS) and grain-size independent (GSI) mechanisms of creep.

Author

*Rheology; Carbon Dioxide; Hydrates; Ice; Mars Surface*

**20040085610** NASA Ames Research Center, Moffett Field, CA, USA

**The Polar Regions and the Search for Evidence of Life on Mars**

McKay, C. P.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The search for life on Mars and evidence for past life connects to polar exploration in two important ways. First the polar regions on Mars are sites of possible liquid water today, and hence possible locations for extant life. Secondly, ancient permafrost may preserve evidence of the nature of martian life.

Author

*Mars (Planet); Mars Surface; Extraterrestrial Life; Water; Permafrost*

**20040085611** Toronto Univ., Ontario, Canada

**The Mars Imager for Cloud and Aerosol (MICA)**

Hipkin, V. J.; Drummond, J. R.; Hackett, J.; Abbatt, J.; Besla, G.; McElroy, C. T.; Melo, S. M. L.; Strong, K.; Caldwell, J. J., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Cloud and dust play an important role in the Mars polar atmosphere. Of particular interest is the evolution of cap-edge dust storms observed during the Mars Global Surveyor mission and the development of the polar hood. This poster describes

the Mars Imager for Cloud and Aerosol (MICA), a four-band visible camera designed to characterize Mars cloud and dust by imaging the limb at sunrise and sunset. It will be capable of producing profiles of Mars aerosol optical properties from 0-75km with a vertical resolution better than 600m. MICA will follow on from Mars Express and MRO cloud and aerosol vertical profile mapping, providing new information, higher vertical resolution and adding to the Mars cloud and dust climatology.
Derived from text
*Aerosols; Climatology; Imaging Techniques; Mars Global Surveyor; Clouds (Meteorology)*

**20040085614** Geological Survey, Flagstaff, AZ, USA
**ASTER Imagery and Interpretation of Glaciers in Jasper National Park and Elsewhere in the Cordillera**
Kargel, J. S.; Molnia, B.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Fourteen-band ASTER imagery has a spatial resolution of 15 m/pixel in VNIR, one band of which is in stereo; 30 m/pixel in VNIR; and 90 m/pixel in TIR. Variable gain settings selectable for snow and ice targets, high radiometric and geometric fidelity, 60-km scene width, special acquisitions of glacier imagery as a part of the GLIMS project (Global Land Ice Measurements from Space, www.glims.org), and high data downlink rate make ASTER ideal for many glacier studies. Spectacular imagery of glaciers in the Cordillera, including some in Jasper Nat. Park, are being used for detailed assessments of glacier morphology, extent, dynamics, hazards, and value as Mars analogs. A large-format poster will present a sample of ASTER imagery for Jasper Nat. Park and other selected areas of the Cordillera in Alaska and British Columbia.
Author
*Glaciers; National Parks; Imaging Techniques; Thermal Emission; Radiometers*

**20040085616** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Polar and Non-Polar Layers on Mars: A Single Mechanism for Formation?**
Mischna, M. A.; McCleese, D. J.; Richardson, M. I.; Vasavada, A. R.; Wilson, R. J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The recent discovery of vast quantities of near-subsurface ice in both polar regions of Mars by the Mars Odyssey Gamma Ray Spectrometer (GRS) has presented us with an interesting quandary. On one hand, these deposits, found poleward of 60 deg in both hemispheres, are consistent with thermal models suggesting ice will be best protected in these regions during periods of high obliquity. On the other hand, the current paradigm regarding the placement of these deposits, i.e., diffusive deposition of water vapor, appears to be inconsistent with the large volume mixing ratios (approx. 90%) inferred from the GRS data. This incongruity argues that diffusion alone cannot be the primary mechanism for the creation of these reservoirs, and that an alternate, large-scale process should be considered.
Author
*Polar Caps; Strata; Mars (Planet)*

**20040085617** Arizona Univ., Tucson, AZ, USA
**Ice in the Polar Regions of Mars: Evidence for Wet Periods in the Recent Past**
Boynton, W. V.; Chamberlain, M.; Feldman, W. C.; Prettyman, T.; Hamara, D.; Janes, D.; Kerry, K., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In our earlier work we showed that the south polar region of Mars had high contents of subsurface ice. This conclusion was based on a preliminary analysis of data from the Mars Odyssey Gamma-Ray Spectrometer instrument suite. Subject to the assumptions made at the time, the GRS observations in the south-polar region could be fit to a two-layer model consisting of a ″dry″ upper layer with low hydrogen content and an ice-rich lower layer. The upper layer ranged in H content, expressed as H2O, from 2% near -45 latitude to 3% near -75 deg. The thickness of the upper layer, expressed as column density, ranged from less than 100 g/sq cm at -55 deg. latitude to 40 g/sq cm near -75 deg. The ice content of the lower layer was inferred to be 35 +/- 15% with the higher end of the range preferred. Several necessary assumptions were made in this
Derived from text
*Ice; Polar Regions; Mars Surface*

**20040085618** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Preliminary Characterization of a Microbial Community of Rock Varnish from Death Valley, California**

Kuhlman, K. R.; LaDuc, M. T.; Kuhlman, G. M.; Anderson, R. C.; Newcombe, D. A.; Fusco, W.; Steucker, T.; Allenbach, L.; Ball, C.; Crawford, R. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Rock varnish (also referred to as desert varnish in the literature because it is particularly noticeable in desert environments) is a dark, thin (typically 50-500 m thick), layered veneer composed of clay minerals cemented together by oxides and hydroxides of manganese and iron. Some scientists suggest that varnish may provide a historical record of environmental processes such as global warming and long-term climate change. However, despite more than 30 years of study using modern microanalytical and microbial culturing techniques, the nucleation and growth mechanisms of rock varnish remain a mystery. Rock varnish is of interest to the Mars science community because a varnish-like sheen has been reported on the rocks at the Viking Lander sites. It therefore important for us to understand the formation mechanisms of terrestrial varnish abiotic, biotic, or a combination of the two -- as this understanding may give us clues concerning the chemical and physical processes occurring on the surface of Mars. It is strongly believed by some in the biogeochemistry community that microbes have a role in forming rock varnish, and iron- and manganese-oxidation by microbes isolated from varnish has been extensively investigated. Only two of these studies have investigated the microbial genetics of varnish. These studies examined the morphological, physiological and molecular characteristics of microbes that had previously been cultured from various rock varnishes and identified the cultivars using 16S rDNA sequencing techniques. However, it is well known that most of organisms existing in nature are refractory to cultivation, so many important organisms would have been missed. The currently described work investigates the genetics of rock varnish microbial community from a site in the Whipple Mtns., south of Death Valley, CA, near Parker, Arizona. We employed both cultural and molecular techniques to characterize the microorganisms found within the varnish and surrounding soil with the objectives of (a) identifying microorganisms potentially involved in varnish formation, and (b) discovering microorganisms that simply use the varnish as an extreme habitat.

Derived from text

*Biogeochemistry; Mars Surface; Microorganisms; Rocks; Varnishes; Death Valley (Ca)*

**20040085619** Oregon State Univ., OR, USA

**Simulation of Atmospheric Circulations Over the Summertime North Pole Using the OSU Mars MM5**

Tyler, D.; Barnes, J. R.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

It is important to develop a more thorough knowledge of mesoscale circulations over the residual polar ice caps of Mars. Mesoscale circulations, forced by topography and gradients in the thermal properties of the surface, can significantly modify surface energy fluxes throughout these regions on relatively small scales. Efforts to more completely describe polar weather and climatology, at resolutions greater than those of present day General Circulation Models, must account for the importance of mesoscale circulations. Moreover, a greater understanding of polar mesoscale circulations will assist other investigations into polar processes. This research is the first comprehensive high-resolution attempt to understand the dynamics of the north polar summertime circulation

Derived from text

*Simulation; Summer; Polar Regions; Atmospheric Circulation; Mars Surface; Topography*

**20040085620** Brown Univ., Worcester, MA, USA

**Geological Observations, Climate Modeling, and Ice Stability: Evidence for Recent Martian Ice Ages**

Mustard, J. F.; Head, J. W.; Kreslavsky, M. A.; Milliken, R. E.; Marchant, D. R.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent exploration of Mars has revealed abundant water ice in near-surface deposits of the mid-to high latitudes in both hemispheres. Here we show evidence that these near-surface, water-ice rich units represent a mixture of ice and dust that is layered, meters thick, and latitude dependent. These units were formed during a geologically recent major martian ice age, and were emplaced in response to the changing stability of water ice and dust on the surface during variations in orbital parameters. Evidence for these units include a smoothing of topography at subkilometer baselines from about 30 deg north and south latitudes to the poles, a distinctive dissected texture in MOC images in the +/- 30 deg-60 deg latitude band, latitude-dependent

sets of topographic characteristics and morphologic features (e.g., polygons, 'basketball' texture, gullies, viscous flow features), and hydrogen concentrations consistent with the presence of abundant ice at shallow depths above 60 deg latitude. The most equatorward extent of these ice-rich deposits was emplaced during the last major martian ice age between 0.4 and 2 Myrs, down to latitudes of 30 deg. Mars is currently in an 'interglacial' period and the ice-rich deposits between 30-60 deg are presently undergoing reworking, degradation and retreat in response to the current stability relations of near-surface ice. Unlike Earth, martian ice ages are characterized by warmer climates in the polar regions and the enhanced role of atmospheric ice and dust transport and deposition to produce widespread and relatively evenly distributed smooth deposits at mid-latitudes during orbital extremes.
Author
*Planetary Geology; Mars (Planet); Paleoclimatology; Ice*

**20040085621** Los Alamos National Lab., NM, USA
**Association of Measured Distribution of Near-Surface Hydrogen at High Northerly Latitudes with Surface Features on Mars**
Feldman, W. C.; Maurice, S.; Prettyman, T. H.; Mellon, M. T.; Squyres, S. W.; Karunatillake, S.; Elphic, R. C.; Funsten, H. O.; Lawrence, D. J.; Tokar, R. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Lower-limit estimates of the global abundance of hydrogen on Mars reveal a remarkable surface distribution [1]. Three discrete reservoirs are apparent. Two of the reservoirs fill large areas that cover much of the northern and southern high-latitude regions, and the third has several components at equatorial to mid latitudes. A map of water-equivalent hydrogen, MH2O, north of +50 deg. latitude derived from epithermal-neutron counting rates measured between areocentric longitudes of 100 deg. and 181 deg. (when the seasonal CO2 frost cover was completely absent), is shown. M(sub H2O) is seen to maximize at 100% by mass, at the north-polar residual cap. This maximum is a component of a generally water-rich region that covers much of the surrounding high-latitude terrain. This region has a local minimum that overlies Olympia Planitia, a secondary maximum that follows a narrow arc at about +75 deg. latitude that connects 100 deg. to 180 deg. east longitude, and a pronounced secondary maximum that is centered at about +70 deg. latitude and -135 deg. east longitude. Whereas the arc-shaped maximum overlies a similar arc of surface water ice that is apparent in visible images of Mars, the secondary maximum has no apparent surface feature. Another feature of the enhanced reservoir of hydrogen at high northerly latitudes is that it is pinched off on one side by a relatively low H2O-abundance region that is centered on - 45 deg. longitude.
Author
*Hydrogen; Distribution; Mars Surface; Polar Regions; Latitude*

**20040085622** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**THEMIS Visible Imaging of the South Polar Layered Deposits, Martian Southern Spring, 2003**
Plaut, J. J.; Christensen, P.; Bender, K.; Bell, J.; Cherednik, L.; Ivanov, A.; Kieffer, H.; McConnochie, T.; Richardson, M.; Titus, T.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The polar layered deposits (PLD) of Mars have attracted considerable attention since their identification in Mariner 9 images, largely due to the possibility that these finely layered, volatile-rich deposits hold a record of recent eras in Martian climate history. The PLD have been a target of imaging and other sensors in the last several decades, but only recently has it been possible to obtain a moderately high resolution image map, using the visible sensor on 2001 Mars Odyssey s Thermal Emission Imaging System (THEMIS). We report here on the acquisition of a 36 meter/pixel contiguous single-band visible image data set of the south polar layered deposits (SPLD), obtained during early southern spring in 2003. The data will undoubtedly be applied to many problems in Mars polar studies. We will discuss here, and in more detail at the Conference, the use of these images to further characterize the population of impact craters on the SPLD, and the implications of the observed population for the age and evolution of the SPLD.
Derived from text
*Thermal Emission; Imaging Techniques; Mars Environment; Mars Surface*

**20040085623** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Analysis of Properties of the North and South Polar Layered Deposits**

Ivanov, A. B.; Byrne, S.; Richardson, M. I.; Vasavada, A. R.; Titus, T. N.; Bell, J. F.; McConnochie, T. H.; Christensen, P. R., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

One of the many questions of Martian exploration is to uncover the history of Mars, through analysis of the polar layered deposits (PLD). Martian polar ice caps hold most of the exposed water ice on the surface of Mars and yet their history and physical processes involved in their formation are unclear. We will attempt to contribute to our knowledge of the composition and stratigraphy of the PLD. In this work we present the latest imaging data acquired by the Mars Odyssey THermal EMission Imaging System (THEMIS) [1] and place it into context of the Mars Global Surveyor (MGS) data. We have discussed the North Polar data in [5]. This work concentrates on data acquired over the South pole of Mars and compares properties of North and South PLD. We are primarily interested in properties of the layers in both ice caps : their continuity, morphology and stratigraphy. These questions can be addressed by THEMIS VIS color images, along with MOC high resolution data and MOLA Digital Elevation Models (DEM). We will investigate thermophysical properties of the layered deposits employing THEMIS IR images. Based on the data obtained by the orbiting spacecraft and described here, we will attempt to expose major directions for modeling and further understanding of the physical processes involved in the formation of the polar layered terrain

Author

*Mars Surface; Ice; Imaging Techniques; Morphology; Thermal Emission*

**20040085624** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Masses of Mars/Seasonal Polar Icecaps**

Smith, David E.; Zuber, Maria T.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Radio tracking of the Mars Global Surveyor spacecraft has revealed temporal changes in the long-wavelength gravity field of Mars that correlate, to first order, with the pattern expected for the seasonal redistribution of carbon dioxide between the atmosphere and surface. Detecting these gravity field changes requires isolating very small perturbations in the velocity of the spacecraft and estimating the very low degree zonal coefficients of the field. A comparison of these coefficients determined every 5 days for a period over 2 Mars years shows annual and semi-annual variations that are similar to those predicted by a General Circulation Model simulation. These changes result from the redistribution of the mass of the planet by the exchange of carbon dioxide between the surface and the atmosphere through deposition and sublimation of CO2 in the polar regions. A simple time-dependent model for the icecaps enables an estimate to be made of the mass of carbon dioxide at each pole as a function of the seasonal parameter, Ls.

