



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 PUBLICATION.** Reports of completed research or major significant phases of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed of continuing reference value. NASA counterpart of peer-reviewed formal professional papers, but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are of preliminary or specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.
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- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

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- Telephone the NASA STI Help Desk at (301) 621-0390
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NASA STI Help Desk  
NASA Center for AeroSpace Information  
7121 Standard Drive  
Hanover, MD 21076-1320

# Introduction

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

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

*STAR* includes citations to Research & Development (R&D) results reported in:

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

## The NASA STI Program

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

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

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

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

# NASA STI Availability Information

## NASA Center for AeroSpace Information (CASI)

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

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

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

## National Technical Information Service (NTIS)

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

## The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** (FDLP) to ensure access by the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal Depository Libraries [http://www.access.gpo.gov/su\\_docs](http://www.access.gpo.gov/su_docs).

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

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

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[Personal Author Index](#)

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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

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VOLUME 41, JULY 11, 2003

## 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*.

**20030058046** Maryland Univ., College Park, MD

### **Innovative Technologies for Actively Controlled Jet-Smooth Quiet Rotorcraft**

Chopra, Inderjit; Jul. 2002; 75 pp.; In English

Report No.(s): AD-A411456; ARO-35899.4-EG-MUR; No Copyright; Avail: CASI; [A04](#), Hardcopy

The status of a number of rotorcraft research tasks supported under the Army Research Office FY96 MURI on Rotorcraft Vibration and Acoustics program is reported herein. Each of over twenty tasks conducted under this program are briefly detailed in an extended abstract format. Readers are encouraged to contact the individual task leaders for more detailed and comprehensive information including journal and conference paper citations. For each task, the following items are presented: the task objectives, the approach being taken, the status of the research at the end of the program of research, collaborations undertaken with government and industrial scientists, and a list of publications in conference proceedings and archival journals.

DTIC

*Helicopters; Aerodynamics*

**20030058938** Rutgers - The State Univ., New Brunswick, NJ

### **Localized Flow Control With Energy Deposition**

Adelgren, Russel G.; Oct. 2002; 361 pp.; In English

Report No.(s): AD-A411007; CI02-798; No Copyright; Avail: CASI; [A16](#), Hardcopy

A series of experiments with energy deposition via laser-induced optical breakdown of air, i.e., a laser spark, have been performed. These experiments have demonstrated the possibility of using a laser spark for supersonic flow control. A focused Nd:YAG laser (pulse time of 10 nanoseconds, pulse frequency of 10 Hz, and capable of energy levels up to 600 milli-Joules per pulse) was used to create the energy deposition laser spark. This laser energy deposition was then tested in quiescent air, upstream of a Mach 3.45 sphere with and without shock impingement, into shock structures within the dual solution domain, and into a compressible shear layer.

DTIC

*Supersonic Flow; Air Flow; Laser Deposition; Position (Location); Energy Technology*

## 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*.

**20030057762** Parsons Transportation Group, Inc., Miami, FL, USA

### **Airport Skopje Feasibility Study. Airport Upgrade/Rehabilitation Report**

Aug. 2000; In English

Report No.(s): PB2002-101050; No Copyright; Avail: National Technical Information Service (NTIS)



This report, conducted by Parsons Transportation Group, was funded by the USA Trade and Development Agency to examine the feasibility of an airport upgrade/rehabilitation project in Macedonia. The report, in one volume, contains information on scope of work, approach, airport background, aviation forecasts, airport facilities survey, airport land use plan and upgrade program, financial considerations, environmental analysis, and list of U.S. sources of supply. This project has the potential to produce \$30 to \$40 million in U.S. exports, with the bulk of those exports coming from 100% HBS equipment, mechanical equipment, baggage reclaim devices, security screening equipment, baggage make-up carousel, maintenance equipment, security access equipment, telecommunications computer equipment, sewage treatment equipment, electrical equipment, project and construction management, terminal components, other building components, de-icing equipment and air traffic control equipment.

NTIS

*Airports; Feasibility Analysis*

**20030057831** Massachusetts Inst. of Tech., Lexington, MA, USA

**Medium Intensity Airport Weather System NEXRAD Selection Recommendations**

Rappa, G. W.; Apr. 29, 2003; 40 pp.; In English

Report No.(s): PB2003-104541; ATC-311; No Copyright; Avail: CASI; [A03](#), Hardcopy

In December of 1999, the Federal Aviation Administration (FAA) contracted Lincoln Laboratory to develop and demonstrate a new type of weather alert system. Their objective was to provide air traffic controllers at medium-intensity airports with a real time color display of weather impacting the terminal airspace. The weather data was to come from nearby Doppler weather surveillance radars, called Next Generation Radar (NEXRAD), typically owned and operated by the National Weather Service (NWS). Lincoln Laboratory has been operating prototypes of the Medium Intensity Airport Weather System (MIAWS) since May of 2000 at field sites in Memphis, TN; Jackson, MS; Little Rock, AR; and Springfield, MO. With the success of the MIAWS prototypes and favorable response among air traffic controller users, the FAA is seeking to rapidly deploy MIAWS systems at 40 airports within the National Airspace System (NAS). This report identifies suitable NEXRAD systems for each of the 40 MIAWS airports and three additional test and/or maintenance FAA facilities. Several other radar selection options are also provided to account for availability and cost-saving contingencies.

NTIS

*Meteorological Radar; Air Traffic Control; Real Time Operation; Display Devices; Airports*

**20030057987** Naval Air Warfare Center, Patuxent River, MD

**Review of the Carrier Approach Criteria for Carrier-Based Aircraft - Phase I: Final Report**

Rudowsky, Thomas; Hynes, Marshall; Luter, Melvin; Niewoehner, Robert; Senn, Page; Oct. 10, 2002; 219 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411068; NAWCADPAX/TR-2002/71; No Copyright; Avail: CASI; [A10](#), Hardcopy

The approach speed criteria used in the design and development of carrier-based aircraft was investigated. This report provides a historical review, analysis of requirements, and an analysis of legacy aircraft relative to the approach speed criteria. The relevancy and adequacy of the carrier approach speed criteria are assessed. Recommendations for future investigations and assessment are presented.

DTIC

*Aircraft Carriers; Aircraft Design; Airspeed*

## 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*.

**20030057796** Wichita State Univ., Wichita, KS, USA, Maryland Univ., College Park, MD, USA

**Guidelines for Analysis, Testing, and Nondestructive Inspection of Impact-Damaged Composite Sandwich Structures**

Shyprykevich, P.; Tomblin, J.; Ilcewicz, L.; Vizzini, A. J.; Lacy, T. E.; Mar. 2003; 106 pp.; In English

Report No.(s): PB2003-104228; No Copyright; Avail: CASI; [A06](#), Hardcopy

Sandwich construction composites are used in a wide variety of structural applications largely because of their relative advantages over other designs in terms of improved stability, weight savings, and ease of manufacture and repair. While the

design of sandwich structures is at a fairly mature stage of development, less progress has been made in understanding the effect of adverse in-service impact events on structural integrity. Foreign object impact damage in sandwich composites can be attributable to a number of fairly common discrete sources and may result in drastic reductions in composite strength, elastic moduli, and durability and damage tolerance characteristics. In this report, past work is summarized and synthesized to provide guidance for analysis, testing, and nondestructive inspection of impact-damaged composite structures.

NTIS

*Sandwich Structures; Composite Structures; Nondestructive Tests; Damage Assessment; Structural Design*

**20030057886** National Academy of Sciences - National Research Council, Washington, DC

**Search, Observation, and Attack Problems**

Bolonkin, Alexander A.; Cloutier, James R.; Jul. 2002; 23 pp.; In English

Contract(s)/Grant(s): Proj-2068

Report No.(s): AD-A410927; AFRL-MN-EG-TR-2003-7017; No Copyright; Avail: CASI; [A03](#), Hardcopy

A significant amount of research is being conducted on the cooperative behavior of multiple uninhabited combat aerial vehicles (UCAVs) in the area of search, observation, target recognition, and attack. The cooperative behavior must be carried out in a communications- limited, noisy, adversarial, and uncertain environment. It is envisioned that effective solutions of these problems will involve a combination of top-level operations research/artificial intelligence type decision making combined with distributed control, distributed estimation, and real-time trajectory optimization. The solutions of several problems which have importance in the cooperative behavior of multiple vehicles are presented.

DTIC

*Active Control; Real Time Operation; Target Recognition; Trajectory Optimization; Pilotless Aircraft*

**20030057949** Georgia Inst. of Tech., Atlanta, GA

**A Three Phase Approach to Solving the Bidline Generation Problem with an Emphasis on Mitigating Pilot Fatigue Through Circadian Rule Enforcement**

Weir, Jeffrey D.; Oct. 16, 2002; 96 pp.; In English

Report No.(s): AD-A410818; CI02-782; No Copyright; Avail: CASI; [A05](#), Hardcopy

A three phase methodology for solving the Bidline problem for airline crew scheduling is proposed. Phase 1 ensures that the all bidlines will meet a fatigue mitigating minimum rest window that will be constant throughout the entire bid period. Phase 2 ensures that most of the bidlines follow regular weekly and monthly patterns much like shiftwork in other industries that have 24-hour-a-day operations. Finally, Phase 3 creates a final monthly schedule that will minimize the number of crews needed during a bid period to cover all of the pairings, and maintain the fatigue-mitigating rest window as well as all of the quality of life issues addressed in Phase 2. Along with this methodology, a heuristic for solving Bin Packing and Cutting-Stock problems is developed.