Author

*Annual Variations; Gravitational Fields; Polar Regions; Mars (Planet)*

**20040085625** Nevada Univ., Reno, NV, USA

**Constraints on the Within Season and Between Year Variability of the North Residual Cap from MGS-TES**

Calvin, W. M.; Titus, T. N.; Mahoney, S. A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAG5-12223; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

There is a long history of telescopic and spacecraft observations of the polar regions of Mars. The finely laminated ice deposits and surrounding layered terrains are commonly thought to contain a record of past climate conditions and change. Understanding the basic nature of the deposits and their mineral and ice constituents is a continued focus of current and future orbited missions. Unresolved issues in Martian polar science include a) the unusual nature of the CO2 ice deposits (″Swiss Cheese″, ″slab ice″ etc.) b) the relationship of the ice deposits to underlying layered units (which differs from the north to the south), c) understanding the seasonal variations and their connections to the finely laminated units observed in high-resolution images and d) the relationship of dark materials in the wind-swept lanes and reentrant valleys to the surrounding dark dune and surface materials. Our work focuses on understanding these issues in relationship to the north residual ice cap. Recent work using Mars Global Surveyor (MGS) data sets have described evolution of the seasonal CO2 frost deposits. In addition, the north polar residual ice cap exhibits albedo variations between Mars years and within the summer season. The Thermal

Emission Spectrometer (TES) data set can augment these observations providing additional constraints such as temperature evolution and spectral properties associated with ice and rocky materials. Exploration of these properties is the subject of our current study.
Derived from text
*Polar Regions; Mars Surface; Ice; Deposits; Annual Variations*

**20040085626** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**South Polar Cryptic Region Revisited: THEMIS Observations**
Titus, T. N.; Kieffer, H. H.; Plaut, J. J.; Christensen, P. R.; Ivanov, A. B., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The early part of the Mars Global Surveyor mission provided good TES coverage of the Mars south polar region. These data allow mapping of the polar cap recession, surface and atmospheric temperatures, and albedo features found within the seasonal cap itself over Ls = 180 - 270 deg. During this period, the seasonal south polar cap retreated continuously and asymmetrically around the geographic pole, similar to the observations of Viking in 1976- 1977 [3]. A prominent albedo feature on the seasonal cap is a region that appears almost as dark as bare ground, yet remains cold. We refer to this region, generally located between latitudes 85 deg. S and 75 deg. S and longitudes 150 deg. W and 310 deg. W, as the Cryptic region.
Author
*Polar Caps; Polar Regions; Surface Temperature*

**20040085627** Geological Survey, Flagstaff, AZ, USA
**Behavior of Solid CO2 on Mars: Still a Zoo**
Kieffer, Hugh H.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Observations of the martian polar caps by TES, THEMIS and MOC have revealed a variety of peculiar patterns: now informally known as Cryptic material, Dalmatlan spots, spiders, oriented fans and fried eggs. These result from the characteristics and behavior of solid CO2 on Mars, which is unlike anything on Earth . The proposed model involves the micro-physical interaction of CO2 and dust with the solar and thermal radiation field on Mars. This abstract is shortened version of that for Mars VI, with no citations.
Derived from text
*Solidified Gases; Carbon Dioxide; Mars Atmosphere; Polar Caps*

**20040085628** George Washington Univ., Hampton, VA, USA
**Recent Detection of Winter Polar Warming in the Mars Upper Atmosphere**
Keating, G. M.; Theriot, M. E., Jr.; Tolson, R. H.; Bougher, S. W.; Forget, F.; AngelatsiColl, M.; Forbes, J. M.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Mars Global Surveyor (MGS) z-axis accelerometer has obtained over 1600 vertical structures of thermospheric density, temperature, and pressure, ranging from 110 to 170 km, between Sept. 1997 and March 1999, compared to only three previous such vertical structures from Viking 1, 2, and Pathfinder. In November 1997, a regional dust storm in the Southern Hemisphere triggered an unexpectedly large thermospheric response at mid-northern latitudes, increasing the altitude of thermospheric pressure surfaces there by as much as 8 km and indicating a strong global thermospheric response to a regional dust storm. From analysis of the MGS accelerometer data, enormous planetary scale waves have been detected in the Martian thermosphere between 60 N and 60 S. Fourier analysis of the wave structure reveals high amplitude waves 2 and 3 which appear to remain at nearly constant longitude between 60 latitude when viewed near 3 PM. However, measurements near 3 AM show evidence of essentially a phase reversal in wave 2. Taking into account the near sun-synchronous orbit it appears that these waves are principally non-migrating tides propagating to the east. Studies by Wilson et al. and Forbes et al. indicate the wave 2 component observed from MGS is principally an eastward propagating diurnal wave 1 which rotates around Mars in the opposite sense of the sun once per day. The wave 1 Kelvin wave principally results from the interaction of tides and topography. Analysis of Thermal Emission Spectrometer (TES) MGS data near 30 km indicates a similar phase to this wave at 30 km, which is in accord with the Kelvin wave, and thus the wave appears to propagate up from below into the

thermosphere. The observed wave 3 may be a combination of an eastward propagating, semi-diurnal wave 1 and the eastward propagating, diurnal wave 2 (basically the wave 2 Kelvin wave). Both the observed wave 2 and wave 3 maximize near the equator. These results give further evidence of coupling between the lower and upper atmosphere.
Derived from text
*Mars Global Surveyor; Upper Atmosphere; Winter; Detection; Mars Atmosphere*

**20040085629** NASA Ames Research Center, Moffett Field, CA, USA
**Carbon Dioxide Convection in the Martian Polar Night and Its Implications for Polar Processes**
Colaprete, A.; Haberle, R. M.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Each Martian year nearly 30% of the atmosphere is exchanged with the polar ice caps. This exchange occurs through a combination of direct surface condensation and atmospheric precipitation of carbon dioxide. It has long been thought the amount of condensation within the polar night is maintained by a balance between diabatic processes such as radiative cooling and latent heating from condensing CO2. This assumption manifests itself in Mars General Circulation Models (GCM) in such a way as to never allow the atmospheric temperature to dip below the saturation temperature of CO2. However, observations from Mars Global Surveyor (MGS) Radio Science (RS) and the Thermal Emission Spectrometer (TES) have demonstrated this assumption to be, at best, approximate. Both RS and TES observations within the polar nights of both poles indicate substantial supersaturated regions with respect to CO2. The observed temperature profiles suggest conditionally unstable regions containing planetary significant amounts of potential convective energy. Presented here are estimates of the total planetary inventory of convective available potential energy (CAPE) and the potential convective energy flux (PCEF). The values for CAPE and PCEF are derived from RS temperature profiles and compared to Mars GCM results using a new convective CO2 cloud model that allows for the formation of CAPE.
Derived from text
*Carbon Dioxide; Free Convection; Mars Atmosphere; Polar Caps; Night Sky; Precipitation (Meteorology)*

**20040085630** Geological Survey, Flagstaff, AZ, USA
**Stratigraphy and Structure of the South Polar Layered Deposits on Mars**
Herkenhoff, K. E.; Soderblom, L. A.; Kirk, R. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The martian polar layered deposits (PLD) are probably the best source of information about the recent climate history of Mars, but their origin and the mechanisms of accumulation are still a mystery. The polar layers are sedimentary deposits that most planetary scientists believe are composed of water ice and varying amounts of wind-blown dust, but their composition is poorly constrained. Because climate changes are likely recorded as variations in composition or deposition/erosion rates between layers, the detailed stratigraphy of the PLD is of great interest. Layer thicknesses of approximately 10 to 50 m were observed in Viking Orbiter images of the north PLD by Blasius et al., and Mars Orbiter Camera (MOC) images resolve layers with similar or lesser thicknesses in both polar regions. In order to accurately determine the thickness of layers and interpret PLD stratigraphy and structure, the topography of exposures must be known. Previous studies have identified deformation in the PLD similar to that observed in terrestrial glaciers, but lack of detailed topography has hindered structural interpretations. Here we describe results of our continuing study to evaluate the topography, structure, and stratigraphy of the south PLD using photoclinometry on MOC images.
Derived from text
*Mars Surface; Planetary Geology; Polar Regions; Stratigraphy; Mineral Deposits*

**20040085631** Arizona State Univ., Tempe, AZ, USA
**Origin of MGS-TES Surface Compositions in the Northern Plains and Polar Region of Mars**
Wyatt, M. B.; Tanaka, K. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The largest extent and highest concentrations of the MGS-TES derived Surface Type 2 (ST2) spectral unit, interpreted as an andesitic and/or partly altered basaltic composition, are mapped in the low-albedo northern lowlands and circumpolar sand seas of Mars. In this study, we examine the relationships between distributions of TES-derived surface compositions and

mapped geologic units in the northern polar regions of Mars and integrate Viking, MGS-MOC and -MOLA and MOTHEMIS datasets to constrain theories of the composition, origin, and evolution of these materials.
Author
*Mars Surface; Geology; Polar Regions; Plains*

**20040085632** NASA, Washington, DC, USA
**Scout Missions and Future Exploration of the Martian Poles**
McBride, K. S.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

NASA's Mars Exploration Program, (MEP) complemented by missions in operation by ESA and the Japanese space agency, is revolutionizing the study of Mars as a planet and potential home for life, past, present or future. Within the MEP there are a number of significant opportunities for the study of the Mars polar regions--from the ongoing Mars Global Surveyor and Odyssey missions, the upcoming Mars Reconnaissance Orbiter, and the soon-to-be-defined Mars Science Laboratory. As an internal complement to the Mars missions being developed by JPL for the MEP, Mars Scout investigations can provide substantial future opportunities to study the polar regions of Mars. These relatively small, PI-led missions provide substantial flexibility within the overall MEP, providing the capability to respond to scientific targets of opportunity in Mars science, with special-interest small missions, or to be developed to respond to instrument opportunities for missions developed by international partners.
Author
*Mars Exploration; Mars Missions; Scout Project*

**20040085633** NASA Ames Research Center, Moffett Field, CA, USA
**The Pascal Mars Scout Mission**
Haberle, R. M., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Pascal is a Mars Climate Network Mission that is being developed for NASA's Mars Scout Program. The mission would establish a network of 18 science weather stations distributed across the entire surface of Mars that operates for 3-10 Mars years (5.6- 18.8 Earth years). Pascal's instrument suite combines entry data from accelerometers and descent cameras, with landed data from pressure, opacity, temperature, wind speed, and water vapor to create a detailed global picture of Martian climate and weather. A panoramic landed camera system acquires images every 30 Sols to monitor changes in the landing environment due to winds. Analysis of data from the science stations, taken as often as once every 15 minutes, will provide a depth of understanding that will vastly increase our knowledge of Mars, and significantly impact site selection for future NASA missions. Pascal is the first mission ever to sample - in situ - the full global diversity of Mars and provide a continuous long-term presence on its surface.
Author
*Climate; Mars Environment; Mars Missions; Weather Stations*

**20040085634** Washington Univ., Seattle, WA, USA
**Evolution of Low-Emissivity Spots in the Martian Winter Polar Caps: Mobility of Dust Grains**
Hansen, G. B.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Temporally and spatially variable regions of low 20- m emissivity occur regularly on the winter polar caps of Mars, as first discovered in Viking orbiter observations, and subsequently in spectra returned by the Mars Global Surveyor Thermal Emission Spectrometer (TES). Although many disparate effects were originally offered to explain these features, the current consensus is that they are caused by regions of relatively fine-grained CO2 frost, probably the result of snowfall, and occurring often in regions of high topographic slopes, implying dynamic atmospheric processes. The dynamic nature of these spots has been demonstrated by repeated TES observations of the same locations. The apparent grain coarsening observed has been explained as a process of ″continued condensation″ or a sintering process starting from micron-sized grains based on theoretical study by Eluszkiewicz. My mapping of the polar cap composition and properties has suggested another possible process: the movement of dust condensation nuclei from the center of newly fallen snow grains (where they are largely

optically hidden) to grain boundaries (where they are fully optically active). This process was suggested by the modeling of low-emissivity spots in which the CO2 ice grain size is little different from, while the apparent dust content is much smaller than in the surrounding regions.
Author
*Carbon Dioxide; Dust; Mars Surface; Polar Caps*

**20040085635** Centre National de la Recherche Scientifique, Orsay, France
**″Cold″ or ″Warm″ Early Mars: New Analysis of Warrego Valles from THEMIS and MOLA Data**
Ansan, V.; Mangold, N.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The debate about the Noachian climate is very dependent on the interpretation of geomorphic features like valley networks. Valley networks were first interpreted as surface runoff under warmer climate, but surface runoff has been criticized because of the low drainage density and alternative hypothesis have been proposed in cold climate. Flows sustained by regional hydrothermal activity have been involved especially for the Thaumasia region in which Warrego networks because of the association of runoff sources with old volcanoes and fault zone. In this study we infirm this possibility and we show that fluvial activity due to precipitation is a likely process to form Warrego valleys. Evidences for such processes are taken from new MGS and Odyssey data.
Derived from text
*Mars Surface; Climate; Geomorphology*

**20040085636** Centre National de la Recherche Scientifique, Orsay, France
**Identification of Past Polar Deposits Among Layered Terrains on Mars: Preliminary Results**
Ansan, V.; Mangold, N.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The origin of layered terrains interpreted to be of sedimentary origin on Mars is debated since their discovery from Viking observations. Lacustrine, fluvial, volcanic ashes, eolian, ancient polar deposition are the usual hypothesis for their origin. Recently, using MOC images, light-toned deposits have been interpreted as old Noachian deposits formed under water. In this study, we focus on the differences in geologic context, age and geomorphic between deposits on the floor of 4 craters. We conclude that 2 crater deposits are likely due to past processes involving water at surface, but that the 2 others have more debatable origin.
Author
*Terrain; Mars Surface; Deposits*