DTIC

*Flight Crews; Scheduling*

**20030058037** Florida State Univ., Tallahassee, FL

**Active Jet Noise Control**

Krothapalli, Anjaneyulu; Feb. 2003; 77 pp.; In English

Contract(s)/Grant(s): N00014-01-1-0396

Report No.(s): AD-A411986; FMRL-03-01; No Copyright; Avail: CASI; [A05](#), Hardcopy

A novel high-speed jet noise suppression technique using high-pressure gas microjet injection at the nozzle exit was developed with promising results using the laboratory scale jet. The main jet parameters, the nozzle pressure ratio and the temperature ratio are chosen to correspond with realistic engine operating conditions. Keeping in mind the applicability of the technique to full-scale engines, the microjet mass flow was kept at less than 2% of the primary jet mass flow. The A-weighted spectrum with appropriate scaling to reflect the full-scale nozzle show a 6 dBA reduction in the peak noise radiation direction. An attempt is made during this investigation to develop Active Noise Control methods for cancellation of broadband jet noise. A demonstration of successful control architecture has been accomplished using the colored random noise cancellation. An actuator based on pulsed microjet appears to be most promising for the current application. A specially designed micro valve operating at high pressures and high frequencies was developed and tested successfully. The valve was able to provide a pulsed jet operating at nozzle exit mean pressure of about 45 sia at 2000 Hz.

DTIC

*Active Control; Noise Reduction; Jet Aircraft Noise; Control*

**20030058050** Air Force Research Lab., Wright-Patterson AFB, OH

**Stable Neural Control of Uncertain Multivariable Systems**

Mears, Mark J.; Polycarpou, Marios M.; Dec. 2001; 26 pp.; In English

Report No.(s): AD-A411951; AFRL-VA-WP-TP-2002-331; No Copyright; Avail: CASI; [A03](#), Hardcopy

Tracking control of a class of nonlinear, uncertain, multi-input, multiple-output systems is addressed in this paper. The control system architecture uses neural networks for function approximation, certainty equivalent control inputs to cancel plant dynamics and smoothed sliding mode control to insure that the trajectories remain bonded. Lyapunov analysis is used to derive equations for the sliding mode control, neural network training, and to show uniform ultimate boundedness of the closed loop systems. Stability analysis results are shown for single-input single-output and two-input two-output systems. Results are then extended to the more general multiple-input multiple-output case where the number of inputs is equal to the number of outputs. Simple simulation examples are used to illustrate control system performance.

DTIC

*Control Systems Design; MIMO (Control Systems); Multivariable Control; Neural Nets; SISO (Control Systems); Control Simulation; Simulation*

**20030058069** Naval Postgraduate School, Monterey, CA

**An Analysis of the Requisition Process and Readiness For F/A 18E/F integrated Readiness Support Team (FIRST) Program**

Noll, Daniel J.; Simonson, Bernad L.; Dec. 2002; 66 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411020; No Copyright; Avail: CASI; [A04](#), Hardcopy

Naval Aviation is beginning a transformation into a new era of logistics support. The beginning of a U.S. Navy/Industry teaming effort started with the U.S. Navy's F/A-18 E/F program. The new aircraft is supported through both standard military logistics programs and a brand new commercial logistics application known as F/A-18 E/F Integrated Readiness Support Teaming (FIRST). The non-traditional contract with Boeing is intended to outsource some maintenance, supply and inventory control for the new aircraft onto Boeing. The intended benefits behind the new concept include reduced costs, increased supply responsiveness and greater efficiency through commercial logistics applications. Promising increased aircraft readiness and seamless implementation, both Boeing and U.S. Navy representatives have great expectations for the new system. Our research investigates the impact FIRST is having on F/A-18 E/F Operational Availability (Ao) through an evaluation of Supply Response Times (SRT) and actual squadron Mission Capability Rates for the period of 01 April 2002 through 30 June 2002. Our results suggest that although repairable parts are currently delivered more quickly through the FIRST program, the contract measurement of SRT may not reflect any long the improvements in F/A-18 E/F readiness.

DTIC

*Attack Aircraft; Military Aviation*

**20030058083** Air Force Research Lab., Wright-Patterson AFB, OH

**A Model of the Acoustic Intensity Field Generated by a Multi-Engine Turbo-Prop Aircraft**

Davis, Brian S.; Sep. 2002; 57 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-7184

Report No.(s): AD-A412231; AFRL-HE-WP-TR-2002-0191; No Copyright; Avail: CASI; [A04](#), Hardcopy

High levels of noise within the fuselage of a turbo-prop aircraft cannot be mitigated by traditional acoustic coating techniques, since the primary frequencies are generally less than 500 Hz. Tests of an advanced device, designed to control the relative phase between the engines, identified 10-20 dB reductions in the acoustic noise levels within the fuselage. An analytical framework was developed to model the observed effects independent of airframe design. The Green's function for the three-dimensional non-homogeneous acoustic wave equation was used to obtain the radiation fields for three specific source functions: a harmonic point source, a pulsating non-harmonic distributed source, and a single uniformly rotating paddle. Comparisons were made between the observed data and models for three specific sets of relative engine phases. Although each model exhibited some of the features of the actual data set, no particular source function reproduced all features of the measured data.

DTIC

*Turboprop Engines; Noise (Sound)*

**20030058741** Naval Postgraduate School, Monterey, CA

**Design Recovery and Implementation of the AYK-14 VHSIC Processor Module Adapter With Field Programmable Gate Array Technology**

Fetter, Bryan J.; Dec. 2002; 218 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411342; No Copyright; Avail: CASI; [A10](#), Hardcopy

The rapid pace of change in the electronics industry and the significant reduction in military budgets over the past decade has forced many military aircraft to extend their service lifetimes. This has led to aircraft with outdated avionics systems being required to accomplish new and more complex missions. This thesis examines the process of reengineering an outdated avionics system to economically upgrade its capabilities through the FPGA implementation of a binary compatible replacement. The system targeted is the AN/AYK-14(V) Navy Standard Airborne Computer, specifically the XN-8 chassis used as the mission computer onboard the F/A-18 C/D aircraft. This thesis is also intended to provide a resource document on the AYK-14 for a study being conducted by the Naval Air Systems Command (NAVAIR) Advanced Weapons Laboratory (AWL). The design of the Input / Output module of the VHSIC Processor Module was recovered through research of documentation and hardware testing. The recovered design was modeled using VHDL, synthesized and implemented using computer-aided design (CAD) tools. This thesis shows that replacement of legacy systems through use of FPGA technology is a viable option, however, expansion of the design is recommended to create a truly binary compatible replacement.

DTIC

*Avionics; Military Aircraft; Life (Durability)*

**20030058753** RAND Corp., Santa Monica, CA

**Military Jet Engine Acquisition: Technology Basics and Cost-Estimating Methodology**

Younossi, Obaid; Arena, Mark V.; Moore, Richard M.; Lorell, Mark; Mason, Joanna; Jan. 2002; 168 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49642-01-C-0003

Report No.(s): AD-A411857; RAND/MR-1596; No Copyright; Avail: CASI; [A08](#), Hardcopy

Good cost estimates contribute significantly to an effective acquisition policy. RAND has a long history of producing cost-estimating methodologies for military jet engines. Two of RAND's more recent studies of turbine engine costs are Nelson (1977) and Birkler, Garfinkle, and Marks (1982). This report updates those earlier studies by incorporating cost and technical data on recent engine development and production efforts. We analyzed this information and produced a set of parametric relationships to estimate turbofan engine development costs, development schedules, and unit production costs. In this analysis, we have extended and improved upon earlier RAND analyses in two key ways: The previous RAND studies grouped turbojet and turbofan engines into the same population. To provide a more homogeneous population, we focused exclusively on parametric relationships for turbofan engines in this study (because pure turbo-jet engines are largely no longer used in modern aircraft). In the previous studies, it was often not clear how the data from a particular engine family was treated. In our analysis, we treat each model (or 'dash number') as a separate observation. We explicitly consider how derivative engines relate to first-of-a-kind engines.

DTIC

*Methodology; Military Aircraft; Cost Estimates; Jet Engines*

**20030058786** Naval Postgraduate School, Monterey, CA

**Case Study of the Development of the Apache Attack Helicopter (AH-64)**

Ference, William W.; Dec. 2002; 95 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411790; No Copyright; Avail: CASI; [A05](#), Hardcopy

This research examines advances in aviation technologies that allowed the Apache to become the world's premier attack helicopter. This thesis presents answers to a structured set of questions that address issues concerning outside influences, technology maturity and program management. It evaluates the role of development and test strategies, and whether these have helped to create a functional system. The research methodology is a Case Study. This thesis provides the reader with a thorough understanding of how the history of Army aviation has evolved leading to the requirement for an attack helicopter on the modern battlefield. The emphasis of this document is to follow a major weapon system through its lifecycle leading to successful deployment. Lessons learned are presented in a clear concise manner addressing issues of prime concern to any size program.

DTIC

*Ah-64 Helicopter; Project Management; Case Histories*

**20030058792** Naval Research Lab., Washington, DC

**Autophagous Design and Material Options for Forward Deployed Aircraft IR decoys with Reduced Risk of Foreign Object Damage**

Thomas, James P.; Mar. 7, 2003; 14 pp.; In English

Contract(s)/Grant(s): N0001402WX30011

Report No.(s): AD-A412216; NRL/MR/6350--03-8672; No Copyright; Avail: CASI; [A03](#), Hardcopy

New infrared (IR) decoys are being developed that will be forward launched from a moving aircraft. Autophagous (self-consuming) materials and components that quickly combust after deployment into harmless debris are considered in this study. The possibility of engine ingestion of an intact IR Decoy strongly suggests the use of relatively 'soft' materials that will minimize damage. Based on this and other findings determined in this study, a laminate shell design comprised principally of polymeric and organic (e.g., paper) layers joined or embedded with pyrotechnic substances is recommended for further research and development. Such a shell will probably require one or more layers of aluminum foil for oxygen and moisture barrier purposes and an inertia or electric activated primer system for ignition after launch. Properly designed, such an autophagous shell should be capable of providing: (a) protective and safe packaging for the IR Decoy during handling and launch; (b) sustained IR reactivity through protection from the atmosphere; and (c) disintegration via combustion of fragmented pieces prior to possible interaction with the launching aircraft.