**20040085637** Planetary Science Inst., Tucson, AZ, USA
**Upper Latitude Ice Flow, Gullies, and Long-Term Glacial History**
Hartmann, W. K.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Varied ice-flow-like features have been found in Mars Global Surveyor (MGS) images of moderate to upper latitudes of Mars. Debris aprons give geomorphological suggestions of flow, and numerical modeling by Turtle et al. indicates ice flow could deform ice-rich slopes on timescales of 10(exp 3)-10(exp 4) y, reaching highly deformed, more steady-state configurations within 10(exp 6) y. Crater counts by Berman and the author (unpublished) suggest that the surface structures at scales of 10-60 m on debris apron surfaces are young, with ages as low as 10(exp 6)-10(exp 7) y. Various aspects of terrain softening, observed in upper latitudes, may also involve ice flow. MGS has shown possible ice-flow softening or viscous relaxation of craters as small as a few km. A dramatic tongue shaped feature on a crater wall at approx. 38 deg S latitude is likely example of a recent ice flow down the wall. The lower crater wall below the tongue is dissected by gullies somewhat different from the classic Malin-Edgett hillside gullies; they may be result of erosion by runoff water from melting of ice in the observed flowing mass, or earlier such masses. Such tongue-like flow features are very rare, but Berman has identified a few similar examples. The south wall of the same crater (unnamed, east of Hellas near Reull Vallis in a region known for debris

aprons) also shows flow features, of different morphology. Here, the valleys are filled with chevron-striated deposits that suggest glacial or rock glacial masses.
Author
*Mars Surface; Glaciers; Planetary Geology; Valleys*

**20040085638** Technische Hochschule, Darmstadt, Germany
**Influence of Ice Rheology and Dust Content on the Dynamics of the North-Polar Cap of Mars**
Greve, Ralf; Mahajan, Rupali A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Martian poles are both covered by ice caps. The seasonal caps, which can extend down to latitudes of 55 deg N/S, consist of only some ten centimeters of CO2 snow which sublimes into the atmosphere during the respective summer season. The smaller residual caps poleward of approximately 80 deg N/S are underlain by massive topographic structures known as the polar layered deposits. The complexes composed of the residual caps and the layered deposits are referred to as the north- and south-polar cap (NPC/SPC), respectively. Owing to the Mars Orbiter Laser Altimeter (MOLA) measurements of the Mars Global Surveyor (MGS) spacecraft, the surface topographies of the NPC and SPC have been mapped very precisely. Previous studies indicate that the NPC is a dynamic ice mass which shows glacial flow of the order of 1 mm/a at present. Its present topography is the result of the climatic history over the last millions of years, which was probably characterized by climate cycles as a consequence of strong, quasi-periodic variations of the orbital parameters obliquity, eccentricity and precession on time-scales of 10(exp 5) - 10(exp 6) years. This idea is supported by the light-dark layered deposits of both polar caps indicating a strongly varying dust content of the ice due to varying atmospheric conditions. In this study, the dynamic and thermodynamic evolution of the NPC will be simulated with the ice-sheet model SICOPOLIS. The boundary conditions of surface accumulation, ablation and temperature are derived directly from the solar-insolation history by applying the Mars Atmosphere-Ice Coupler MAIC developed by Greve et al.. We consider steady-state scenarios under present climate conditions as well as transient scenarios over the last millions of years of climate history. A large uncertainty in model studies of that kind results from the poorly constrained rheological properties of the ice and the unknown dust content. Therefore, we will look systematically into the influence of these two aspects on the evolution of ice topography and glacial flow of the ice body. Some basic considerations for this investigation are given below.
Author
*Mars (Planet); Polar Caps; Rheology; Planetary Geology*

**20040085639** NASA Ames Research Center, Moffett Field, CA, USA
**Long Day's Drive: An Alternative Paradigm for Martian Robotic Exploration**
Sims, M. H.; McKay, C. P.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Long Day's Drive (LLD) will investigate the north polar layered deposits (PLD). The overarching science rationale for LDD is the belief that the PLD preserve within their stratigraphy an interpretable record of recent climate and geologic history for Mars. Our primary goal is to obtain data that can provide a basis for interpreting that record. In addition, we will test the hypothesis that the ice of the PLD contains organics at higher concentrations than the aeolian dust sampled at the two Viking sites. Finally, we seek to contribute to the understanding of Mars' total volatile inventory by detailed determination of the ice content of the PLD over the traverse.
Author
*Mars (Planet); Robotics; Mars Probes*

**20040085640** Nagaoka Univ. of Technology, Nagaoka, Japan
**Grain Growth of Ice Which Contains Microparticles**
Azuma, N.; Takeda, T.; Funaki, K.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Martian ice-cap ice contains a large number of microparticles (less than 1%vol.). To estimate grain size in Martian polar ice caps is of vital importance to understand the deformation mechanisms in the ice caps. However, the estimate greatly depends on the microparticle content in ice because microparticles impede grain growth. The dependence of grain growth rate

on the concentration of microparticles have not been well investigated experimentally because of the difficulty in preparation of samples containing uniformly distributed microparticles. We conducted grain growth experiments using artificial ice samples that have various concentrations (0.1-5%) of silica particles with a uniform size of 0.3 m. Here we discuss the dependence of grain growth rate on concentration of microparticles. We also present the effect of the microparticles on the grain size evolution of ice during deformation.
Author
*Mars Surface; Ice; Grain Size*

**20040085641** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**An Assessment of the Issues and Concerns Associated with the Analysis of Ice-bearing Samples by the 2009 Mars Science Laboratory**
Beaty, D. W.; Miller, S. L.; Bada, J. L.; Bearman, G. H.; Black, P. B.; Bruno, R. J.; Carsey, F. D.; Conrad, P. G.; Daly, M.; Fisher, D., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In early 2003, the Mars Icy Sample Team (MIST) was formed to address several questions related to the acquisition and analysis of ice-bearing samples on the surface of Mars by a robotic mission. These questions were specifically framed in the context of planning for the 2009 Mars Science Laboratory (MSL) lander, but the answers will also also have value in planning other future landed investigations.
Author
*Ice; Mars Surface Samples; Acquisition*

**20040085642** Toledo Univ., OH, USA
**Yearly Comparisons of the Mars North Polar Cap: 1999, 2001, and 2003 MOC Observations**
Benson, J. L.; James, P. B.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The seasonal cycle of the martian north polar cap has been studied since the time of William Herschel, who published the first quantitative observations of the seasonal recession of the polar caps in 1784. Ground-based observations made after Herschel were summarized by Slipher in 1962. More recent ground-based observations of the north polar cap have been done by Iwasaki et al. Mariner 9 and Viking also made north polar observations. Cantor et al. used Hubble Space Telescope observations between 1990 and 1997 to determine several north polar recessions and Lambert albedos of the cap. Mars Global Surveyor went into orbit around Mars in September 1997. The wide-angle cameras on the Mars Orbiter Camera (MOC) acquire images of the entire planet every day at a resolution of approx. 7.5 km/pixel in both red (575 nm - 625 nm) and blue (400 nm - 450 nm) bandpasses (WAR and WAB). Some polar cap observations were acquired during the aerobraking (AB) and science phasing (SPO) of MGS before systematic mapping began in March, 1999 at Ls = 110 .
Derived from text
*Mars Surface; Polar Caps; Annual Variations*

**20040085643** Arizona State Univ., Tempe, AZ, USA
**Detailed Geologic Analysis of Part of the South Polar Layered Deposits, Planum Australe, Mars**
Kolb, E. J.; Tanaka, K. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

We have begun geologic mapping of the martian south polar layered deposits (SPLD) as part of a project to map PLD at both poles at 1:1,500,000 scale. In this abstract, we present preliminary geologic mapping results of SPLD exposed in a trough system east of and adjacent to Chasma Australe within Planum Australe. Our mapping has allowed us to address outstanding SPLD-related issues including: SPLD bedding characterization, relative timing and modes of trough emplacement, and the formation of secondary features such as the north-trending ridged-and-grooved (″wire brush″) terrain and the sinuous, generally east-trending ridges (″snakes″). The major goals of the mapping project consist of: (1) Construction of stratigraphic sections of the PLD, including topographic analysis of prominent layers and layer sequences and investigation of intra- and interpolar stratigraphic and topographic variations in the PLD and residual ice caps, (2) detection and interpretation of structural deformation in the PLD, (3) description and interpretation of the erosional history of the PLD.

Geologic mapping of the PLD is being performed using a GIS-integrated, multi-dataset approach consisting of current and to-be-released data products including MOLA topography, MOC NA images and THEMIS VIS and IR datasets. Here, we discuss the geology of the SPLD within a broad trough whose floor dips gently from near the center of the SPLD down toward the margin of Planum Australe. This north-trending, radially orientated trough portrays some diverse and enigmatic landforms (within the region of 100 to 270 W, 80 to 87 S). Data coverage of the trough feature includes 114m/pixel MOLA-derived DEMs and shaded relief maps, 105 mappable MOC NA images and several VIS and IR THEMIS images. We have developed several geologic cross-sections across and along the length of the trough to aid in the characterization of bedding attitude and structure of PLD exposed within the trough.
Derived from text
*Planetary Geology; Polar Regions; Mineral Deposits; Stratigraphy; Geological Surveys; Topography; Mars Surface*

**20040085644** Brown Univ., Providence, RI, USA
**Amazonian Geologic History of the North Polar Cap of Mars: Stratigraphy, Melting, and Retreat**
Fishbaugh, Kathryn E.; Head, James W., III; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Mariner 9 and Viking era studies showed the polar caps to consist of layers with varying amounts of dust and ice, termed the polar layered deposits (ApI), and a residual polar cap (Api) consisting of ice and dust overlying these. In the north, this residual cap consists of water ice and in the south of water and CO2 ice, yet CO2 clathrate may also compose a percentage of the Apl and residual ice at both poles. Most authors believe that the variability in dust content within the Apl is to some degree controlled by orbital oscillations. Only recently have researchers considered the martian polar caps as possibly behaving similarly to terrestrial ice caps, both glaciologically and geologically. Tanaka and Kolb and Kolb and Tanaka have outlined a possible geologic history of the poles, suggesting that melting and flow have not occurred. Yet, several authors have estimated ice flow rates, of mm to meters/yr, and Fisher has put forth the idea that ice flow may play a crucial role in the forming of the northern spiraling troughs. Just as terrestrial ice sheets experience meltwater outbursts in the form of jkulhlaups, Chasma Boreale may also have been formed in part by melting of the ApI (possibly due to volcanic eruption) and outflow. There is also geologic evidence for at least one stage of retreat of the north polar cap. Thus, the martian north polar cap has a much more complex and Earth-like history than simple accumulation of residual ice and dust. A major outstanding question in the study of the north polar cap is, When did all of this occur?. Tanaka and Scott have placed the beginning of ApI deposition for both caps in the Late Amazonian, and Herkenhoff and Plaut, based on crater counts, have estimated maximum surface ages of 7-15 x 10(exp 6) yrs. (south) and less than 100 x 103 yrs. (north). The goal of our research thus far has been to piece together a possible history of the north polar cap from the end of Vastitas Borealis Formation (VBF) deposition in the Late Hesperian to the current estimates of the beginning of ApI deposition nearly 3 billion years later in the Late Amazonian. Thus, we have studied the major stratigraphy of the polar deposits, the evidence for growth and retreat of the polar cap, and its melting history.
Derived from text
*Polar Caps; Stratigraphy; Amazon Region (South America); Mars Surface; Melting; Paleontology*

**20040085645** Arizona State Univ., Tempe, AZ, USA
**Using Mars Orbiter Laser Altimeter Data to Detect Subglacial Features at the Residual North Polar Ice Cap**
Payne, M. C.; Farmer, J. D.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Digital Elevation Models (DEMs) constructed from Mars Orbiter Laser Altimeter (MOLA) data are a valuable tool in the analysis of surface geomorphic features. When formatted for use in a Geographical Information Systems (GIS) software package, such as ESRI s ArcView, MOLA data can be used to compose DEMs. In turn, the DEMs can be used to create contour maps, to create profiles through features of interest, and to generate hill-shaded views that provide an image-like perspective of selected areas. Furthermore, DEMs eliminate many problems associated with photographic images, such as over- or underexposure, sun angle, and high albedo. In this study, we examined an area near the margins of the north polar cap in Olympia Planitia, using MOLA DEMs. We show that in marginal glacial areas where the ice is thin, MOLA detects variations in subglacial land surface topography, including a variety of distinctive geomorphic features (e.g. impact craters, fluvial channels, coniform features of probable volcanic origin, etc.). We offer a simple model to explain why MOLA is sensitive to subglacial geomorphology, and then demonstrate the potential for determining important aspects of the geologic history of polar regions obscured by surface ice and snow, using superpositional relationships apparent in MOLA DEMs. Study Area: The region of study is located along the margin of the Martian north polar cap. This broad area, named Mare Boreum, consists

of a perennial polar cap of H2O ice, underlying CO2 ice , surrounded by four distinct polar sand seas and a remnant polar cap margin extending from ~ 80 -75 N latitude and ~ 105 -255 W longitude. The site discussed here is centered at ~77 N, 183 E. A feature resembling a small volcano, and a bifurcated valley, are visible in Viking images of this area. MOLA data for the site were used to test hypotheses for the origin of these features. In the process of that work on surface features, a number of subglacial geomorphic features were also detected in DEMs.
Derived from text
*Mars Surface; Polar Caps; Digital Elevation Models*

**20040085646** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**CryoScout: A Descent Through the Mars Polar Cap**
Hecht, M. H.; Saunders, R. S.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

CryoScout was proposed as a subsurface investigation of the stratigraphic climate record embedded in Mars North Polar cap. After landing on a gentle landscape in the midst of the mild summer season, CryoScout was to use the continuous polar sunlight to power the descent of a cryobot, a thermal probe, into the ice at a rate of about 1 m per day. CryoScout would probe deep enough into this time capsule to see the effects of planetary obliquity variations and discrete events such as dust storms or volcanic eruptions. By penetrating tens of meters of ice, the mission would explore at least one of the dominant ″MOC layers″ observed in exposed layered terrain.
Author
*Mars Environment; Mars Surface; Polar Caps; Mars Probes*

**20040085648** Planetary Science Inst., Tucson, AZ, USA
**Modeling the Deformation of Lobate Debris Aprons on Mars by Creep of Ice-rich Permafrost**
Turtle, E. P.; Pathare, A. V.; Crown, D. A.; Chuang, F. C.; Hartmann, W. K.; Greenham, J. C.; Bueno, N. F.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