DTIC

*Military Aircraft; Aircraft Hazards; Decoys*

**20030058795** Dayton Univ. Research Inst., OH

**Point of Maintenance Ruggedized Operational Device Evaluation and Observation Test Report**

Gorman, Megan; Donahoo, Carlton; Quill, Laurie; Jernigan, Johnnie; Nov. 2002; 114 pp.; In English

Contract(s)/Grant(s): F33615-99-D-6001; Proj-1710

Report No.(s): AD-A412249; AFRL-HE-WP-TR-2002-0251; No Copyright; Avail: CASI; [A06](#), Hardcopy

The Air Force Directorate of Maintenance (USAF/ILM) and the Standard Systems Group, Maintenance Systems Division (HQ SSG/ILM) sponsored an evaluation test for the purpose of identifying potential electronic tools for use at the flightline point of maintenance. The Air Force Research Laboratory, Logistics Readiness Branch (AFRL/HESR) and the University of Dayton Research Institute (UDRI) were commissioned by SSG/ILM to independently and objectively perform the evaluation. The evaluation was conducted at the 57th AGS, Nellis AFB, Nevada, 20-22 August 2002. The Ruggedized Operational Device Evaluation and Observation (RODEO) test examined hardware packaging, software user interface, and environmental factors associated with the usability of potential Point of Maintenance (POMx) electronic tools (E-Tools). The test evaluated the usability of 11 potential e-tools for use in an Air Force flightline environment. The evaluation compared the platforms for maintenance documentation (e.g., opening work orders) from the aircraft location. The eleven devices consisted of: (1) five notebook computers, (2) two handheld computers, (3) two palm computers, and (4) two alternative computer types (a slate computer and a hybrid handheld/ notebook). Air Force personnel used each device in a flightline-type setting to simulate opening work orders. They were required to try each device with and without chemical gloves and masks. This report documents the findings of the evaluations, based on analysis of participant comments, ratings, and rankings.

DTIC

*Evaluation; Ruggedness; Electronic Equipment*

**20030058838** Naval Research Lab., Washington, DC

**Human Factors Study: Vector Map Evaluation for TAMMAC**

Trenchard, Michael E.; Edwards, Stephanie S.; Clarke, William K.; Lohrenz, Maura C.; Collins, Christopher; Mar. 7, 2003; 27 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412191; NRL/MR/7440--03-8292; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Tactical Aircraft Moving Map Capability (TAMMAC) Program (NAVAIR PMA-209) has identified the use of vector map products as a high priority growth item. The TAMMAC Program will conduct an EME effort during FY03-FY05 to incorporate the use of vector map data, specifically, the National Imagery and Mapping Agency's (NIMA) Vector Product Format (VPF) standard. In support of this effort, the Naval Research Laboratory was tasked to evaluate the potential functional benefits of vector map data and specific NIMA vector map products. This study focused on the functional aspect of using vector maps in the cockpit. The results from this effort are to help develop and refine the implementation requirements of vector maps as a growth item in TAMMAC and influence requirements for future map displays. In addition, the results are

to help segregate the mission planning aspects of vector map mission planning from cockpit functional needs.  
DTIC

*Human Factors Engineering; Display Devices; Computer Aided Mapping*

**20030058853** Naval Postgraduate School, Monterey, CA

**Case Study of the Development of the Target Acquisition Designation/Pilot Night Vision System**

Oelrich, Jerome A.; Dec. 2002; 115 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411034; No Copyright; Avail: CASI; [A06](#), Hardcopy

This thesis is a case study of the extent to which a series of factors influenced development of the U.S. Army Target Acquisition Designation System/Pilot Night Vision System (TADS/PNVS). This study is one of a series being prepared under an ongoing research effort sponsored by Headquarters U.S. Army Material Command (AMC). These studies will look at various weapon systems that participated in Operation Desert Storm (ODS) and will study the effectiveness of their Development Strategies, for the purpose of later comparing system effectiveness in ODS. The TADS/PNVS was developed for the AH-64A Apache Helicopter, as a sighting system for the Hellfire missile system. This case study focuses on the system's three critical technologies, evaluates their technical maturity at various stages versus Technology Readiness Levels, and analyzes how that affected the later development and testing. The study also highlights funding stability, user involvement, integrated product teams, and testing strategies. The thesis focuses particular attention on testing, and whether testing of the TADS/PNVS system was sufficient and timely during development.

DTIC

*Night Vision; Target Acquisition; Aircraft Pilots; Defense Program; Protective Clothing*

**20030058860** National Academy of Sciences - National Research Council, Washington, DC

**Search for Enemy Targets**

Bolonkin, Alexander A.; Cloutier, James; Jun. 14, 2002; 51 pp.; In English

Contract(s)/Grant(s): Proj-2068

Report No.(s): AD-A411003; AFRL-MN-EG-TR-2003-7016; No Copyright; Avail: CASI; [A04](#), Hardcopy

A significant amount of research is being conducted on the cooperative behavior of multiple uninhabited combat aerial vehicles (UCAVs) in the area of search, observation, target recognition, and attack. The cooperative behavior must be carried out in a communications- limited, noisy, adversarial, and uncertain environment. It is envisioned that effective solutions of these problems will involve a combination of top-level operations research/artificial intelligence type decision making combined with distributed control, distributed estimation, and real-time trajectory optimization. The solutions of several problems which have importance in the cooperative behavior of multiple vehicles are presented.

DTIC

*Pilotless Aircraft; Combat; Artificial Intelligence; Target Recognition*

**20030058940** Civil Aerospace Medical Inst., Oklahoma City, OK, USA

**Development of an Empirically-Based Index of Aircraft Mix**

Pfleiderer, Elaine M.; May 2003; 14 pp.; In English

Contract(s)/Grant(s): AM-B-02-HRR-522

Report No.(s): DOT/FAA/AM-03/8; No Copyright; Avail: CASI; [A03](#), Hardcopy

The present study is part of an ongoing effort to identify objective predictors of subjective air traffic controller workload. The study begins with a comparison of the salient variables governing en route controllers perceptions of the performance capabilities of a sample of aircraft and the actual performance of the aircraft in the en route environment. A group of 24 Certified Professional Controllers (CPCs) from Kansas City (N = 17) and Boston (N = 7) en route centers provided estimates of cruising speed, climb, and descent rates for a sample of 24 aircraft types. A matrix of squared Euclidean distances derived from summary measures (i.e., means of estimated speed, climb, and descent rates) was used to construct a classical multidimensional scaling (CMDS) model representing controllers perceptions of the performance capabilities of each aircraft type. A second matrix was derived from means of speed, climb, and descent rates for the same 24 aircraft types computed from a sample of live air traffic data collected from the Kansas City and Boston en route centers. This matrix was used to construct a second CMDS model representing actual aircraft performance. Interpretation of the dimensions of the CMDS model of ATC estimates suggested that Dimension 1 was related to engine type, whereas Dimension 2 was primarily associated with aircraft weight class. In the model of SAR data, both engine type and weight class were predominantly associated with Dimension

1. Results are used to develop a measure of aircraft mix (i.e., the mix of aircraft with different performance characteristics) to be added to a suite of controller activity and taskload measures.

Author

*Air Traffic Control; Aircraft Design; Aerospace Engineering; Civil Aviation; Aircraft Models; Numerical Analysis*

**20030058942** Air Force Research Lab., Wright-Patterson AFB, OH

**Simulation Laboratory for Unmanned Aerial Vehicle Research**

Nalepka, Joseph; Duquette, Matthew; Jan. 2003; 8 pp.; In English

Report No.(s): AD-A411093; AFRL-VA-WP-TP-2003-302; No Copyright; Avail: CASI; [A02](#), Hardcopy

Virtual simulations are simulations that are operated at real-world time intervals and usually require human-in-the-loop intervention to accomplish a set of simulation tasks. An example of this type of simulation would be a pair of piloted aircraft working together to acquire and deliver a weapon on to a specific target. For Unmanned Aerial Vehicles (UAVs), this type of simulation will be used to address issues related to mixed fleet operations, autonomous control, concepts of operation, and the UAV operator/vehicle interface.

DTIC

*Pilotless Aircraft; Simulation; Computerized Simulation; Automatic Control; Operations Research*

**20030058956** Air Force Inst. of Tech., Wright-Patterson AFB, OH

**A Systems Engineering Approach to Aircraft Kinetic Kill Countermeasure Technology: Development of an Active Air Defense System for the C/KC-135 Aircraft. Volume 2**

Cherry, Mark C.; Dewitt, Bruce R.; Dusseault, Christopher G.; Hagan, Joel J.; Peterson, Brian S.; Dec. 1995; 282 pp.; In English

Report No.(s): AD-A412355; AFIT/GSE/ENY/95D-01-VOL-2; No Copyright; Avail: CASI; [A13](#), Hardcopy

Modern Surface to Air Missiles (SAMs) present a significant threat to today's military and civilian aircraft. Current countermeasure systems such as flares and chaff rely on decoying the missile threat and do not provide adequate protection against advanced computerized missiles (Schaffer, 1993:1). An aircraft defense system that actively seeks out and defeats an incoming missile by placing a physical barrier in the missile's path offers a promising alternative to current countermeasures technology. This thesis reports the preliminary design of an active aircraft defense system for the protection of the C/KC-135 aircraft from SAMs. The developed system utilizes a kinetic kill mechanism to protect the aircraft from shoulder launched missiles while the aircraft is in the takeoff and climb-out configurations. Both smart anti-missile expendables and dumb projectile expendables are evaluated. The iterative Systems Engineering approach is used to narrow the solution set to the optimal design. The final outcome is the refined design of two candidate aircraft defense system employing a kinetic kill mechanism. Both systems utilize a modified ultra-violet tracker and employ one of two types of nets, one made out of Detonation Cord and the other made out of Spectra.

DTIC

*Air Defense; Systems Engineering; Transport Aircraft*

## 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*.

**20030058058** Ohio State Univ., Columbus, OH

**Combining State Dependent Riccati Equation Approach With Dynamic Inversion: Application to Control of Flight Vehicles**

Yedavalli, Rama K.; Shankar, Praveen; Doman, David B.; Feb. 2003; 18 pp.; In English

Contract(s)/Grant(s): F33615-01-2-3154

Report No.(s): AD-A411945; AFRL-VA-WP-TP-2003-300; No Copyright; Avail: CASI; [A03](#), Hardcopy

State Dependent Algebraic Riccati Equation (SDRE) techniques are rapidly emerging as a design method, which provides a systematic and effective means of designing nonlinear controllers, observers, and filters. This paper describes a new method of integrating the SDRE technique with the Dynamic Inversion control law that is frequently used in the design of aircraft

control systems. This paper also provides an example by applying this control design technique to a reusable launch vehicle.  
DTIC

*Dynamic Control; Aircraft Design; Aircraft Control; Control*

## 09

### RESEARCH AND SUPPORT FACILITIES (AIR)

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

**20030058954** Army Engineer Research and Development Center, Vicksburg, MS, USA

#### **Rejuvenators, Rejuvenator/Sealers, and Seal Coats for Airfield Pavements**

Shoenberger, James E.; February 2003; 122 pp.; In English

Report No.(s): AD-A412361; ERDC/GSL-TR-03-1; No Copyright; Avail: CASI; [A06](#), Hardcopy

There are a number of proprietary rejuvenator, rejuvenator/sealer, and a seal coat materials currently available. It should be noted that throughout this report the term rejuvenator will be used to describe both rejuvenator and rejuvenator/sealer materials, because the primary purpose in this study was to use these materials to rejuvenate the asphalt pavement. Because of the proprietary nature of these materials, specifications that use performance-based requirements rather than material requirement specifications are highly preferred. One important requirement in the development of this type of specification is a field performance comparison of the various materials with known application and material property parameters. The objective of this study was to investigate the comparative field performance of various rejuvenators and seal coat materials. The field performance of these materials was evaluated over a period of more than 1 year. The materials evaluated in this study were proprietary products. The study was not intended to determine the best or optimum rejuvenator or seal coat material but was intended to provide information for the development or updating of guide specifications for field use of these types of materials. The scope of this study was to evaluate several types of coal-tar- and petroleum-based rejuvenators and seal coat materials. The materials were placed at two airfields and their effect on the binder properties of the treated pavement was compared to untreated areas. The field performance of the rejuvenator and seal coat materials was evaluated through their effects on skid resistance, texture, and changes on visual appearance. This report covers the placement and performance of the materials included in this study.

DTIC

*Pavements; Protective Coatings; Runways*

**20030059034** Defence Science and Technology Organisation, Edinburgh, Australia

#### **The Royal Australian Air Force, Virtual Air Environment, Interim Training Capability**

Blacklock, Jon; Zalcmann, Lucien; April 2003; 43 pp.; In English; Original contains color illustrations

Report No.(s): DSTO-CR-0279; DODA-AR-012-558; Copyright; Avail: CASI; [A03](#), Hardcopy

Currently some Australian Defence personnel train using live assets. This may be prohibitively expensive and some of these assets have very short lifetimes before a major overhaul is required. DSTO has participated in a series of concept demonstrations showing the potential of synthetic, virtual environment technologies to support such operational training. These demonstrations showed both Joint and Coalition interoperability. A Distributed Interactive Simulation (DIS), virtual environment, training system known as the Air Defence Ground Environment Simulator (ADGESIM) has been developed and delivered. A mix of Commercial-Off-The-Shelf (COTS) products and customized, thin client applications where required, approach has been adopted. This system is now being used by Air Defence Operators and Fighter Controllers, at RAAF 1 Williamstown, for real operational training. This paper describes some of the distributed, virtual, simulation concepts and technologies used, in DSTO's Advanced Distributed Simulation Laboratory at Fishermans Bend, Melbourne, to develop this training system.

Author

*Pilot Training; Virtual Reality; Military Aircraft; Armed Forces (Foreign); Distributed Interactive Simulation*



**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*.

**20030057968** Military Operations Research Society, Alexandria, VA  
**Tackling the Space Community's Analytical Challenges Workshop Report**

Beers, Suzanne M.; May 30, 2002; 54 pp.; In English

Contract(s)/Grant(s): N00014-99-C-0113

Report No.(s): AD-A411158; No Copyright; Avail: CASI; [A04](#), Hardcopy

USA Space Command combines Air Force, Army and Navy space components to provide space-based support and combat capabilities to the warfighting Commanders-in-Chief (CINCs). The support is currently focused predominantly in the areas of communication, navigation, meteorology, surveillance and reconnaissance. Although no current combat capabilities are provided directly from space, the future is ripe to exploit space for 'gaining and maintaining the high ground.' Some of the current combat capabilities being explored by the space community are space based radar and laser platforms, common aerodynamic vehicles and conventional ballistic missiles that would carry various payloads in and through space for precision strike. These current and future capabilities would benefit from a broad range of analytical support, defining the associated doctrine, exploring relevant tactics, comparing operational concepts, and assuring sustainment over the lifetime of the envisioned systems. The MORS Workshop 'Tackling the Space Community's Analytical Challenges' focused a select group of analysts and decision makers to help define these space community challenges; survey current approaches, methodologies, models, tools and databases; identify gaps in the existing analytic capabilities; and, propose workable solutions to fill these gaps and support the needs of the warfighter.

DTIC

*Data Bases; Military Operations*

**20030058790** Thiokol Propulsion, Brigham City, UT, USA  
**Solar Thermal Propulsion IHRPT Demonstration Program**

Lester, D. M.; Wassom, S. R.; Jensen, Kent; Pearson, J. C.; Holmes, M. R.; Jan. 31, 2000; 4 pp.; In English

Contract(s)/Grant(s): Proj-1011

Report No.(s): AD-A411572; AFRL-PR-ED-AB-2000-025; No Copyright; Avail: CASI; [A01](#), Hardcopy

Spacecraft powered by solar thermal propulsion engines will be able to provide the velocity change required to economically maneuver large payloads from one orbit to another or to perform interplanetary missions. This innovative concept, when applied, will double the efficiency of currently used LH2-L02 chemical upper stages. Solar thermal propulsion uses the sun's energy to heat a low molecular-weight working fluid such as hydrogen to very high temperatures (3,000 K). The stored thermal energy is then converted to kinetic energy as the working fluid exits a diverging nozzle. Under funding from the Integrated High Payoff Rocket Propulsion Technology (IHRPT) program, the Air Force Research Laboratory (AFRL) at Edwards AFB, CA, has sponsored the team of Thiokol Propulsion and SRS Technologies to demonstrate the technological readiness and performance of an inflatable solar thermal propulsion system. This paper will address the current status of this program, which includes the following accomplishments: (1) component trade studies completed for struts, torus, and lenticular; (2) rapid prototyping and hardware-in-the-loop system installed and verified; (3) inflation control system designed, fabricated, and tested in both ambient and space environments; (4) integrated system fabricated and deployed in space environment; (5) sun sensors for focus control system fabricated and tested; (6) conceptual design and 3-D dynamic model made of focus control system; and (7) modal testing of inflatable concentrator completed in ambient conditions. The program will culminate in a full-up integrated proof-of-concept ground test. This will demonstrate that the technology is ready for development of the flight hardware for the AFRL Solar Orbital Transfer Vehicle (SOTV) program.

DTIC

*Solar Energy; Inflatable Structures; Rocket Engines; Thermal Reactors; Proving; Dynamic Models; Solar Thermal Propulsion; Spacecraft Propulsion*

13  
**ASTRODYNAMICS**

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

**20030057780** Swedish Defence Research Establishment, Stockholm  
**Preliminary Structural-design of a Supersonic Heavy Attack Missile**

Jarlas, R.; Feb. 2002; In Swedish

Report No.(s): PB2003-103168; FOI-R-0397-SE; No Copyright; Avail: National Technical Information Service (NTIS)

Discussions, estimations, analyses and decisions that have led to the preliminary structural design of the missile at hand are summarized in this report. The aim of this document is to draw a general picture of the path that has been taken, and to illustrate how the increased information gained and the decisions made have led to a clearer view of a feasible design. The objective is to propose a design and also to establish and evaluate methods for concurrent engineering practices at the department of Aeronautics, FFA. Technical details have been left out on purpose when they were not needed to exemplify the operating procedures, or when these details are important as documentation of the analysis and of assumptions used at a certain stage in the decision making process.

NTIS

*Missiles; Structural Design; Procedures*

**20030057824** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Space Vehicle Deployment from Space Station Orbit**

Henry, Paul K.; Sergeevsky, Andrey B.; Sharma, Jayant; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 725-746; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

When launching a spacecraft from Earth parking orbit to deep space, it is highly desirable to have the hyperbolic excess velocity vector ( $v$ -infinity) contained in the parking orbit plane. Ground launches can force the parking orbit plane to contain the  $v$ -infinity vector by using launch azimuth and lift-off time as independent variables. When launching from the Space Station, a new set of variables comes into play. The Station orbit is of fixed inclination but precessing due to the Earth's oblateness. Its plane will seldom (and may never) contain the desired  $v$ -infinity vector. Consequently, the departure strategy will usually require multiple burns and include a plane change. Also, the concept of 'launch period' will be somewhat different from Earth surface launches. An analysis of the deployment of interplanetary spacecraft from Space Station is described, with emphasis on the effect of the trajectory characteristics on station operations. Several planetary mission types are analyzed for manned Mars missions. In addition, high declination departures of spacecraft on unmanned missions to an asteroid are examined. The constraint of Station orbit nodal position is quantified and the operational implications for station reboost strategy are examined.