A wide variety of mid- to high-latitude surface features on Mars has long been attributed to viscous creep and flow phenomena associated with near-surface ground ice. On the basis of Viking Orbiter images, Squyres identified two classes of creep-related landforms: (1) softened terrain, which results from in situ viscous deformation and is particularly evident in impact craters with degraded rims and flattened topographic profiles, and (2) debris aprons, which are produced by mass wasting along escarpments, e.g., lobate debris aprons, lineated valley fill, and concentric crater fill. Such features have been attributed to kilometer-thick layers of permafrost (with upper boundaries less than 200 m deep) at higher latitudes, an interpretation that is consistent with recent Mars Odyssey GRS observations indicating a high water content very close to the Martian surface. We are using MGS MOC and MOLA data to document the structural and topographic characteristics of softened landforms and debris aprons in the Hellas and Noachis regions. By comparing the observed landforms to the results of finite-element models of viscous creep relaxation, which incorporate recent laboratory measurements of ice/rock mixtures, we can constrain the conditions necessary to allow such deformation on Mars.
Author
*Permafrost; Deformation; Debris; Mars Surface; Planetary Geology*

**20040085650** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Probing the Subsurface of the Martian Polar Regions with MARSIS on Mars Express**
Plaut, J. J.; Picardi, G., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The European Space Agency (ESA) is currently conducting a mission to Mars known as Mars Express. The orbiter carries an instrument called the Mars Advanced Radar for Subsurface and Ionospheric Sounding (MARSIS). The MARSIS experiment is a joint project between NASA and the Italian Space Agency, and is being carried out by the University of Rome, the Jet Propulsion Laboratory, Alenia Aerospazio, and the University of Iowa. This paper describes the science objectives of

the experiment, the instrument characteristics, and applications of the MARSIS investigation to studies of the martian polar regions.
Author
*Ionospheric Sounding; Mars Surface; Mars Missions; Mars Atmosphere; Mars Express*

**20040085651** Centre des Etudes Terrestraire et Planetaire, Saint Maur des Fosses, France
**Detection and Localization of Mars Sub-Surface Ice by Surface Impedance Measurements from a Rover as Part of the WISDOM/PASTEUR and Other Rover Experiments**
Hamelin, M.; Grard, R.; Berthelier, J.-J.; Ney, R.; Trautner, R.; Simoes, F.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Water and ice on Mars are of great interest for geological, biological and engineering issues. The recent Mars Odyssey missions have shown the presence of water ice in the upper subsurface of Mars in polar regions. At lower latitudes or in particular basins ice should be found at larger depths of several meters. The WISDOM experiment (Water Ice and Subsurface Deposit Observations on Mars) is devoted to the exploration of the subsurface and the search for water and ice in medium latitudes where the subsurface ice could be found at even larger depths. For that purpose it combines a mutual impedance measurement to study the upper layers and a Ground Penetrating Radar that allows reaching larger depths down to a few hundred of meters. In the case of medium-high latitude missions where ice is believed to be at a depth of a few meters, the Mutual and Self Impedance techniques to measure the subsurface permittivity can be used as in the WISDOM project. The instrument is a surface electrode array (7 electrodes) deployed or trailed behind a rover. The multiple combinations between electrodes allow to detect ice embedded in the regolith under an upper layer of dry regolith, and to estimate the depth and ice concentration of the icy layer. It would be possible to follow the ice localization along the track of the rover. That would be very useful information to decide where to drill for a direct access to the ice layer.
Author
*Electrical Impedance; Surface Properties; Mars Surface; Ice*

**20040085652** National Air and Space Museum, Washington, DC, USA
**Constraining the Nature and Distribution of Polar Deposits on Mars Using Ground Penetrating Radar**
Grant, J. A.; Leuschen, C. J.; Schutz, A. E.; Rudy, J.; Williams, K. K.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Ground Penetrating Radar (GPR) is capable of addressing a variety of geological problems on the Earth and planets. Terrestrial GPR applications have increased dramatically over the past 30 years and the instrument has become ensconced as an efficient means for non-intrusive definition of radar properties to 10 s of meters depth [e.g., 1-3]. Given these capabilities, it is likely that measurements made by a rover-deployed GPR on Mars would help achieve a range of Mars Exploration Program goals including those related to understanding the nature and evolution of polar and near-polar deposits and shallow ground ice [4, 5]. For example, a rover-deployed GPR could penetrate eolian drift or snow masking layered or ground ice-rich units and gullies [6-8] to define the stratigraphy of polar layered deposits [9], the distribution of high latitude ground ice [4, 5], or gully settings.
Author
*Ground Penetrating Radar; Ice; Mars Surface; Mars Exploration; Deposits; Planetary Geology*

**20040085653** FOELDIX, Budapest, Hungary
**Experimental Instrument on Hunveyor for Collecting Bacteria by Their Electrostatic Coagulation with Dust Grains (FOELDIX): Observation of Electrostatical Precipitated Coagulated Units in a Nutrient Detector Pattern**
Foldi, T.; Berczi, S.; Palasti, E.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564
Contract(s)/Grant(s): MUI-TP-190/2002; MUI-TP-190/2003; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Electrostatic coagulation properties of dust above planetary surfaces were studied by FOELDIX-1 instrument of Hunveyor. We developed FOELDIX-1 by a detector unit in order to observe biomarkers on Mars by collecting dust thrown out from dusty regions. The dust collector experiment, with the observation capability of the size dependent dust particles, was developed by a nutrient containers which forming a pattern can show various types of bacteria in the inner detector-wall of

the FOELDIX-1 instrument . Coagulation of electrostatically charged dust particles, rare H2O molecules and suggested extremophile bacteria from the dusty Martian surface is transported by our experimental assemblage through the space with electrodes and allows to precipitate in the vicinity of some specially charged electrodes. If living units form a community, a consortia of bacteria and fungal spores with the attached soil then the cryptobiotic crust components of Mars may also be found and distinguished by this measuring technology.
Author
*Mars Surface; Bacteria; Measuring Instruments*

**20040085654** Brown Univ., Providence, RI, USA
**North Polar Cap of Mars: Correlation of Layers Within and Between Troughs**
Milkovich, S. M.; Head, J. W., III; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Layered deposits exist within the northern residual cap of Mars exposed on the walls of the dark lanes or troughs seen cutting into the cap. These deposits consist of extensive lateral layers of ice and dust and are found throughout the polar cap. They were first identified in Mariner 9 images and later studied in detail with the Viking orbiters. Recent images from Mars Global Surveyor show that the layers have a range of thicknesses and albedos, and are not continuous throughout the cap. Formation theories regard the layers as products of climate change due to orbital cycles, similar to climate changes caused by Milankovitch cycles on Earth, although the details of the formation processes remain unknown. Characterization of the layered deposits is key to understanding the details of the layer formation process as well as understanding the processes which shape the polar regions and the martian climate as a whole. This study quantitatively correlates layers in images in order to assess variations within the layered deposits. Such variations can provide constraints for layer formation; for example, how widespread and how uniform is layer deposition on an individual layer scale, and how well do layers correlate within and between troughs?
Author
*Albedo; Mars Photographs; Polar Caps; Troughs; Deposits; Climate Change; Climate*

**20040085655** Toronto Univ., Ontario, Canada
**The Use of Paleolimnology for Tracking Climate Change in the Canadian High Arctic: Analogies for Mars Exploration**
Lim, D. S. S.; Douglas, M. S. V.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Canadian High Arctic is a distinct region of our planet in the way that it supports life, responds to shifts in the climate, and affects the environments of the rest of the globe. High Arctic characteristics such as low incoming radiation, small land mass (one tenth the size of tropical regions), and high-albedo surfaces (as a result of the longevity and high reflectivity of the snow and ice cover) exacerbate the effects of hemispheric temperature trends and contribute to the environmental vulnerability of this area of our globe. Over the last hundred years, an arctic warming trend has been recorded with increases in average arctic temperatures exceeding those recorded for the hemisphere as a whole. High arctic environmental changes are not, however, isolated to this region, since they are strongly tied to general circulation patterns due to its inherent role as an energy sink. For example, changes to the High Arctic s climate, such as increases in river run-off as a result of warming effects, may result in the alteration of global thermohaline circulation patterns and eventually lead to changes in low latitude climate systems. Further investigation of high arctic climate and environmental change is still needed to better understand their widespread effects, which necessitates (a) the acquisition of baseline ecological data and (b) long-term monitoring efforts. A paucity of long-term environmental data exists for the High Arctic, due largely to the logistical difficulties and constraints associated with field expeditions in this remote polar region. The physical, biological and chemical limnological and paleolimnological data from the lakes and shallow ponds that dot the High Arctic tundra can provide a means of efficiently and economically meeting both of these requirements. These water bodies are both sensitive and vulnerable to such environmental influences as global warming, increased UV-B penetration, and local pollution inputs. Furthermore, these lakes and ponds contain both ecological and genetic information that may help to expand our understanding of such basic biological concepts as speciation, and top-down trophic control, and, as a result, assist in the refinement of eco-management techniques used on temperate lakes.
Derived from text
*Arctic Regions; Canada; Climate Change; Limnology; Mars Exploration; Analogies; Paleontology*

**20040085656** Centre National de la Recherche Scientifique, Orsay, France

**Distribution and Climatic Control of Small Scale Polygons on Mars**

Mangold, N.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

On the Earth, the formation of patterned ground occurs in periglacial or alpine regions submitted to permanent or transient freezing temperatures. Two climatic effects control their formation: (1) Freeze-thaw cycles which form sorted polygons, hummocks or stripes from ice segregation in lenses and concentration of stones or pebbles and (2) thermal contraction which forms crack networks by volume decrease of the ground during winter. Ice-wedge polygons are due to a combination of thermal contraction and seasonal melting because meltwater freezes in the cracks in winter and creates a weakness that is reused for cracking. The occurrence of polygons on Mars similar to those found on Earth in periglacial regions is thus interesting to study recent modifications of ice distribution and climate. Here, I detail the classification of polygons on Mars and focus on one type of the polygons located close to the south ice cap.

Derived from text

*Climatology; Polygons; Mars Surface; Planetary Geology*

**20040085657** Centre National de la Recherche Scientifique, Orsay, France

**Geographical Relationships Between Small Scale Polygons and Ground Ice Distribution from Neutron Spectrometer on Mars**

Mangold, N.; Maurice, S.; Feldman, W.; Costard, F.; Forget, F.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The occurrence of polygons on Mars similar to those found on Earth in periglacial regions is the subject of debates since three decades. Large polygonal systems have been identified on Viking images of the Northern plains. New high resolution images of the Mars Observer Camera MOC of Mars Global Surveyor (MGS) show small-scale polygons much more similar in size to terrestrial patterned ground. The necessary element to the formation of polygons, either by thermal contraction or by freeze-thaw cycles, is the presence of ice in the ground. Our study shows that the global distribution of small-scale polygons on Mars is correlated with the distribution of near-surface ice obtained from the Neutron Spectrometer (NS), one of the component of the Gamma Ray Spectrometer (GRS) aboard Mars Odyssey. This correlation favors the periglacial origin of these polygons which can thus be used as indicators of ground ice and climate variations.

Author

*Polygons; Neutron Spectrometers; Ice; Mars Surface; Glaciers*

**20040085658** Boston Univ., Boston, MA, USA

**Tongue-shaped Lobes on Mars: Relation to Rock Glacier Deposits and Long-Term History of Emplacement**

Marchant, D. R.; Head, J. W.; Kreslavsky, M. A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent work based upon Mars Global Surveyor (MGS) data, in conjunction with previous analyses of Viking data, suggests that rock glaciers, similar in form to those found in polar climates on Earth, have been an active erosional feature in the recent geologic history of Mars. A wide range of literature exists describing rock glacier characteristics, form, and distribution, but diversity of opinion exists on rock glacier nomenclature and genesis. We previously outlined the two-fold genetic classification of Benn and Evans for terrestrial rock glaciers, and then proposed a non-genetic descriptive set of terms to be applied to martian features. Different processes and environments could produce similar or gradational landforms and thus the landforms themselves might not be unequivocal indicators of a specific origin. Thus, we follow Whalley and Azizi and suggest that non-genetic descriptive terms be used for the martian features. We call on established anatomical morphology for nomenclature. The tongue-shaped lobe can be divided into the tip, or apex, the blade (the flat surface just behind the tip), the body and its rear part (the dorsum), and the tongue root. Ridges along the edges are called marginal ridges and those concave outward ones at the tongue apex are called apical ridges. Within the tongue body and in the dorsum area occur a series of chevronshaped ridges with the apex of the chevrons pointing toward the tongue apex. The central part of the tongue is depressed. The tongue root zones occur in the upper parts of crater walls in subdued alcoves. The tongue width narrows by at least a factor of two from the root zone toward the tongue body. Chevron ridges occur primarily within this transition zone. Surrounding the tongue-shaped lobes are linear to elongate smoothed and subdued ridges and mounds, some with scalloped margins. The scalloped margins occur on the inside and the broad structure often mimics the tongue shape. Subdued channels

emerge from the apices of these broad features as shown. We interpret these broad features to be remnants of earlier larger and more extensive lobes. On the basis of the characteristics of the tongue-shaped lobes on Mars, their associated features, and comparison to features in the Antarctic Dry Valleys of known origin, we can reach the following conclusions: 1) A variety of features on Mars are very similar to features on Earth that form in glacial and periglacial environments; 2) Confusing nomenclature, genetic classifications, possible form convergence or equifinality, and uncertain origins of many of the terrestrial examples all make direct application of general Earth morphological comparisons to Mars difficult; 3) We therefore have developed a descriptive and non-genetic nomenclature for these features; 4) Careful comparison of the Mars features to well-studied Earth analogs in the Mars-like environment of the Antarctic Dry Valleys can lead to insights into the origin of these features on Mars; 5) The morphology and characteristics of the Mars features examined in this study have been carefully compared to three types of features in the Antarctic Dry Valleys: a) gelifluciton lobes, b) rock glaciers, and c) alpine glaciers; 6) The tongue-like lobate, concave nature of these features is very similar to alpine glaciers and debris-covered glacier deposits. In these cases, the percentage of ice in the original deposit was very high, and sublimation and melting led to retreat, and subsidence and downwasting of any debris cover, leaving marginal morainal ridges as a main feature; 7) The presence of fainter, broad lobelike features with scalloped margins of similar orientation suggest the former wider extent of such activity; 8) The lack of crosssectional crosssectional convexity in these tongue-shaped lobes and related deposits suggests that the ice involved in their formation is now largely gone. This suggests that conditions in the past favored the formation of active glaciers and glaciaandforms, and that the present time is more equivalent to an interglacial period; 9) The presence of these features on pole-facing interior crater walls suggests that this micro-environment is very favorable for the accumulation of snow and the initiation of local glaciation; 10) This type of glaciation appears to be a significant process in the modification of crater walls and floors. We now turn to an analysis of the interior of a crater wall located at 44.4S, 195.3W and illustrating a longer-term evolution than those shown. This region lies on the north (polefacing) wall of a crater in the southern hemisphere and shows a variety of features that contrast radically with the features seen on the southern (equator-facing) wall. Average slopes on the northern wall are approximately 16 degrees and the floor of the crater slopes about 2-3 to the south.
Derived from text
*Mineral Deposits; Glaciers; Landforms; Mars Surface; Planetary Geology; Paleontology; Sedimentary Rocks*