Author

*Parking Orbits; Orbital Launching; Interorbital Trajectories; Space Station Freedom; Launch Windows*

**20030059038** Naval Postgraduate School, Monterey, CA

**Design of Optimal Cyclers Using Solar Sails**

Stevens, Robert E.; Dec. 2002; 140 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411096; No Copyright; Avail: CASI; [A07](#), Hardcopy

Ongoing interest in establishing a base on Mars has spurred a need for regular and repeated visits to the red planet using a cycling shuttle to transport supplies, equipment and to retrieve surface samples. This thesis presents an approach to designing an optimal heliocentric cycling orbit, or cycler, using solar sails. Results show that solar sails can be used to significantly reduce  $V$  infinity s at Mars and Earth.

DTIC

*Solar Sails; Space Shuttles; Mars (Planet); Earth (Planet)*

## 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*.

**20030058035** Naval Research Lab., Washington, DC

### SPOTR

Shapiro, A.; Uliana, E. A.; Yaplee, B. S.; Mar. 25, 1970; 26 pp.; In English

Report No.(s): AD-A411765; NRL-6956; No Copyright; Avail: CASI; [A03](#), Hardcopy

Present operational requirements need a simple method to accurately determine the position and height of terrestrial locations on a worldwide basis. Recently, artificial satellites have been used as radar reference points in the sky for determining the position and height of such locations. Satellite systems such as Secor (1) have shown that it is possible to achieve accuracies of the order of a few meters under optimum conditions. However, the unknown variations of the satellite's orbit require the placing of several reference ground stations close to the unknown location, so that simultaneous observations will reduce the satellite orbit errors. If the position and height of widely separated locations are needed, the method becomes quite cumbersome, for it requires the repeated physical relocation of the ground reference stations.

DTIC

*Artificial Satellites; Radar Navigation*

**20030058090** Air Force Research Lab., Edwards AFB, CA, USA

### DSP Techniques for Positioning of Off-Axis Solar Concentrators

Beasley, Joseph N.; Jan. 27, 2003; 19 pp.; In English

Contract(s)/Grant(s): Proj-1011

Report No.(s): AD-A410954; AFRL-PR-ED-VG-2003-016; AFRL-PR-ED-VG-2003-016; No Copyright; Avail: CASI; [A03](#), Hardcopy

Presentation viewgraphs on digital signal processing techniques for the positioning of off-axis solar concentrators.

DTIC

*Signal Processing; Fourier Transformation*

**20030058767** Alabama Univ., Tuscaloosa, AL, USA

### Experimental and Numerical Investigation of High Speed High-Temperature Jet Interaction Flowfields

Bowersox, Rodney D. W.; Aug. 31, 2002; 174 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0479

Report No.(s): AD-A410909; TAMU-HAL-2002-002; ARO-39115.1-EG; No Copyright; Avail: CASI; [A08](#), Hardcopy

An experimental analysis of the mean and turbulent flow properties for sonic and Mach 3 injection into a Mach 3 freestream was accomplished. The range of conditions included:  $MPR = 0.005-0.09$ ,  $P_j/p = 0.6-19.0$ ,  $T_j/T = 1.0-13.6$ ,  $y = 1.4$  and  $1.67$ , and  $P_{eb}/P = 0.19-6.15$  (over, perfectly and underexpanded). Injection temperature had a small effect on the boundary layer separation distance. The effective backpressure was an accurate indicator of the jet flow condition. The interaction force increased almost linearly with increasing MPR. The amplification factor was inversely proportional to MPR. In general, the turbulence levels formed three distinct regions across the plume. Region 1 was defined as the upper region of the plume where the turbulence levels were moderate. Region 2 was the high turbulence level region located along the lower portion of the plume near the missile fuselage. Region 3 was the relatively low turbulence region along the plume core, where in the upper half, the turbulence levels were very low, and moving down towards the missile fuselage, the levels increased to those in region 2. The present data suggest a qualitative correlation between the shear strain rate field and the turbulence across the plume.

DTIC

*Flow Distribution; High Speed; Supersonic Speed; Jet Flow; Numerical Analysis; Flow Characteristics*

**20030058821** Naval Research Lab., Monterey, CA

### Superobbing Satellite Winds for NAVDAS

Pauley, P.; Mar. 6, 2003; 106 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411981; NRL/MR/7530--03-8670; No Copyright; Avail: CASI; [A06](#), Hardcopy

This report presents the results from a series of tests on the superobbing strategy for satellite-derived winds in NAVDAS (NRL Atmospheric Varoatopma Data Assimilation System). Introduction Neighboring high-density satellite winds tend to be

highly correlated horizontally. Appropriately superobbing satellite winds can preserve most of the variability present in these observations while reducing the degree of horizontal correlation and reducing the number of single-level observations to process. This paper discusses the manner in which satellite winds are averaged into 'superobs' in NAVDAS Results from a series of tests of different aspects of the NAVDAS satellite wind superobbing strategy are also presented, using data from the six-hour time window centered on 1200 UTC 29 April 2002. The data and individual tests are described in sections 2 and 3 of this paper, respectively, the results are compared in section 4, and changes to NAVDAS and future work are proposed in the final section.

DTIC

*Artificial Satellites; Performance Tests; Data Systems; Wind Effects*

**20030059042** Institute of Space Medico-Engineering, Beijing, China

**Space Medicine and Medical Engineering, Volume 15, No. 6**

Wei, J. H.; Dec. 2002; 104 pp.; In Chinese

Report No.(s): PB2003-104353; No Copyright; Avail: CASI; **A06**, Hardcopy

;Partial Contents: Analysis of Human Two-dimension Target-aiming Movement (in English); Study on Anti + Gx Respiratory Maneuver and its Training Method; Effects of Head Down Tilt on Intra-ocular Pressure, Near Vision, and Visual Field and the protection effect Chinese Herbs; A Vertical Vibration Model of Human Body in Supine Position; Application of Adaptive Canceling Methods in Temperature Control in Ultrasonic Therapeutic Treatment; A Dynamic Model of the Extravehicular Activity Space Suit; Review of Influence of Landing Impact on Human Body and its Medical Evaluation.

NTIS

*Aerospace Medicine; Head Down Tilt; Impact Loads; Landing Loads; Medical Science*

## 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*.

**20030057815** McDonnell-Douglas Space Systems Co., Houston, TX, USA

**Advanced Automation for In-Space Vehicle Processing**

Sklar, Michael; Davis, Tom; Wegerif, Dan; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 695-725; In English; See also 20030057810; No Copyright; Avail: CASI; **A03**, Hardcopy

The purpose of the Advanced Automation for In-Space Vehicle Processing study is to determine the requirements to support automated processing and assure that the SSF Phase I design can be evolved to provide the required systems. The processing tasks considered are Exploration mission vehicle systems on-board a predicted Phase II Space Station. Automation, in this study refers to the replacement of all potential human tasks which includes both physical and cognitive tasks. Thus, both robotic manipulator and artificial intelligence technologies have been considered. The specific objectives required to meet these overall goals are described below: Evaluate on-orbit vehicle processing tasks using a single hierarchy of developed criteria to determine which tasks are suitable for automation. The criteria include expected benefits, impacts on the station, task difficulty for humans, task complexity and technology capability. Determine the effect of automation on the vehicle processing flows, including the overall task times and EVA shifts required based on complete automation analysis. Analysis includes detailed descriptions of all manual and automated tasks and the equipment and resources required for automation.

Author

*Artificial Intelligence; Automation; Aerospace Systems; Space Stations; Tasks; Manipulators; Robot Arms*

**20030057825** NASA Johnson Space Center, Houston, TX, USA

**Graphical Analysis of Mars Vehicle Assembly**

Lewis, Kevin; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 749-773; In English; See also 20030057810; No Copyright; Avail: CASI; **A03**, Hardcopy

The task assigned to the Mission Planning and Analysis Division for FY89 was to produce a video tape depicting the assembly of a Mars Piloted Vehicle at a man tended vehicle assembly platform, co-orbiting with Space Station Freedom. This

request was made by the Transportation Node Integration Agent of the Lunar/Mars Exploration Office. Along with the request, a data package was provided which contained the latest technical briefings by the Transportation Node and Space Transportation Integration Agents. This information was used as the basis of a conceptual study performed using kinematic manipulator simulations.

Author

*Video Tapes; Mars Missions; Orbital Assembly; Mission Planning; Space Station Freedom*

## 17

### SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information see also *04 Aircraft Communications and Navigation*; and *32 Communications and Radar*.

**20030058718** RAND Corp., Santa Monica, CA

#### **Optimal Commercial Satellite Leasing Strategies**

Mattock, Michael G.; Jan. 2002; 26 pp.; In English

Report No.(s): AD-A411885; RAND/MR-1402; No Copyright; Avail: CASI; **A03**, Hardcopy

There is a gap that will extend into the foreseeable future between the military requirement for long-haul wideband communications and communications satellite capacity the military owns. The USA government will need to bridge the gap by leasing commercial communications satellite services. Military communications planners are faced with the difficult task of choosing the appropriate amount of communications capacity to lease, and the appropriate length of the lease, given uncertainty over future communications demand. This report presents a simple, graphical technique to help communications planners determine the appropriate amount of communications capacity to lease when facing uncertain demand. A simple mathematical model shows why the graphical technique works. Extensions to the basic model show how price uncertainty and the ability to salvage unused capacity change the appropriate amount of capacity to lease. Finally, a multiple-period version of the basic model shows how communications planners can consider the trade-offs between long- and short-term leases when demand grows over time.

DTIC

*Communication Satellites; Satellite Communication; Leasing; Communication Networks; Resource Allocation*

**20030058813** Swedish Defence Research Establishment, Stockholm, Sweden

#### **Synthesis Methods for Missile Autopilots**

Eliasson, P.; Forssell, L.; Hamberg, J.; Sjoebloom, M.; Wirkander, S. L.; 2002; 62 pp.; In Swedish

Report No.(s): PB2003-103232; FOI-R-0326-SE; No Copyright; Avail: CASI; **A04**, Hardcopy

In this report different missile control design methods and modeling methodologies are compared. In chapter 1 traditional and modern design and modeling methodologies are reviewed and compared. In chapter 2 the theory of robustness analysis is covered and such an analysis is applied to a simple missile model. The results of an explicit robust stability analysis and micro analysis are compared and they are seen to agree. In chapter 3 an equation based SoFRam missile model is given and chapter 4 provides a sketch of a traditional gain scheduling controller for this model. Chapters 5 and 6 describe how the design of nonlinear controllers can be partly automatized. Chapter 5 describes how an equation based model implemented in the symbolic language Maple can be transformed to a form that can be used by the simulation environment Simulink. Chapter 5 shows how controllers to models obtained this way can be produced by the Nonlinear Synthesis Toolbox. These two chapters describe ongoing work.

NTIS

*Automatic Pilots; Turning Flight; Missile Control; Missile Configurations; Control Systems Design*

## 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*.

**20030057810** NASA, Washington, DC, USA

**Beyond the Baseline: Proceedings of the Space Station Evolution Symposium, Volume 1, Part 2, Space Station Freedom**  
May 1990; 398 pp.; In English; Space Station Evolution Symposium, 6-8 Feb. 1990, League City, TX, USA; See also 20030057811 - 20030057825

Report No.(s): NASA/CP-10044-Vol-1-Pt-2; NAS 1.55:10044-Vol-1-Pt-2; S-606-Vol-1-Pt-2; No Copyright; Avail: CASI; [A17](#), Hardcopy

This report contains the individual presentations delivered at the Space Station Evolution Symposium in League City, Texas on February 6, 7, 8, 1990. Personnel responsible for Advanced Systems Studies and Advanced Development within the Space Station Freedom Program reported on the results of their work to date. Systems Studies presentations focused on identifying the baseline design provisions (hooks and scars) necessary to enable evolution of the facility to support changing space policy and anticipated user needs. Also emphasized were evolution configuration and operations concepts including on-orbit processing of space transfer vehicles. Advanced Development task managers discussed transitioning advanced technologies to the baseline program, including those near-term technologies which will enhance the safety and productivity of the crew and the reliability of station systems. Special emphasis was placed on applying advanced automation technology to ground and flight systems.

Author

*Space Station Freedom; Conferences; Systems Analysis; Automation; Knowledge Based Systems; Robotics; Aerospace Systems*

**20030057811** NASA Johnson Space Center, Houston, TX, USA

**Data Management System (DMS) Evolution Analysis**

Douglas, Katherine; *Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2*; May 1990, pp. 427-447; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

The all encompassing goal for the Data Management System (DMS) Evolution Analysis task is to develop an advocacy for ensuring that growth and technology insertion issues are properly and adequately addressed during DMS requirements specification, design, and development. The most efficient methods of addressing those issues are via planned and graceful evolution, technology transparency, and system growth margins. It is necessary that provisions, such as those previously mentioned, are made to accommodate advanced missions requirements (e.g., Human Space Exploration Programs) in addition to evolving Space Station Freedom operations and user requirements .

Author

*Data Management; Technology Utilization; Systems Engineering; Design Analysis; Avionics*

**20030057812** TRW Systems Integration Group, Houston, TX, USA

**Evolutionary Space Station GN&C Study**

Kennedy, Jerry; *Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2*; May 1990, pp. 481-502; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Guidance, Navigation and Control (GN&C) techniques and equipment to support evolutionary station concepts are being analyzed to assess the impact on the baseline GN&C system. Three functional areas of GN&C will be addressed: Attitude Control, Traffic Management, and Reboost. A summary of the mission concepts, station configurations, simulation results, and preliminary assessments of the baseline GN&C systems are presented.

Author

*Space Stations; Guidance (Motion); Space Navigation; Attitude Control; Traffic*

**20030057813** Rockwell International Corp., USA

**Space Station Freedom Electric Power System-SEI (Lunar Mars Mission) Accommodation Study**

Friefeld, J. M.; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 611-619; In English; See also 20030057810; No Copyright; Avail: CASI; [A02](#), Hardcopy

This presentation provides an overview of the anticipated power supply needs for the Space Station Freedom (SSF) and how these needs might affect the spacecraft design and configuration. Topics covered include: SSF power growth considerations, power generation summary, primary power distribution options, power distribution option comparison, and other power growth issues.

CASI

*Space Station Freedom; Spacecraft Design; Spacecraft Configurations; Space Station Power Supplies; Space Station Structures; Spacecraft Power Supplies*

**20030057816** Harris Corp., USA

**Assuring Data Transparency through Design Methodologies**

Williams, Allen; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 373-388; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper addresses the role of design methodologies and practices in the assurance of technology transparency. The development of several major subsystems on large, long life cycle government programs was analyzed to glean those characteristics in the design, development, test and evaluation that precluded or enabled the insertion of new technology. The programs examined were Minuteman, DSP, B1-B, and space shuttle. All these were long life cycle, technology-intensive programs. The design methodologies (or lack thereof) and design practices for each were analyzed in terms of the success or failure in incorporating evolving technology. Common elements contributing to the success or failure were extracted and compared to current methodologies being proposed by the Department of Defense and NASA. The relevance of these practices to the design and deployment of Space Station Freedom were evaluated.

Author

*Methodology; Technology Utilization; Spacecraft Design; Aerospace Systems; Design Analysis; NASA Space Programs*

**20030057817** NASA Johnson Space Center, Houston, TX, USA

**Space Station EVA System Evolution Study**

Rouen, Michael N., Technical Monitor; Slade, H. G.; Panzarella, L. N.; Anderson, D. E.; Simonds, C.; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 389-425; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

Evaluation of Space Station Freedom support of manned exploration is in progress to identify SSF EVA system evolution requirements and capabilities. The output from these studies will provide data to support the preliminary design process to ensure that Space Station EVA system requirements for future missions (including the Transportation Node) are adequately considered and reflected. The study considers SSF support of future missions and the EVA system baseline to determine adequacy of EVA requirements and capabilities, and to identify additional requirements, capabilities, and necessary technology upgrades. EVA demands levied by formal requirements and indicated by evolution mission scenarios are high for the out-years of Space Station Freedom. An EVA system designed to meet the baseline requirements can easily evolve to meet evolution demands with few exceptions. Results to date indicate that upgrades or modifications to the EVA system may be necessary to meet all foreseeable hangar induced EVA environments. Work continues to quantify the EVA capability in this regard. Evolution mission scenarios with EVA in and around unshielded nuclear propulsion engines are inconsistent with anthropomorphic EVA capabilities.

Author

*Extravehicular Activity; Space Station Freedom; Manned Space Flight; Systems Engineering*

**20030057818** NASA Johnson Space Center, Houston, TX, USA

**Communications and Tracking Distributed Systems Evolution Study**

Culpepper, William; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 505-533; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Communications and Tracking (C & T) techniques and equipment to support evolutionary space station concepts are being analyzed. Evolutionary space station configurations and operational concepts are used to derive the results to date. A description of the C & T system based on future capability needs is presented. Included are the hooks and scars currently identified to support future growth.

Author

*Space Station Freedom; Spacecraft Configurations; Spacecraft Communication; Tracking (Position); Systems Analysis; Spacecraft Design*

**20030057819** NASA Langley Research Center, Hampton, VA, USA

**Dynamic Characteristics of Space Station Freedom Mars and Lunar Evolution Reference Configurations**

Ayers, J. Kirk; Lim, Tae W.; Cooper, Paul A.; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 535-576; In English; See also 20030057810; No Copyright; Avail: CASI; A03, Hardcopy

One concept for a manned mission to Mars uses an evolutionary version of Space Station Freedom (SSF) as a transportation node. The station is modified by the addition of dual keels, an upper and lower boom, additional laboratory and habitation modules, increased power and an assembly platform. With these modifications the station is called the Mars Evolution Reference Configuration (MERC). The mass of the station is 65 percent greater than the mass of SSF and its moments of inertia through the mass center are greater by approximately a factor of four. Over a period of months, several flights from Earth to low-Earth-orbit carry the components of a manned Mars piloted vehicle (MPV) to the MERC where the vehicle is constructed on the assembly platform. After each flight the station is reboosted to an appropriate altitude, such that the orbit decay due to atmospheric drag forces lowers the spacecraft to the proper altitude at the appropriate time for rendezvous with the next assembly flight. When the assembly process is completed, the MPV, which has a mass of approximately 200,000 lbm, is situated on the evolutionary station. The mass increase of the MERC with MPV system over SSF is 112 percent and the moments of inertia about axes through the mass center increase by up to a factor of 12. When the MPV is assembled, inspected and verified, the mission is ready to proceed and the MPV is moved from the station to a staging area and mated with fueled trans-Mars injection stages for the flight to Mars. This presentation describes a finite element model of the MERC formulated to investigate the expected low frequency modes and its variation with the addition of a large payload. A basic reboost procedure using near-continuous firing of reaction control system jets is proposed with off-modulation of the jets used to control flight attitude. The reboost procedure is described with the closed-loop attitude control dictating jet on/off cycling based on feedback signals which contain both the rigid body rotation information and the elastic rotations local to the attitude sensor. The presentation contains a description of the dynamic response at critical points of the station during the reboost and concludes with results of a brief study of the dynamic characteristics of a Lunar transportation node configuration.