**20040085660** NASA Ames Research Center, Moffett Field, CA, USA
**3D Simulations of the Early Mars Climate with a General Circulation Model**
Forget, F.; Haberle, R. M.; Montmessin, F.; Cha, S.; Marcq, E.; Schaeffer, J.; Wanherdrick, Y.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The environmental conditions that existed on Mars during the Noachian period are subject to debate in the community. In any case, there are compelling evidence that these conditions were different than what they became later in the amazonian and possibly the Hesperian periods. Indeed, most of the old cratered terrains are disected by valley networks (thought to have been carved by flowing liquid water), whereas younger surface are almost devoid of such valleys. In addition, there are evidence that the erosion rate was much higher during the early noachian than later. Flowing water is surprising on early Mars because the solar luminosity was significantly lower than today. Even with the thick atmosphere (up to several bars).To improve our understanding of the early Mars Climate, we have developed a 3D general circulation model similar to the one used on current Earth or Mars to study the details of the climate today. Our first objective is to answer the following questions : how is the Martian climate modified if 1) the surface pressure is increased up to several bars (our baseline: 2 bars) and 2) if the sun luminosity is decreased by 25 account the heat possibly released by impacts during short periods, although it may have played a role .For this purpose, we have coupled the Martian General Circulation model developed at LMD with a sophisticated correlated k distribution model developped at NASA Ames Research Center. It is a narrow band model which computes the radiative transfer at both solar and thermal wavelengths (from 0.3 to 250 microns).
Derived from text
*Atmospheric General Circulation Models; Mars Atmosphere*

**20040085661** Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany
**CO2 Ice in Polygonal Troughs in Malea Planum, Mars: Sub-Surface H2O Ice, MOC Images and TES Surface Temperature**
Markiewicz, W. J.; Kossacki, K. J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In this work we analyze the diurnal and seasonal changes of the surface temperature in the south polar region of Mars.

This work is a continuation of that presented were we have modelled the seasonal cycle of CO2 surface ice within the polygonal features in the Malea Planum region. Our present goal is to investigate the influence of the physical and topographical properties of the polygonal features and the subsurface permafrost on the spatially averaged regolith (surface) temperature. We compare the results of simulations to the seasonal profile of surface temperature derived from the data obtained with the Thermal Emission Spectrometer (TES) on board of the Mars Global Surveyor (MGS). Polygonal patterns were observed with the Mars Orbiter Camera (MOC) also on board of the MGS. An example of such an image, together with the wide angle MOC context image is shown. The image was taken during early southern spring, L(sub s)=224.96 degrees, the image is centered on 67.71 S and 303.77 W. The high albedo material within the polygonal troughs is interpreted as remnant seasonal CO2 ice. Formation of the troughs on Mars was analyzed.
Derived from text
*Carbon Dioxide; Diurnal Variations; Ice; Spectrometers; Surface Temperature; Thermal Emission; Troughs; Polygons; Mars Surface; Mars Global Surveyor; Water*

**20040085662** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Life Detection and Characterization of Subsurface Ice and Brine in the McMurdo Dry Valleys Using an Ultrasonic Gopher: A NASA ASTEP Project**
Doran, P. T.; Bar-Cohen, Y.; Fritsen, C.; Kenig, F.; McKay, C. P.; Murray, A.; Sherrit, S.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Evidence for the presence of ice and fluids near the surface of Mars in both the distant and recent past is growing with each new mission to the Planet. One explanation for fluids forming springlike features on Mars is the discharge of subsurface brines. Brines offer potential refugia for extant Martian life, and near surface ice could preserve a record of past life on the planet. Proven techniques to get underground to sample these environments, and get below the disruptive influence of the surface oxidant and radiation regime, will be critical for future astrobiology missions to Mars. Our Astrobiology for Science and Technology for Exploring Planets (ASTEP) project has the goal to develop and test a novel ultrasonic corer in a Mars analog environment, the McMurdo Dry valleys, Antarctica, and to detect and describe life in a previously unstudied extreme ecosystem; Lake Vida (Fig. 1), an ice-sealed lake.
Author
*Ice; Planetary Geology; Mars Surface; Mars Environment; Exobiology*

**20040085663** NASA, Washington, DC, USA
**Planetary Protection for Polar Mars Missions**
Rummel, J. D.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The picture of Mars that is emerging from the Mars Global Surveyor and Odyssey results contrasts markedly from that portrayed shortly after the Viking missions ended. Particularly intriguing is the abundance of water ice seen both in the polar caps themselves, and in lower latitudes outside of the polar regions. Along with the new data comes a heightened consideration of the potential for biological contamination that may be carried by future missions, and its possible effects. Particularly challenging are scenarios where missions carrying perennial heat sources of high capacity and longevity (e.g., Radioisotope Thermoelectric Generators) could, by non-nominal landings or other mission operations be introduced to close contact with water ice on Mars - potentially forming Earthlike environments that could accommodate the growth of contaminant organisms.
Author
*Mars Missions; Planetary Protection*

**20040085664** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA
**Episodic Endogenetic-driven Atmospheric and Hydrologic Cycles and Their Influence on the Geologic Records of the Northern and Southern Hemispheres, Mars**
Dohm, J. M.; Fairen, A. G.; Baker, V. R.; Ferris, J. C.; Anderson, R. C.; Uceda, E. R.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Diverse evidence shows a direct correlation between episodic endogenetic events of the Tharsis magmatic complex

(TMC)/Superplume, flood inundations in the northern plains, and glacial/ lacustrine/ice sheet activity in the south polar region, which includes Hellas and Argyre impact basins, corroborating the MEGAOUTFLO hypothesis. The TMC encompasses a total surface area of approximately 2 x 10(exp 7) sq km, which is slightly larger than the estimated size of the Southern Pacific Superplume. These hydrologic events include: (1) a Noachian to possibly Early Hesperian oceanic epoch and related atmospheric and environmental change (a water body covering about 1/3 of the planet s surface area) related to the incipient development of Tharsis Superplume and the northwestern sloping valleys (NSVs) and possibly early circum-Chryse development, the northwest and northeast watersheds of Tharsis, respectively, (2) a smaller ocean inset within the former larger ocean related to extensive Late Hesperian to Early Amazonian effusive volcanism at Tharsis and Elysium and incisement of the circum-Chryse outflow system. During this time, magmatic/plume-driven tectonic activity transitioned into more centralized volcanism. This Late Hesperian water body may have simply diminished into smaller seas and/or lakes during the Amazonian Period, or renewed activity at Tharsis and Elysium resulted in brief perturbations from the prevailing cold and dry climatic conditions to later form minor seas or lakes. All of the hydrologic phases transitioned into extensive periods of quiescence.
Derived from text
*Atmospheric Circulation; Hydrological Cycle; Climatology; Mars Surface*

**20040085665** Atmospheric and Environmental Research, Inc., Lexington, MA, USA
**A Microphysically-based Approach to Inferring Porosity, Grain Size, and Dust Abundance in the Seasonal Caps from Atmospherically-corrected TES Spectra**
Eluszkiewicz, J.; Titus, T. N.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

One of the highlights of the TES observations in the polar regions has been the identification of a ″cryptic″ region in the south where CO2 appears to be in the form of a solid slab rather than a fluffy frost. While the exact mechanism(s) by which the cryptic region is formed are still subject of some debate, it appears certain that a type of rapid metamorphism related to the high volatility of CO2 ice is involved. The high volatility of CO2 ice under martian conditions has several Solar System analogs (N2 on Triton and Pluto, SO2 on Io), thus making the martian cryptic region somewhat less cryptic and certainly non-unique among planetary objects. In an endmember scenario, both the formation and the spectral properties of the cryptic region (and of other areas in the seasonal caps) can be quantitatively modeled by considering sintering of an ensemble of quasi-spherical CO2 grains. This model includes the special case of instanteneous slab formation, which occurs when the grains are sufficiently small (in the submicron range) so that their sintering timescale is short relative to the deposition timescale (a situation analogous to the ″sintering″ of water droplets falling into a pond).
Author
*Carbon Dioxide; Deposition; Dust; Grain Size; Mars Environment; Porosity*

**20040085666** NASA Ames Research Center, Moffett Field, CA, USA
**Reconciling the MOLA, TES, and Neutron Observations of the North Polar CO2 Mass Budget on Mars**
Haberle, R. M.; Mattingly, B.; Titus, T. N.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

There are now three independent observations of the CO2 polar cap mass budget of Mars' north polar cap. The first is based elevation changes detected by the Mars Orbiter Laser Altimeter (MOLA) on the Mars Global Surveyor (MGS). The second is based on MGS Thermal Emission Spectrometer (TES) broadband observations of the solar and infrared radiation fields at the top of the atmosphere. The third is based on neutron counts measured by the neutron spectrometer (NS) on Odyssey. The TES data are based on an energy balance. The net radiative loss (gain) in a column is balanced by latent heating due condensation (sublimation) of CO2. In calculating the mass budget, the other main energy sources, atmospheric heat transport and subsurface conduction, were neglected. At the pole, atmospheric heat transport is indeed a small term. However, subsurface heat conduction can be significant because at the North Pole water ice, which has a high thermal conductivity compared to bare soil, is a dominant component of the subsurface. Thus, heat conducted down into the ice during summer will slowly bleed back out during fall and winter reducing the amount of CO2 that condenses on the pole. We have taken a first cut at quantifying this effect by fitting a curve to Paige's estimates of the conducted energy flux in his analysis of Viking IRTM data.
Derived from text
*Mars Surface; Polar Caps; Carbon Dioxide*

**20040085667** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**MRO's High Resolution Imaging Science Experiment (HiRISE): Polar Science Expectations**

McEwen, A.; Herkenhoff, K.; Hansen, C.; Bridges, N.; Delamere, W. A.; Eliason, E.; Grant, J.; Gulick, V.; Keszthelyi, L.; Kirk, R., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Mars Reconnaissance Orbiter (MRO) is expected to launch in August 2005, arrive at Mars in March 2006, and begin the primary science phase in November 2006. MRO will carry a suite of remote-sensing instruments and is designed to routinely point off-nadir to precisely target locations on Mars for high-resolution observations. The mission will have a much higher data return than any previous planetary mission, with 34 Tbits of returned data expected in the first Mars year in the mapping orbit (255 x 320 km). The HiRISE camera features a 0.5 m telescope, 12 m focal length, and 14 CCDs. We expect to acquire approximately 10,000 observations in the primary science phase (approximately 1 Mars year), including approximately 2,000 images for 1,000 stereo targets. Each observation will be accompanied by a approximately 6 m/pixel image over a 30 x 45 km region acquired by MRO s context imager. Many HiRISE images will be full resolution in the center portion of the swath width and binned (typically 4x4) on the sides. This provides two levels of context, so we step out from 0.3 m/pixel to 1.2 m/pixel to 6 m/pixel (at 300 km altitude). We expect to cover approximately 1% of Mars at better than 1.2 m/pixel, approximately 0.1% at 0.3 m/pixel, approximately 0.1% in 3 colors, and approximately 0.05% in stereo. Our major challenge is to find the dey contacts, exposures and type morphologies to observe.

Derived from text

*High Resolution; Reconnaissance; Remote Sensing; Mars Global Surveyor; Imaging Techniques; Space Missions*

**20040085668** NASA Ames Research Center, Moffett Field, CA, USA

**Obliquity Driven Climate Change in Mars' Recent Past**

Haberle, R. M.; Montmessin, F.; Forget, F.; Spiga, A.; Colaprete, A.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Mars has a natural mechanism for experiencing significant climate change and redistributing surface ice. Obliquity changes alone are quite capable of moving ice into low latitudes and may provide an explanation for the many geological landforms that strongly indicate recent climate change.

Author

*Climate Change; Ice; Mars Atmosphere; Atmospheric Models; Geology*

**20040085669** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**The Polar Regions and Martian Climate: Studies with a Global Climate Model**

Wilson, R. J.; Richardson, M. I.; Smith, M. D.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Much of the interest in the polar regions centers on the fact that they likely contain the best record of Martian climate change on time scales from years to eons. This expectation is based upon the observed occurrence of weathering product deposits and volatile reservoirs that are coupled to the climate. Interpretation and understanding of these records requires understanding of the mechanisms that involve the exchange of dust, water, and carbon dioxide between the surface and atmosphere, and the atmospheric redistribution of these species. We will summarize our use of the GFDL Mars general circulation model (MGCM), to exploration aspects of the interaction between the global climate and the polar regions. For example, our studies have shown that while the northern polar cap is the dominant seasonal source for water, it can act as a net annual source or sink for water, depending upon the cap temperatures and the bulk humidity of the atmosphere. This behavior regulates the annual and global average humidity of the atmosphere, as the cap acts as a sink if the atmosphere is too wet and a source if it is too dry. We will then focus our presentation on the ability of the MGCM to simulate the observed diurnal variations of surface temperature. We are particularly interested in assessing the influence of dust aerosol and water ice clouds on simulated surface temperature and the comparison with observations. Surface thermal inertia and albedo are critical boundary inputs for MGCM simulations. Thermal inertia is also of intrinsic interest as it may be related to properties of the surface such as particle size and surface character.

Author

*Atmospheric General Circulation Models; Climate Models; Mars (Planet); Mars Atmosphere; Polar Caps*

**20040085670** NASA Ames Research Center, Moffett Field, CA, USA

**A GCM Recent History of the Northern Martian Polar Layered Deposits**

Levrard, B.; Laskar, J.; Forget, F.; Montmessin, F.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The polar layered deposits are thought to contain alternate layers of water and dust in different proportions resulting from the astronomical forcing of the martian climate. In particular, longterm variations in the orbital and axial elements of Mars are presumed to generate variations of the latitudes of surface water ice stability and of the amount of water exchanged in the polar areas. At high obliquity, simplified climate models and independent general circulation simulations suggest a transfer of water ice from the north polar region to tropical areas, whereas at lower and present obliquities, water ice is expected to be stable only at the poles. If so, over obliquity cycles, water ice may be redistributed between the surface water reservoirs leading to their incremental building or disintegration depending on the rates of water transfer. If only a relative limited amount of the available water is exchanged on orbital timescales, this may provide an efficient mechanism for the formation of the observed polar deposits. Within this context, GCM simulations of the martian water cycle have been performed for various obliquities ranging from 15 degrees to 45 degrees and for a large set of initial water ice locations to determine the rate of water exchange between the surface water reservoirs as a function of the obliquity. Propagating these rates over the last 10 Ma orbital history gives a possible recent evolution of these reservoirs.