Author

*Space Station Freedom; Space Transportation; Manned Mars Missions; Spacecraft Configurations; Orbital Servicing; Low Earth Orbits; Orbital Assembly*

**20030057821** NASA Johnson Space Center, Houston, TX, USA

**Space Station Freedom Central Thermal Control System Evolution**

Bullock, Richard; Olsson, Eric; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 449-479; In English; See also 20030057810; No Copyright; Avail: CASI; A03, Hardcopy

The objective of the evolution study is to review the proposed growth scenarios for Space Station Freedom and identify the major CTCS hardware scars and software hooks required to facilitate planned growth and technology obsolescence. The Station's two leading evolutionary configurations are: (1) the Research and Development node, where the fundamental mission is scientific research and commercial endeavors, and (2) the Transportation node, where the emphasis is on supporting Lunar and Mars human exploration. These two nodes evolve from the from the assembly complete configuration by the addition of manned modules, pocket labs, resource nodes, attached payloads, customer servicing facility, and an upper and lower keel and boom truss structure. In the case of the R & D node, the role of the dual keel will be to support external payloads for scientific research. In the case of the Transportation node, the keel will support the Lunar (LTV) and Mars (MTV) transportation vehicle service facilities In addition to external payloads. The transverse boom is extended outboard of the alpha gimbal to accommodate the new solar dynamic arrays for power generation, which will supplement the photovoltaic system. The design, development, deployment, and operation of SSF will take place over a 30 year time period and new Innovations and maturation in technologies can be expected. Evolutionary planning must include the obsolescence and insertion of the new



technologies over the life of the program, and the technology growth issues must be addressed in parallel with the development of the baseline thermal control system. Technologies that mature and are available within the next 10 years are best suited for evolutionary consideration as the growth phase begins in the year 2000. To increase TCS capability to accommodate growth using baseline technology would require some penalty in mass, volume, EVA time, manifesting, and operational support. To be cost effective the capabilities of the heat acquisition, transport, and rejection subsystems must be increased.

Author

*Space Station Freedom; Temperature Control; Technology Utilization; Systems Engineering*

**20030057822** NASA Langley Research Center, Hampton, VA, USA

**Operations Modeling for SSF Evolution**

Ganoë, George G.; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 629-649; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

The operations required to support the on-orbit Space Station Freedom activities planned or being studied will be complex. Operational capability to perform tasks will be dependent on many factors such as manpower availability, logistics, other tasks being worked and Space Station configuration. This effort uses information available about these and other factors to perform operations analysis for given missions and determine the feasibility of target configuration concepts to support those missions. Studies have been conducted to determine processing requirements for a number of potential evolutionary missions on the Space Station Freedom. These studies have identified the need for growth of the Space Station in various ways. Some of the studies have dealt with the operational needs for the particular mission that they are concerned with, but none have looked at the total evolutionary operations requirement. In order to pursue the subject of overall on-orbit operations to any appreciable level of detail, data bases of operational on-orbit tasks need to be compiled, and an analysis tool is needed to assist the analyst. A number of existing operations tools have been reviewed, and none have been found to satisfactorily perform the functions needed to analyze integrated operations requirements for the evolutionary Space Station Freedom. However, during the tool review, some existing applications were found to provide subsets of the required functionality, and these are being considered for incorporation into the analysis tool.

Author

*Mission Planning; Space Station Freedom; Crew Procedures (Inflight); Tasks; Data Bases; Operations Research; Systems Analysis; Space Processing*

**20030057823** McDonnell-Douglas Space Systems Co., Cocoa Beach, FL, USA

**On-Orbit Assembly Task Definition Study**

Vargo, Rick; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 651-665; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

McDonnell Douglas Space Systems Company at Kennedy Space Center (MDSSC-KSC) has been tasked since November 1987 to provide support to the Space Station Evolution Working Group (EWG) based at NASA's Langley Research Center (LaRC). Work in the first year of this study included extensive data gathering and the development of study methodologies. The OEXP case studies as summarized in NASA Technical Memorandum 4075, Exploration Studies Technical Report FY 1988 Status, and NASA Document Z-2.1-002, Study Requirements Document FY 1989 Studies (SRD), define the mission scenarios and technical requirements which MSFC engineers and their contractors (Martin Marietta and Boeing) utilized in their design of exploration vehicles. LaRC selected case studies and vehicle designs upon which the study team performed processing analyses. An on-orbit SSF refurbishment crew of four dedicated to OEXP vehicle processing was baselined for all studies. In some instances, LaRC modified the vehicle designs, launch manifests, or mission scenarios provided by MSFC to obtain specific data from the processing analyses. The results from the following case studies analyzed during 1989 are provided in this report: Phobos Gateway On-Orbit Assembly and Launch, Lunar Evolution Vehicle On-Orbit Refurbishment, and Mars Mission Vehicle On-Orbit Assembly and Launch. In addition, a concept for facility accommodations at Space Station Freedom (SSF) was developed and support equipment to be provided at the facility was defined. In support of the MSFC Launch/On-Orbit Processing (LOOP) study, LaRC asked us to assess ground and on-orbit processing impacts resulting from launching the OEXP vehicles on several different ETO launch vehicles. Results developed by this study, including processing tasks and times, and personnel and equipment requirements, will be entered into the VPOD data base. VPOD will be used by LaRC to analyze future OEXP vehicles configurations, SSF facility and resource impacts, and life cycle cost predictions.

Author

*Aerospace Systems; Engineers; Equipment Specifications; Life Cycle Costs; Methodology; Design Analysis; Assembling*

## 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*.

**20030057956** Air Force Research Lab., Edwards AFB, CA, USA

### **Advanced Diagnostics for Millimeter-Scale Micro Pulsed Plasma Thrusters**

Spanjers, Gregory G.; Antonsen, Erik L.; Burton, Rodney L.; Keidar, Michael; Boyd, Iain D.; May 2, 2002; 10 pp.; In English  
Contract(s)/Grant(s): Proj-1011

Report No.(s): AD-A410781; AFRL-PR-ED-TP-2002-093; AFRL-PR-ED-TP-2002-093; No Copyright; Avail: CASI; [A02](#), Hardcopy

A class of Micro-Pulsed Plasma Thrusters (MicroPPTs) is being developed by the Air Force Research Laboratory (AFRL) to provide precise attitude control and stationkeeping ability to 25-kg class satellites. Operating by means of a surface discharge across a Teflon(TM) propellant fuel bar only a few millimeters in diameter, the MicroPPT delivers a thrust-to-power ratio of 5 - 10 microN-s/J. Due to the low pulse energy and size, the MicroPPT produces a spatially-confined and diffuse plasma plume that is difficult to analyze with material probes. Efforts to characterize MicroPPT plume are underway. To this end, a Herriott Cell interferometer is introduced to establish the plume electron and neutral densities. Comparison of the measured electron density with modeling predictions shows close agreement. Additionally, a Pockels cell has been developed to provide a zero-impedance MicroPPT breakdown voltage measurement. Current research focuses on an infrared-emission measurement capability to determine propellant surface temperature during thruster operation.

DTIC

*Pulsed Plasma Thrusters; Propellants; Plumes; Plasmas (Physics); Millimeter Waves; Electrical Measurement; Diagnosis*

**20030057985** Air Force Research Lab., Edwards AFB, CA, USA

### **Material Property Sensitivities on Cryo Upperstage Rocket Engines**

Olson, Karen; Sep. 10, 1999; 38 pp.; In English

Contract(s)/Grant(s): Proj-3058

Report No.(s): AD-A411209; AFRL-PR-ED-TP-99-0180; No Copyright; Avail: CASI; [A03](#), Hardcopy

Presentation slides for briefing on rocket engine components given at the 26th annual Western regional conference.

DTIC

*Liquid Hydrogen; Rocket Engines; Cryogenic Rocket Propellants*

**20030057991** Orbital Technologies Corp., Madison, WI, USA

### **Advanced Cryogenic Solid Hybrid Rocket Engine Developments: Concept and Test Results**

St.Clair, Christopher P.; Rice, Eric E.; Knuth, William H.; Gramer, Daniel J.; Jul. 1998; 10 pp.; In English

Contract(s)/Grant(s): F04611-98-C-0010; F04611-97-C-0020; Proj-1011

Report No.(s): AD-A411214; AFRL-PR-ED-TP-1998-158; No Copyright; Avail: CASI; [A02](#), Hardcopy

ORBITEC has conducted considerable R&D under various USAF and NASA contracts and company sponsored efforts to develop a new class of rocket propulsion devices, cryogenic solid rocket engines. The basic concept of these engines is to freeze a propellant which is normally a gas at room temperature into a solid propellant grain. This solid grain is then combusted with a second propellant. These rocket engines promise a number of advantages over conventional liquid rocket engines, including increased simplicity, safety, propellant density, and potentially performance with the addition of High-Energy Density Matter (HEDM's). ORBITEC has tested cryogenic solid hybrid rocket engines including the following propellant combinations: (1) solid oxygen/gaseous hydrogen; (2) solid hydrogen/gaseous oxygen; (3) solid methane/gaseous oxygen; and (4) solid methane-aluminum/gaseous oxygen. The primary focus of this paper is on solid oxygen/gaseous hydrogen. Work achieved to date includes: (1) a total of over 50 solid oxygen test firings; (2) establishment of regression rate data for the different propellant combinations, where the rates can be a factor of 20 to 40 times higher than conventional HTPB-based hybrids; (3) achievement of burn durations from 1 to 30 seconds; and (4) engine chamber pressures as high as 250 psi. The potential applications include: research devices to test high-energy density matter (HEDM); hybrid rocket launch vehicle upper stages; or orbit transfer vehicles. During a current sponsored USAF Research Laboratory (RL, Edwards Air

Force Base, CA) project, ORBITEC is to design, develop and test a larger, SOX/LH2 flight-type engine that will have throttling and O/F ratio control.

DTIC

*Hybrid Rocket Engines; Solid Propellant Rocket Engines*

**20030058039** Phillips Lab., Edwards AFB, CA

**Solar Thermal Propulsion Experiments Design**

Laug, Kristi K.; Jan. 1996; 13 pp.; In English

Report No.(s): AD-A411920; No Copyright; Avail: CASI; [A03](#), Hardcopy

Satellites that are currently under powered or have low photovoltaic (PV) efficiency, may be rejuvenated by dosing them with laser power beamed from earth. Also, current strictly solar thermal propulsion schemes may be able to use laser power as a replacement energy source when they are eclipsed. Several questions must be answered before a multiple use of laser power may be designated. The questions are outlined in the background section of this paper. They deal with gains that may be realized using solar power for operating specific hardware as opposed to laser power. A series of experiments that will give us information we can use to answer the questions will be performed. However, this paper outlines and presents only the design of experiments based upon statistical methods generated by Dr. Genuchi Taguchi.