Author

*Polar Regions; Climate Models; Dust; Ice; Mars Surface; Polar Caps; Obliqueness*

**20040085671** California Univ., Santa Barbara, CA, USA

**Detection of Organic Compounds in Polar Ices on Mars Using AP MALDI**

Becker, Luann; Brinckerhoff, William; Cotter, Robert J.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

With the current and planned missions to Mars and to some outer planetary moons such as Europa and Titan, NASA is now entering a new phase of planetary exploration strongly motivated by Astrobiology. Our interest in Mars is, in part, a result of recent studies of martian meteorites that suggest that the early history of the red planet was remarkably similar to that of the Earth, where life apparently arose both quickly and early on (possibly as soon as approx.3.85 Ga). If this is indeed the case, then Mars was presumably a much warmer, wetter, planet then it is today. This hypothesis is further supported by the images returned by the Viking, Mariner and Mars Global Surveyor (MGS) orbiter spacecrafts that all show compelling evidence that copious liquid water existed on the surface of Mars in the past. In fact, new images provided by MGS suggest that there may be current sources of liquid water and ice at or near the surface of the red planet. Other MGS images show evidence of an early ocean at the North Pole and extensive underwater channels draining into large valleys (Valles Marineris) near the equator. All of these data support the possibility that life may have arisen on Mars in liquid water environments.

Author

*Space Exploration; Mars Surface; Exobiology; Ice; Water; Mars Environment*

**20040085672** British Antarctic Survey, Cambridge, UK

**Life in Martian Snows: Measurements of UV Protection Under Natural Antarctic Snows in the UVC (254 nm)**

Cockell, C. S.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Ultraviolet radiation down to 195 nm penetrates to the surface of the Martian north polar ice cap during the polar summer on account of the lack of an ozone column, in contrast to the Earth where only radiation above ~290 nm penetrates to the surface (except under ozone depletion, when radiation down to ~280 nm may penetrate). During the winter, spring and fall some ozone production does occur over the Martian poles, but the column abundance is about two orders of magnitude lower than terrestrial stratospheric ozone values. Although this ozone will provide some protection from UVC (200-280 nm) radiation, it is transient. The DNA-damage experienced on the surface of the Martian poles is approximately (under clear, dust-free skies at vernal equinox) three orders of magnitude higher than that experienced by terrestrial polar organisms (under an undepleted ozone column at the same orbital position).

Author

*Ultraviolet Radiation; Antarctic Regions; Ice; Mars Surface*

**20040085673** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Martian North Polar Impacts and Volcanoes: Feature Discrimination and Comparisons to Global Trends**

Sakimoto, E. H.; Weren, S. L.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The recent Mars Global Surveyor and Mars Odyssey Missions have greatly improved our available data for the north polar region of Mars. Pre- MGS and MO studies proposed possible volcanic features, and have revealed numerous volcanoes and impact craters in a range of weathering states that were poorly visible or not visible in prior data sets. This new data has helped in the reassessment of the polar deposits. From images or shaded Mars Orbiter Laser Altimeter (MOLA) topography grids alone, it has proved to be difficult to differentiate cratered cones of probable volcanic origins from impact craters that appear to have been filled. It is important that the distinction is made if possible, as the relative ages of the polar deposits hinge on small numbers of craters, and the local volcanic regime originally only proposed small numbers of volcanoes. Therefore, we have expanded prior work on detailed topographic parameter measurements and modeling for the polar volcanic landforms and mapped and measured all of the probable volcanic and impact features for the north polar region as well as other midlatitude fields, and suggest that: 1) The polar volcanic edifices are significantly different topographically from midlatitude edifices, and have steeper slopes and larger craters as a group; 2) The impact craters are actually distinct from the volcanoes in terms of the feature volume that is cavity compared to feature volume that is positive relief; 3) There are actually several distinct types of volcanic edifices present; 4) These types tend to be spatially grouped by edifice. This is a contrast to many of the other small volcanic fields around Mars, where small edifices tend to be mixed types within a field.

Author

*Mars Craters; Mars Volcanoes; Planetary Geology; Terrain Analysis*

**20040085674** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Speculations on Orbital Forcing of Sublimation from the Polar Caps**

Hecht, M. H.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Calculation of the periodic variations in the martian orbital parameters by Ward and subsequent refinements to the theory have inspired numerous models of variation of the martian water cycle. The limitations of models such as this can not be overstated. Albedo, for example, has a much greater influence on temperature than orbital forcing, and seems to be linked to insolation, possibly via its influence on dust transport. To make further progress, either new constraints must be identified, or additional clues must be obtained from remote sensing and in situ exploration.

Derived from text

*Hydrological Cycle; Polar Caps; Mars Surface*

**20040085675** Tennessee Univ., Knoxville, TN, USA

**Neutron Detector for Mars Rover Missions**

Moersch, J. E.; Drake, D. M.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent results from the Mars Odyssey orbiter mission have added immensely to our understanding of the distribution of water ice in the Martian polar deposits. Regional-scale mapping (approximately 300-km resolution) by Odyssey s Gamma Ray Spectrometer and its two neutron detector subsystems has revealed shallow (approximately 1m deep) subsurface deposits of water ice in concentrations ranging from 35-100% in the south polar region and 50- 75% in the north. Odyssey's Thermal Emission Imaging System has also found thermal evidence for water ice exposed at the surface of the permanent southern cap, mapable at the 100-meter scale. The next step in studying ice deposits in the polar regions of Mars will be to visit them on the surface with mobile robotic explorers. Rover missions offer the opportunity to map the small-scale distribution of water ice, study its mode(s) of deposition and removal, and perhaps gain insight into the climatic history of Mars. When galactic cosmic rays interact with planetary material nuclei, a variety of particles are produced, including neutrons. Most of the neutrons produced in these interactions are characterized by energies in the 0.5-6 MeV (″fast″) range. These neutrons lose energy by scattering from the nuclei in the surrounding medium. In general, neutrons lose more energy in collisions with lighter nuclei. Thus, the energy of neutrons that leak out of the surface is very sensitive to the presence or absence of hydrogen. The most likely reservoir of hydrogen in the Martian surface is water or water ice, although hydrated minerals (e.g. clays) may also account for some Martian H. The primary signature of the presence of hydrogen in the regolith is carried by epithermal

(0.3 eV- 0.5 MeV) neutrons, because in this energy region a small amount of hydrogen is extremely effective on moderating the energy of the neutrons. The thermal neutron (less than 0.3 eV) flux is also related to the hydrogen content in that the neutrons that leave the epithermal flux end up becoming thermal neutrons. Thus, the ratio of thermal to epithermal neutrons leaking out of the Martian surface provides the best indicator of hydrogen content. Monte Carlo simulations suggest that in typical Martian soil, a range of water concentration from 0-5% (by mass) gives rise to ratios of thermal/epithermal neutron counting rates that vary by a factor of approximately 6.
Derived from text
*Neutron Counters; Planetary Geology; Mars Roving Vehicles; Space Missions; Detectors; Thermal Neutrons*

**20040085676** York Univ., Toronto, Ontario, Canada
**Development of a Mars General Circulation Model**
Moudden, Y.; Beagley, S. R.; Fomichec, V.; McConnell, J. C.; Akingunola, A.; Munioz, A. Garcia; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Abstract Only; Available from CASI on CD-ROM only as part of the entire parent document

Efforts are underway in the Department of Earth and Atmospheric Science at York University to develop a General Circulation Model for Mars. The model, which we call MGEM, is based on the dynamic core of the Meteorological Service of Canada's weather forecast model GEM (Global Environmental Multiscale Model) and is a multiscale grid point semi-Lagrangian semi-implicit model, with a non-hydrostatic option. The multiscale option allows for a horizontal resolution that will enable us to address the mesoscale issues in the Mars atmosphere such as dust lifting mechanisms. The dynamical core has already been tested using TES temperature and surface pressure fields and MOLA topography from MGS. Appropriate changes to the physics parameterizations are being made to deal with the major components of Mars climate. These consist of solar and IR radiative scheme including a non-LTE package, a large scale carbon dioxide condensation scheme and its interaction with the total mass, a dust lifting and transport scheme with its effect on the energy budget. A comprehensive description of the water cycle including the subsurface transport in the regolith, the surface fluxes and the atmosphere transport and condensation is also being developed. The model also is capable of transporting species and chemical and aerosol packages will be added. Other groups within Canada, viz. at Dalhousie University, University of Toronto, University of Western Ontario and University of British Columbia, are planning to contribute to the effort. We believe that MGEM will be a useful tool for the Martian scientific community, and with the increasing interest in the Mars exploration, MGEM will be useful for instrument design and planning for the future missions.
Derived from text
*Atmospheric General Circulation Models; Mars Atmosphere; Multiscale Models; Meteorology*

**20040085677** Calgary Univ., Alberta, Canada
**Geophysical Investigations at a Mars Analog Site: Devon Island, Nunavut**
Nieto, C. E.; Stewart, R. R.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Haughton meteorite impact structure, located on Devon Island, Nunavut is one of the most Mars-like places on Earth. The Haughton crater is cold (average temperature - 17 C), dry, rocky, dusty, and windy. As part of the effort at NASA SETI Institute Haughton Mars Project (HMP), the University of Calgary Applied Geophysics Group conducted geophysical surveys, both ground-penetrating radar (GPR) and high-resolution seismic, in the summer of 2002. Objectives of the geophysical work were to image the permafrost layer as well as assess deeper geologic horizons. GPR data were acquired using Sensors & Software NOGGIN 250 MHz system and PulseEKKO devices with 50 and 100 MHz antennae. These surveys imaged depths from about 0.5m to 3m and indicate layering and permafrost events. High-resolution seismic results, recorded with a Geometrics 60-channel recording system and accompanying 28 Hz omni-directional geophones, also show the permafrost layer. Shallow excavations, seismic refractions, and GPR reflections at the site all proved useful and indicate that the permafrost layer is at a depth of about 60cm. We also tested geophysical operations in prototype spacesuits and found the suits to be manageable although cumbersome. We plan on returning to the Haughton crater in the summer of 2003 for further geophysical surveying and system testing.
Author
*Meteorite Collisions; Impact; Seismology; Imp*

**20040085678** Boston Urban Observatory, Boston, MA, USA

**Preservation of Ancient Glacial Ice Below Sublimation Till in the Dry Valleys of Antarctica: Implications for Mars**

Pathare, A. V.; Marchant, D. R.; Head, J. W.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Recent observations of circumpolar Martian terrains by the Gamma Ray Spectrometer are most consistent with the presence of widespread water ice in the uppermost meter of the near-surface blanketed by a thin dusty mantle [1]. A key question for Martian climatology concerns the stability of this buried ice: most models presume that the rate of exchange with the atmosphere is primarily a function of nearsurface and atmospheric temperatures [e.g., 2]. However, the preservation of buried glacial ice in the dry valleys of Antarctica suggests a more complex mantle-dependent process. Within Beacon Valley, a thin till layer known as ″Granite drift″ that is less than one meter thick overlies stagnant Miocene glacier ice, the minimum 8.1 Ma age of which is derived from 40Ar/39Ar analyses of volcanic ash deposits within Granite drift that appear to lie conformably above the ice [3]. Furthermore, the concentration of cosmogenic 3He in dolerite cobbles within the till exhibits steadily decreasing values that are most consistent with drift formation via sublimation of underlying ice [4].

Author

*Antarctic Regions; Ice; Planetary Geology; Mars Surface; Atmospheric Temperature; Climatology; Cosmology; Deposits*

**20040085679** European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands

**The Application of the Electric Sounding Technique to the Search for Water at Shallow Depths with Planetary Landers and Rovers: A Survey of the RSSD-ESA Activities**

Simoes, Fernando; Trautner, Roland; Grard, Rejean; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The possible presence of subsurface solid or liquid water can be detected in-situ by measuring the electric properties of the soil. The Research and Scientific Support Department (RSSD) of the European Space Agency (ESA) has been engaged in the design of dedicated space instruments since 1990, when we first proposed a technique for measuring the complex permittivity of solid or liquid materials with multipolar arrays. In short, an alternating current is injected in the ground by means of two transmitter electrodes and the induced differential voltage is measured by two receiver electrodes. Information about the electric properties of the medium is derived from the voltage/current ratio, or mutual impedance of the quadrupole. We shall review the specificity and complementarity of the various ongoing and planned activities, which form this line of research at RSSD in partnership with other laboratories.

Author

*Mars Surface; Electrical Properties; Water*

**20040085680** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Interannual Comparison of Water Vapor in the North Polar Region of Mars**

Tamppari, L. K.; Smith, M. D.; Hale, A. S.; Bass, D. S.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In order to better understand the current climate of Mars, we seek to understand atmospheric water in the north polar region. Our approach is to examine the water transport and cycling issues within the north polar region and in/out of the region on seasonal and annual timescales. Viking Mars Atmospheric Water Detector (MAWD) data showed that water vapor increased as the northern summer season progressed and temperatures increased, and that vapor appeared to be transported southward . However, there has been uncertainty about the amount of water cycling in and out of the north polar region, as evidenced by residual polar cap visible brightness changes between one Martian year (Mariner 9 data) and a subsequent year (Viking data). These changes were originally thought to be interannual variations in the amount of frost sublimed based on global dust storm activity . However, Viking thermal and imaging data were re-examined and it was found that 14-35 pr m of water -ice appeared to be deposited on the cap later in the summer season, indicating that some water may be retained and redistributed within the polar cap region. This late summer deposition could be due to adsorption directly onto the cap surface or due to snowfall. We seek to understand what happens to the water on seasonal and interannual timescales. We address these issues by examining water vapor in the north polar region of Mars during the north spring and summer period from MGS TES data and by comparing these results to the Viking MAWD results.

Author

*Atmospheric Moisture; Mars Atmosphere; Mars Surface; Polar Regions*

**20040085681** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Thermophysical Properties of Mars' North Polar Layered Deposits and Related Materials from Mars Odyssey THEMIS**

Vasavada, A. R.; Richardson, M. I.; Byrne, S.; Ivanov, A. B.; Christensen, P. R., et al.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The presence of a thick sequence of horizontal layers of ice-rich material at Mars north pole, dissected by troughs and eroding at its margins, is undoubtedly telling us something about the evolution of Mars climate [1,2] we just don t know what yet. The North Polar Layered Deposits (NPLD) most likely formed as astronomically driven climate variations led to the deposition of conformable, areally extensive layers of ice and dust over the polar region. More recently, the balance seems to have fundamentally shifted to net erosion, as evidenced by the many troughs within the NPLD and the steep, arcuate scarps present near its margins, both of which expose layering. We defined a number of Regions of Interest ROI) for THEMIS to target as part of the Mars Odyssey Participating Scientist program. We use these THEMIS data in order to understand the morphology and color/thermal properties of the NPLD and related materials over relevant (i.e., m to km) spatial scales. We have assembled color mosaics of our ROIs in order to map the distribution of ices, the different layered units, dark material, and underlying basement. The color information from THEMIS is crucial for distinguishing these different units which are less distinct on Mars Orbiter Camera images. We wish to understand the nature of the marginal scarps and their relationship to the dark material. Our next, more ambitious goal is to derive the thermophysical properties of the different geologic materials using THEMIS and Mars Global Surveyor Thermal Emission Spectrometer TES) data.

Derived from text

*Mars Surface; Polar Regions; Planetary Geology*

**20040085682** NASA Johnson Space Center, Houston, TX, USA

**Low-Temperature, Aqueous Alteration of Soil in Wright Valley, Antarctica, Compared with Aqueous Alteration on Mars**

Wentworth, S. J.; Gibson, E. K., Jr.; McKay, D. S.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Original contains color and black and white illustrations; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

The Dry Valleys of Antarctica are possibly one of the best analogs on Earth of the environment at the surface of Mars. Many types of research have been focused on the Dry Valleys, partly because of the potential application to Mars, and also because of the importance of the Dry Valleys in understanding the characteristics and development of terrestrial polar deserts. In 1983, we published a detailed study of weathering products and soil chemistry in a soil pit at Prospect Mesa, Wright Valley, as a possible analog to Mars. Much more is now known about Mars, so we are re-examining that earlier work and comparing it with newer martian data. The Mars information most pertinent to this work includes (A) the strong evidence for recent aqueous activity on Mars, along with more recent evidence for present-day, near-surface water ice on Mars; and (B) the identification of meteorites from Mars and the subsequent, definitive proof that low temperature, aqueous weathering has occurred in these meteorites prior to their ejection from Mars.

Derived from text

*Antarctic Regions; Low Temperature; Mars Surface; Soils; Valleys; Aqueous Solutions; Revisions*

**20040085686** Academy of Sciences (Russia), Moscow, Russia

**Accuracy of Mars' Polar Axis Determination by Earth-based RSDI**

Holin, I. V.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Radar Speckle Displacement Interferometry (RSDI) is a new Earth-based radar technique to measure instantaneous spin components of inner planets with unprecedented accuracy. To avoid mixing with known techniques (VLBI, RORI) note that RSDI is based on the effect of far coherence (speckle displacement).

Author (revised)

*Mars (Planet); Planetary Rotation; Radar Astronomy; Speckle Interferometry*

**20040085687** Goettingen Univ., Germany

**On the CO2 Hydrate Physical Chemistry at Martian Conditions**

Genov, G.; Kuhs, W. F.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

In 1970 Miller and Smythe concluded that the CO2 hydrate is stable on Mars and that the mixture of pure condensates of CO2 and H2O is unstable at the poles. Moreover, some limited kinetic data suggested that the hydrate formation process was fast enough in a meteorological time-scale, which meant, it would lead to a diurnal and annual hydrate cycle. Some authors even put forward the idea that most of the ice in the polar caps was in a hydrate form . Unfortunately, the hydrate and the ice are quite undistinguishable with conventional spectroscopic methods. Moreover, very little is known about the physico-chemical properties of CO2 hydrates at low temperatures encountered on Mars. We have started to investigate the thermodynamic, physical and kinetic properties of CO2 hydrate under Martian surface and subsurface p-T conditions.

Author

*Mars Surface; Polar Caps*

**20040085688** Copenhagen Univ., Denmark

**Investigation of Exchange Processes in the Martian Water Cycle**

Schmidt, K. G.; Third International Conference on Mars Polar Science and Exploration; 2003; 1 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Water is found on Mars in the three reservoirs: The polar caps, the permafrost, and the atmosphere. We focus on the processes of mass exchange of water between the atmosphere and the polar caps as well as exchange with the regolith in order to investigate the relative importance of the two surface reservoirs to the present water cycle on Mars. The polar caps of Mars are believed to consist mostly of water ice with large amounts of dust in both of them and some CO2ice. On images from space crafts stripes or layers are seen on the slopes of the polar caps facing the equator, which may be related to climate changes in the history of Mars, just as the climate history of the Earth is captured in the ice caps of Greenland and Antarctica. A characteristic feature of the north polar cap is a spiralling pattern of scarps and troughs organized around the pole. Horizontal or north-facing areas appear white, while the scarps expose the dark layers. The alternating white polar ice and exposed layers suggest that the cap interacts with the atmosphere through deposition and sublimation processes and plays an active role in the current water cycle on Mars. The spiralling scarps and troughs are thought to be formed in a combination of sublimation, wind effects, deposition and ice flow.

Derived from text

*Water; Antarctic Regions; Climate Change; Hydrological Cycle; Mars Surface*

**20040085689** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Evolving Technologies for In-Situ Studies of Mars Ice**

Carsey, F. D.; Hecht, M. H.; Third International Conference on Mars Polar Science and Exploration; 2003; 2 pp.; In English; See also 20040085564; Copyright; Avail: CASI; A01, Hardcopy; Available from CASI on CD-ROM only as part of the entire parent document

Icy sites on Mars continue to be of high scientific importance. These sites include the polar caps, the southern mid-latitude subsurface permafrost, and the seasonal frost. These sites have interest due to their roles in climate processes, past climates, surface and near-surface water, astrobiology, geomorphology, and other topics. As is the case for many planetary features, remote sensing, while of great value, cannot answer all questions; in-situ examination is essential, and the motivation for in-situ observations generally leads to the subsurface, which, fortunately, is accessible on Mars. It is clear in fact that a Mars polar cap subsurface mission is both scientifically compelling and practical. Recent data from orbiting platforms has provided a remarkable level of information about the Mars ice caps; we know, for example, the size, shape and annual cycle of the cap topography as well as we know that of Earth, and we have more information on stratification that we have of, for example, the ice of East Antarctica. To understand the roles that the Mars polar caps play, it is necessary to gather information on the ice cap surface, strata, composition and bed. In this talk the status of in-situ operations and observations will be summarized, and, since we have conveniently at hand another planet with polar caps, permafrost and ice, the role of testing and validation of experimental procedures on Earth will be addressed.

Author

*In Situ Measurement; Planetary Cryospheres; Mars (Planet)*

**20040085958** Morgan Research Corp., Huntsville, AL, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA
**Atmospheric Models for Aerocapture**
Justus, C. G.; Duvall, Aleta L.; Keller, Vernon W.; April 09, 2004; 6 pp.; In English; 40th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NNM04AA02C; No Copyright; Avail: CASI; A02, Hardcopy

There are eight destinations in the solar System with sufficient atmosphere for aerocapture to be a viable aeroassist option - Venus, Earth, Mars, Jupiter, Saturn and its moon Titan, Uranus, and Neptune. Engineering-level atmospheric models for four of these targets (Earth, Mars, Titan, and Neptune) have been developed for NASA to support systems analysis studies of potential future aerocapture missions. Development of a similar atmospheric model for Venus has recently commenced. An important capability of all of these models is their ability to simulate quasi-random density perturbations for Monte Carlo analyses in developing guidance, navigation and control algorithm, and for thermal systems design. Similarities and differences among these atmospheric models are presented, with emphasis on the recently developed Neptune model and on planned characteristics of the Venus model. Example applications for aerocapture are also presented and illustrated. Recent updates to the Titan atmospheric model are discussed, in anticipation of applications for trajectory and atmospheric reconstruct of Huygens Probe entry at Titan.
Author
*Atmospheric Models; Aerocapture; Huygens Probe; Environmental Monitoring*

**20040085983** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Atmospheric Models for Aerocapture**
Justus, C. G.; Duval, Aleta; Keller, Vernon W.; December 19, 2003; 1 pp.; In English; AIAA Joint Propulsion Conference, 12-16 Jul. 2004, Fort Lauderdale, FL, USA
Contract(s)/Grant(s): NAS8-60000; No Copyright; Avail: Other Sources; Abstract Only

There are eight destinations in the Solar System with sufficient atmosphere for aerocapture to be a viable aeroassist option - Venus, Earth, Mars, Jupiter, Saturn and its moon Titan, Uranus, and Neptune. Engineering-level atmospheric models for four of these targets (Earth, Mars, Titan, and Neptune) have been developed for NASA to support systems analysis studies of potential future aerocapture missions. Development of a similar atmospheric model for Venus has recently commenced. An important capability of all of these models is their ability to simulate quasi-random density perturbations for Monte Carlo analyses in developing guidance, navigation and control algorithms, and for thermal systems design. Similarities and differences among these atmospheric models are presented, with emphasis on the recently developed Neptune model and on planned characteristics of the Venus model. Example applications for aerocapture are also presented and illustrated. Recent updates to the Titan atmospheric model, in anticipation of applications for trajectory and atmospheric reconstruct of Huygens Robe entry at Titan, are discussed. Recent updates to the Mars atmospheric model, in support of ongoing Mars aerocapture systems analysis studies, are also presented.
Author
*Aerocapture; Atmospheric Models; Solar System; Space Missions*

**20040086066** Science Applications International Corp., Huntsville, AL, USA
**A Study of Possible Solar Sail Applications for Mars Missions**
Percy, Thomas K.; Taylor, Travis; Powell, T. Conley; [2004]; 7 pp.; In English; JPC 2004 Conference, 11-14 Jul. 2004, Fort Lauderdale, FL, USA; Copyright; Avail: CASI; A02, Hardcopy

A study was performed in conjunction with the In Space Technology Investment Area of NASA's Marshall Space Flight Center to investigate potential applications of solar sails to Mars missions. While solar sails have been proposed as possible candidates for several missions, including Geostorm and a Polar Observer mission, Mars has often been overlooked as a potential destination. It was found that solar sails may have potential in Mars observation missions with smaller payloads. Sail aerocapture maneuvers also show an improvement in payload delivery capability. This study has shown that solar sail spacecraft rival chemical interplanetary probes to Mars and may have applications in future Mars exploration.
Author
*Solar Sails; Mars Missions; Payloads; Mars Exploration*

**20040086099** Morgan Research Corp., Huntsville, AL, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA
**Validation of Mars-GRAM and Planned New Features**
Justus, C. G.; Duvall, Aleta; Keller, Vernon W.; April 09, 2004; 8 pp.; In English; 35th COSPAR Scientific Assembly Meeting, 18-25 Jul. 2004, Paris, France
Contract(s)/Grant(s): NNM04AA02C; No Copyright; Avail: CASI; A02, Hardcopy

For altitudes below 80 km, Mars Global Reference Atmospheric Model (Mars-GRAM 2001) is based on output climatology from NASA Ames Mars General Circulation Model (MGCM). At COSPAR 2002, results were presented of validation tests of Mars-GRAM versus data from Mars Global Surveyor Thermal Emission Spectrometer (TES) and Radio Science (RS) experiment. Further validation tests are presented comparing Mars- GRAM densities with those from the European Mars Climate Database (MCD), and comparing densities from both Mars-GRAM and MCD against TES observations. Throughout most of the height and latitude range of TES data (040 km and 70s to 70N), good agreement is found between atmospheric densities from Mars-GRAM and MCD. However, at the season and latitude zone for Mars Phoenix arrival and landing (Ls = 65 to 80 degrees and latitude 65 to 75N), Mars-GRAM densities are about 30 to 45 percent higher than MCD densities near 40 km altitude. Further evaluation is warranted concerning potential impact of these model differences on planning for Phoenix entry and descent. Three planned features for Mars-GRAM update are also discussed: (1) new MGCM and Thermospheric General Circulation Model data sets to be used as a revised basis for Mars-GRAM mean atmosphere, (2) a new feature to represent planetary-scale traveling waves for upper altitude density variations (such as found during Mars Odyssey aerobraking), and (3) a new model for effects of high resolution topographic slope on winds near the surface (0 to 4.5 km above MOLA topography level). Mars-GRAM slope winds will be computed from a diagnostic (algebraic) relationship based on Ye, Segal, and Pielke (1990). This approach differs from mesoscale models (such as MRAMS and Mars MM5), which use prognostic, full-physics solutions of the time- and space-dependent differential equations of motion. As such, slope winds in Mars-GRAM will be consistent with its ″engineering-level″ approach, and will be extremely fast and easy to evaluate, compared with mesoscale model solutions. Mars-GRAM slope winds are not being suggested as a replacement for sophisticated, full-physics Mars mesoscale models, but may have value, particularly for preliminary screening of large numbers of candidate landing sites for future Mars missions, such as Phoenix and Mars Science Laboratory. Test output is presented from Mars-GRAM slope winds in the area of Gusev Crater and Valles Marineris.
Author
*Mars Missions; Mars Global Surveyor; Climatology; Mars Surface; Mars Environment*

## 92
## SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see *93 Space Radiation*.

**20040085904** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Tether-Cutting Energetics of a Solar Quiet Region Prominence Eruption**
Sterling, Alphonse C.; Moore, Ronald L.; The Astrophysics Journal; December 20, 2003; Volume 599, pp. 1418-1425; In English; Copyright; Avail: Other Sources

We study the morphology and energetics of a slowly evolving quiet-region solar prominence eruption occurring on 1999 February 8-9 in the solar north polar crown region, using soft X-ray data from the soft X-ray telescope (SXT) on Yohkoh and Fexv EUV 284 Angstrom data from the EUV Imaging Telescope (EIT) on the Solar and Heliospheric Observatory (SOHO). After rising at approximately equal to l kilometer per second for about six hours, the prominence accelerates to a velocity of approximately equal to 10 kilometers per second, leaving behind EUV and soft X-ray loop arcades of a weak flare in its source region. Intensity dimmings occur in the eruption region cospatially in EUV and soft X-rays, indicating that the dimmings result from a depletion of material. Over the first two hours of the prominences rapid rise, flare-like brightenings occur beneath the rising prominence that might correspond to tether-cutting magnetic reconnection. These brightenings have heating requirements of up to approximately 10(exp 28)-10(exp 29) ergs, and this is comparable to the mechanical energy required for the rising prominence over the same time period. If the ratio of mechanical energy to heating energy remains constant through the early phase of the eruption, then we infer that coronal signatures for the tether cutting may not be apparent at or shortly after the start of the fast phase in this or similar low-energy eruptions, since the plasma-heating energy levels would not exceed that of the background corona.
Author
*Solar Prominences; Tethering; Solar Flares; Morphology; Polar Regions*

**20040085914** NASA Marshall Space Flight Center, Huntsville, AL, USA
**CME Eruption Onset Observations from EIT and SXT**
Sterling, A. C.; [2004]; 1 pp.; In English; Solar, Heliosphere and Interplanetary Workshop, 28 Jun. - 1 Jul. 2004, Big Sky, MT, USA; No Copyright; Avail: Other Sources; Abstract Only

Why CMEs erupt is a major outstanding puzzle of solar physics. Signatures observable at the earliest stages of eruption

onset may hold precious clues about the onset mechanism. We present observations in EUV from SOHO/EIT and in soft X-rays from Yohkoh/SXT of the re-eruption and eruption phases of CME expulsion, along with the eruption's magnetic setting found from SOHO/MDI magnetograms. Most of our events involve clearly-observable filament eruptions and multiple neutral lines, and we use the magnetic settings and motions of the filaments to help infer the geometry and behavior of the associated erupting magnetic fields. Pre-eruption and early-eruption signatures include a relatively slow filament rise prior to eruption, and intensity ″dimmings″ and brightenings, both in the immediate neighborhood of the ″core″ (location of greatest magnetic shear) of the erupting fields and at locations remote from the core. These signatures and their relative timings place observational constraints on eruption mechanisms; our recent work has focused on implications for the so-called ″tether cutting″ and ″breakout″ models, but the same observational constraints are applicable to any model.
Author
*Magnetic Signatures; Extreme Ultraviolet Radiation; Signatures; X Rays; Noble Metals; Expulsion*

**20040085976** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Flows in the Solar Convection Zone**
Hathaway, D. H.; [2004]; 1 pp.; In English; Committee on Space Research Assembly, 18-23 Jul. 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

Flows within the solar convection zone are the primary drivers of the Sun's magnetic activity cycle. Differential rotation stretches out the magnetic field and converts poloidal fields into toroidal fields. Zones of strong radial shear are found at both the surface and at the base of the convection zone (the tachocline). The poleward meridional flow near the surface transports magnetic flux that is observed to reverse the magnetic poles near the time of cycle maxima. The deeper (and as yet unobserved), equatorward meridional flow should carry magnetic flux toward the equator where it reconnects with oppositely directed fields in the other hemisphere. The non-axisymmetric flows (granules, supergranules, and giant cells) also transport magnetic flux but in a more random, diffusive, manner. Supergranules and giant cells also play significant roles in driving the large-scale, axisymmetric flows themselves. The effect of solar rotation on supergranulation produces the shear layer near the surface and enhances the meridional flow. The effect of solar rotation on giant cells should produce the latitudinal differential rotation, the shear in the tachocline, and the meridional circulation. In this presentation I will describe the observed and theorized characteristics of the flows in the solar convection zone and discuss their connections to the solar activity cycle.
Author
*Convection; Solar Activity; Flow Characteristics; Sun*

**20040086077** Science Applications International Corp., Huntsville, AL, USA
**Trajectory and System Analysis For Outer-Planet Solar-Electric Propulsion Missions**
Cupples, Michael; Woo, Byoungsam; Coverstone, Victoria L.; Hartmann, John W.; [2004]; 26 pp.; In English; Copyright; Avail: CASI; A03, Hardcopy

Outer-planet mission and systems analyses are performed using three next generation solar-electric ion thruster models. The impact of variations in thruster model, flight time, launch vehicle, propulsion and power systems characteristics is investigated. All presented trajectories have a single Venus gravity assist and maximize the delivered mass to Saturn or Neptune. The effect of revolution ratio - the ratio of Venusian orbital period to the flight time between launch and flyby dates - is also discussed.
Author
*Solar Electric Propulsion; Ion Engines; Trajectory Analysis; Systems Analysis; Propulsion System Performance*

**20040086081** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Solar Magnetic Explosions, Spicules, and the Heliosphere**
Moore, Ronald L.; Yamauchi, Yohei; [2004]; 1 pp.; In English; 2004 Conference of the American Astronomical Society/Solar Physics Division, 30 May - 3 Jun. 2004, Denver, CO, USA; No Copyright; Avail: Other Sources; Abstract Only

We present an example of each of the following observed characteristics of the magnetic origins of quiet-region coronal heating, spicules, macrospicules, and coronal mass ejections (CMEs). (1) In quiet regions, the luminosity of the corona is roughly proportional to the edge length of the underlying photospheric magnetic network. (2) Spicules and EUV explosive events are concentrated at the edges of the magnetic network. (3) Many macrospicules have the magnetic structure of a surge rooted around an inclusion of opposite-polarity magnetic flux. (4) CMEs and eruptive flares are driven by explosions of sheared magnetic fields rooted along polarity dividing lines (neutral lines) in the photospheric magnetic flux. These characteristics together suggest that the mainstay of the heliosphere, the corona/solar wind rooted in quiet regions and coronal

holes, may be driven by myriads of tiny magnetic explosions at the network edges, explosions like those that drive CMEs but of vastly smaller scale. If so, the steady solar wind and the CMEs that disrupt it both have the same root cause: explosions of initially-closed, strongly-sheared, bipolar magnetic fields. The photospheric vector magnetograms, chromospheric filtergrams, EUV spectra, and coronal images from Solar-B are expected to have sufficient sensitivity, spatial resolution, and cadence to test this scenario for coronal heating in quiet regions and coronal holes. This work was supported by NASA/OSS through its Solar and Heliospheric Physics SR and T Program and Sun-Earth Connection GI Program.
Author
*Solar Magnetic Field; Spicules; Heliosphere*

**20040086091** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Solar Spicules: Prospects for Breakthroughs in Understanding with Solar-B**
Sterling, A. C.; [2004]; 1 pp.; In English; Committee on Space Research, 18-25 Jul. 2004, Paris, France; No Copyright; Avail: Other Sources; Abstract Only

Spicules densely populate the lower solar atmosphere; any image or movie of the chromosphere shows a plethora of them or their ″cousins,″ such as mottles or fibrils. Yet despite several decades of effort we still do not know the mechanism that generates them, or how important their contribution is to the material and energy balance of the overall solar atmosphere. Solar-B will provide exciting new chromospheric observations at high time- and spatial-resolution, along with associated quality magnetic field data, that promise to open doors to revolutionary breakthroughs in spicule research. In this presentation we will review the current observational and theoretical status of spicule studies, and discuss prospects for advances in spicule understanding during the Solar-B era.
Author
*Solar Atmosphere; Spicules; NASA Space Programs*

**20040086462** NASA Marshall Space Flight Center, Huntsville, AL, USA
**Main-Sequence CMEs as Magnetic Explosions: Compatibility with Observed Kinematics**
Moore, Ron; Falconer, David; Sterling, Alphonse; [2004]; 1 pp.; In English; 2004 Shine Workshop, 26 Jun. - 2 Jul. 2004, Big Sky, MT, USA; No Copyright; Avail: Other Sources; Abstract Only

We examine the kinematics of 26 CMEs of the morphological main sequence of CMEs, those having the classic three-part bubble structure of (1) a bright front eveloping (2) a dark cavity within which rides (3) a bright blob/filamentary feature. Each CME is observed in Yohkoh/SXT images to originate from near the limb (\g or equal to 0.7 R(sub Sun) from disk center). The basic data (from the SOHO LASCO CME Catalog) for the kinematics of each CME are the sequence of LASCO images of the CME, the time of each image, the measured radial distance of the front edge of the CME in each image, and the measured angular extent of the CME. About half of our CMEs (12) occur with a flare, and the rest (14) occur without a flare. While the average linear-fit speed of the flare CMEs (1000 km/s) is twice that of the non-flare CMEs (510 km/s), the flare CMEs and the non-flare CMEs are similar in that some have nearly flat velocity-height (radial extent) profiles (little acceleration), some have noticeably falling velocity profiles (noticeable deceleration), and the rest have velocity profiles that rise considerably through the outer corona (blatant acceleration). This suggests that in addition to sharing similar morphology, main-sequence CMEs all have basically the same driving mechanism. The observed radial progression of each of our 26 CMEs is fit by a simple model magnetic plasmoid that is in pressure balance with the radial magnetic field in the outer corona and that propels itself outward by magnetic expansion, doing no net work on its surroundings. On average over the 26 CMEs, this model fits the observations as well as the assumption of constant acceleration. This is compatible with main-sequence CMEs being magnetically driven, basically magnetic explosions, with the velocity profile in the outer corona being largely dictated by the initial Alfien speed in the CME (when the front is at approx. 3 (sub Sun), analogous to the mass of a main-sequence star dictating the luminosity.
Author
*Solar Magnetic Field; Coronal Mass Ejection; Kinematics*

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## SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see 52 Aerospace Medicine. For theory see *73 Nuclear Physics*.

**20040085746** NASA Langley Research Center, Hampton, VA, USA
**Sampling Errors of Monthly-mean Radiative Fluxes from the Earth Radiation Budget Satellite**
Bess, T. Dale; Wong, Takmeng; Smith, G. Louis; [2002]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Earth Radiation Experiment (ERBE) consisted of scanning and non-scanning radiometers on the dedicated Earth Radiation Budget Satellite ERBS) and also on the NOAA-9 and -10 operational spacecraft. The non-scanning radiometers included a pair of wide field-of-view (WFOV) radiometers for measuring outgoing longwave radiation and reflected solar radiation (Luther et al., 1986). The ERBS was placed into an orbit with 57 deg. inclination and 620 km altitude on 16 October 1984. The instruments began collecting data in November 1984 and the non-scanning radiometers provided data until June 2002, providing a 17-year data set.
Derived from text
*Data Acquisition; Long Wave Radiation; Radiometers; Terrestrial Radiation*

**20040085919** NASA Marshall Space Flight Center, Huntsville, AL, USA
**The Energy Spectra of Heavy Nuclei Measured by the ATIC Experiment**
Panov, A. D.; Adams, J. H.; Ahn, H. S.; Bashindzhagyan, G. L.; Batkov, K. E.; Chang, J.; Christl, M.; Fazley, A. R.; Ganel, O.; Gunasingha, R. M., et al.; [2004]; 1 pp.; In English; 35th COSPAR Scientific Assembly, 18-25 Jul. 2004, Paris, France; Copyright; Avail: Other Sources; Abstract Only

ATIC (Advanced Thin Ionization Calorimeter) is a balloon-borne experiment to measure the spectra and composition of primary cosmic rays in the region of total energy from 100 GeV to near 100 TeV for Z from 1 to 26. ATIC consists of a pixelated silicon matrix detector to measure charge plus a fully active BGO calorimeter, to measure energy, located below a carbon target interleaved with three layers of scintillator hodoscope. The ATIC instrument had a second (scientific) flight from McMurdo, Antarctica from 12/29/02 to 1/18/03, yielding 20 days of good data. The GEANT 3.21 Monte Carlo code with the QGSM event generator and the FLUKA code with the DPMJET-II event generator were used to convert energy deposition measurements to primary energy. We present the preliminary energy spectra for the abundant elements C, O, Ne, Mg, Si and Fe and compare them with the results of the first (test) flight of ATIC in 2000-01 and with results from the HEAO-3 and CRN experiments.
Author
*Energy Spectra; Heavy Nuclei; Ionization; Heat Measurement*

**20040086061** NASA Langley Research Center, Hampton, VA, USA
**Validation of the CERES Shortwave Measurements over Desert and Cloud Scenes**
Currey, Chris; Green, Richard; [1999]; 4 pp.; In English; No Copyright; Avail: CASI; A01, Hardcopy

The Clouds and the Earth's Radiant Energy System (CERES) broadband shortwave channel, 0.3 - 5 micron, measures atmosphere and surface reflected solar radiation. CERES provides an in-flight tungsten lamp to monitor the shortwave radiometric stability over the lifetime of the instrument. Initial Tropical Rainfall Measurement Mission (TRMM) tungsten calibration results indicate a 0.6% change over the first six months of mission life. The three channel intercomparison technique and the solar diffuser calibration results show shortwave stabilities of 0.2% and 0.3% for the same time period. Current belief is that the tungsten lamp, not the radiometer, has drifted. Radiometers, optics, and onboard calibrators exposed to the harsh space environment often degrade. Independent validation studies based on bright Earth viewing measurements are necessary to support the in-flight filtered calibration results. Instrument measurements of filtered radiances are
Derived from text
*Aerospace Environments; Radiant Flux Density; Radiometers; Solar Radiation*

## 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.

**20040085536**
**Incremental Seismic Rehabilitation of Schools Buildings (K-12)**
Dec. 2002; In English
Report No.(s): PB2004-106536; No Copyright; Avail: National Technical Information Service (NTIS)

This manual is intended to assist school administration personnel responsible for the funding and operation of existing school facilities across the USA. This guide and its companion documents are the products of a Federal Emergency Management Agency (FEMA) project to develop the concept of incremental seismic rehabilitation-that is, building

modifications that reduce seismic risk by improving seismic performance and that are implemented over an extended period, often in conjunction with other repair, maintenance, or capital improvement activities. The manual was developed after analyzing the management practices of school districts of varying sizes located in various seismic zones in different parts of the USA. It focuses on the identified concerns and decision-making practices of K-12 public and private school managers and administrators. This manual is part of a set of manuals intended for building owners, managers, and their staff: Incremental Seismic Rehabilitation of School Buildings (K-12), FEMA 395; Incremental Seismic Rehabilitation of Hospital Buildings, FEMA 396; Incremental Seismic Rehabilitation of Office Buildings, FEMA 397; Incremental Seismic Rehabilitation of Multifamily Apartment Buildings, FEMA 398; Incremental Seismic Rehabilitation of Retail Buildings, FEMA 399; Incremental Seismic Rehabilitation of Hotel and Motel Buildings, FEMA 400; Incremental Seismic Rehabilitation of Storage Buildings, FEMA 401; and Incremental Seismic Rehabilitation of Emergency Buildings, FEMA 402. Each manual in this set addresses the specific needs and practices of a particular category of buildings and owners, and guides owners and managers through a process that will reduce earthquake risk in their building inventory.
NTIS
*Buildings; Earthquakes; Schools; Manuals*

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