DTIC

*Solar Energy; Rocket Engines; Solar Thermal Propulsion*

**20030058089** Air Force Research Lab., Edwards AFB, CA, USA

**The USAF Electric Propulsion Research Program**

Spores, Ronald A.; Spanjers, Gregory G.; Birkan, Mitat; Lawrence, Timothy J.; Oct. 2001; 14 pp.; In English

Contract(s)/Grant(s): Proj-4847

Report No.(s): AD-A411920; AFRL-PR-ED-TP-2001-223; No Copyright; Avail: CASI; [A03](#), Hardcopy

An overview of current electric propulsion research and development efforts within the USA Air Force is presented. The Air Force supports electric propulsion primarily through the Air Force Office of Scientific Research (AFOSR), the Air Force Research Laboratory (AFRL) and the AFOSR European Office of Aerospace Research and Development (EOARD).

DTIC

*Electric Propulsion; Military Technology; Defense Program; Armed Forces (United States)*

**20030058737** Air Force Research Lab., Edwards AFB, CA, USA

**New Satellite Propulsion System Has Mass Below 100 Grams (0.22 pounds)**

Spanjers, Greg; Jul. 31, 2001; 10 pp.; In English

Contract(s)/Grant(s): Proj-1011

Report No.(s): AD-A411569; AFRL/PRS-ED-TP-2001-170; No Copyright; Avail: CASI; [A02](#), Hardcopy

There is an increased need for propulsive microsattellites to support a range of future specialized Air Force and NASA missions. In response to this need, the Air Force Research Laboratory's (AFRL) Spacecraft Propulsion unit at Edwards AFB, CA, has developed the 100-gram Micro Pulsed Plasma Thruster (MicroPPT), a simple, miniaturized propulsion device designed for propulsive attitude control on present 100-kilogram small satellites, and for stationkeeping and primary propulsion on next-generation 25-kilogram-class microsattellites. The primary features of the MicroPPT are the use of a solid inert propellant (Teflon), expected high-Isp due to the use of electromagnetic acceleration, and a simple, lightweight design based largely on commercial, flight-qualified electronic components. For 100-kilogram-class small satellites a set of 4 MicroPPTs, each designed with 3 selectable thrust directions, can provide full spacecraft attitude control, yet require only 1/10th the mass of standard torque rods and reaction wheels. The MicroPPT was invented in 1997 and it is currently slated for flight as a micropropulsion demonstration aboard the AFRL TechSat21, scheduled for launch in 2004. The rapid advancement of the MicroPPT from invention to flight manifestation is indicative of the inherent simplicity of the device, and of the importance AFRL is placing on the development of microsattellite enabling technologies. This paper describes the design and functioning of the MicroPPT, including its propellant assembly, electronic firing mechanism, self-consuming satellite design, and cable guns. Laboratory testing, modeling, and analysis have led to MicroPPT assembly designs that demonstrate long lifetimes without char formation. MicroPPT lifetime is now limited only by the amount of available propellant and has demonstrated over 1 million discharges without failure.

DTIC

*Thrusters; Electric Propulsion; Spacecraft Propulsion; Plasma Engines; Microsattellites; Microrocket Engines*

**20030058762** Air Force Research Lab., Edwards AFB, CA, USA

**Technology for Sustainment of Strategic Systems**

McFall, Keith; Jan. 16, 2002; 4 pp.; In English

Contract(s)/Grant(s): F04611-00-C-0057; Proj-4373

Report No.(s): AD-A410654; AFRL/PRS-ED-TP-2002-009; No Copyright; Avail: CASI; [A01](#), Hardcopy

The objectives of the Technology for Sustainment of Strategic Systems (TSSS) program are to enable improved strategic system capabilities, reduce system costs, and sustain the capabilities needed to develop future systems. The Air Force Research Laboratory Propulsion Directorate (AFRL/PR) leads three strategic system propulsion technology development areas under the TSSS program: Missile Propulsion, Aging and Surveillance, and Post Boost Control System. These Air Force-managed efforts are enabling the USA' solid rocket industry to significantly advance propulsion technology, providing increased performance, reduced cost, and increased reliability compared to present state-of-the-art systems. Through the government-funded TSSS programs, often augmented by industry investments, the capability of the nation to maintain a superior deterrence capability into the future is being greatly enhanced. The AFRL/PR's TSSS technology development efforts are providing military and commercial users with capabilities significantly greater than state-of-the-art solid rocket propulsion systems. These programs also serve a critical role in sustaining the technology development capability of the solid rocket industry.

DTIC

*Solid Propellant Rocket Engines; Technology Utilization; Missile Control; Sustainer Rocket Engines*

**20030058774** Air Force Research Lab., Edwards AFB, CA, USA

**Time-Resolved Surface Temperature Measurement for Pulsed Ablative Thrusters**

Antonsen, Erik L.; Burton, Rodney L.; Spanjers, Gregory G.; Spores, Ronald A.; Jan. 27, 2003; 10 pp.; In English

Contract(s)/Grant(s): Proj-1011

Report No.(s): AD-A410957; AFRL-PR-ED-TP-2002-318; AFRL-PR-ED-TP-2002-318; No Copyright; Avail: CASI; [A02](#), Hardcopy

A time-resolved surface temperature diagnostic for ablation-controlled arcs is in development at the Air Force Research Laboratory at Edwards AFB. The diagnostic draws on heritage from the experimental dynamic crack propagation community which has used photovoltaic infrared detectors to measure temperature rise in materials in the process of fracture. The microsecond time scales involved in the fracture process suggest that such detectors may be applicable to the ablation-controlled discharges in pulsed plasma thrusters as a direct measurement of surface temperature during and after the arc. HgCdTe detectors are evaluated for use on the surface of a micro-pulsed plasma thruster invented at the AFRL. Evaluation of the diagnostic focuses on application of the detector in the presence of a plasma and initial studies of calibration techniques. Initial data is reviewed with future studies planned for advancement of the technique including applications to other types of pulsed thrusters.

DTIC

*Ablation; Pulsed Plasma Thrusters; Temperature Measurement; Plasma Engines; Spacecraft Propulsion; Surface Temperature*

**20030058839** Air Force Research Lab., Edwards AFB, CA, USA

**Rocket Propulsion Technology Impact on TSTO Launch System Cost**

Mossman, Jason B.; Perkins, David R.; May 8, 2001; 37 pp.; In English

Contract(s)/Grant(s): AF Proj. 3058

Report No.(s): AD-A411282; AFRL-PR-ED-TP-2001-104; No Copyright; Avail: CASI; [A03](#), Hardcopy

The benefits of advanced liquid rocket propulsion technology are evaluated for two-stage-to-orbit (TSTO) reusable launch systems. Life cycle cost (LCC) is used as a figure-of-merit and is driven by high launch rate requirements. This paper reports the methods and results of that study. The reported analysis focused on chemical rocket propulsion using either hydrogen or hydrocarbon fuels, and oxygen or high purity hydrogen peroxide as oxidizers. Results indicate that advanced rocket propulsion can cut life cycle costs in half and recurring costs (cost for additional flights) by a factor of three. The most important propulsion parameter to be improved for this class of vehicle is the reusability of the rocket engines, with performance improvements a distant second. Additionally, a TSTO vehicle using liquid oxygen and hydrocarbon propellants in both stages has the lowest LCC. Results were relatively insensitive to engine reliability and cost.

DTIC

*Liquid Propellant Rocket Engines; Life Cycle Costs; Reusable Rocket Engines; Launch Vehicles*

**20030058958** Air Force Research Lab., Edwards AFB, CA, USA

**Air Force Research Laboratory's Rocket Engine Program Enters Fast-Paced Test Phase**

Thornburg, Jeff; Oct. 18, 2002; 6 pp.; In English

Contract(s)/Grant(s): F04611-94-C-0035; Proj-6340

Report No.(s): AD-A411890; AFRL-PR-ED-PR-2002-240; No Copyright; Avail: CASI; A02, Hardcopy

EDWARDS AFB, Calif. Testing is underway of critical components for integration into the world's first full flow cycle hydrogen/oxygen boost engine. Recent tests of the Integrated Powerhead Demonstration project here established a technical first for the USA and mark the first advancements in boost engine technology since the space shuttle main engine was initially developed in the 1970's. The Department of Defense's Integrated Powerhead Demonstration project developed by the Air Force Research Laboratory Propulsion Directorate is ongoing at the Aerojet-Complex test facilities in Sacramento.

DTIC

*Hydrogen Oxygen Engines; Rocket Engines; Spacecraft Propulsion; Test Facilities*

**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*.

**20030057744** Lawrence Livermore National Lab., Livermore, CA

**Portable Multiplex Pathogen Detector**

Rao, R.; Visuri, S.; McBride, M. T.; Matthews, D.; Jul. 15, 2002; 8 pp.; In English

Report No.(s): DE2003-15002775; No Copyright; Avail: Department of Energy Information Bridge

Tumor marker concentrations in serum provide useful information regarding clinical stage and prognosis of cancer and can thus be used for presymptomatic diagnostic purposes. Currently, detection and identification of soluble analytes in biological fluids is conducted by methods including bioassays, ELISA, PCR, DNA chip or strip tests. While these technologies are generally is to develop a simple, point-of-care, portable, liquid array-based immunoassay device capable of simultaneous detection of a variety of cancer markers. Here we describe the development of assays for the detection of Serum Prostate Specific Antigen, and Ovalbumin from a single sample. The multiplexed immunoassays utilize polystyrene microbeads. We also describe the laser-based instrumentation used to acquire fluorescent bead images. Following the assay, droplets of bead suspension containing a mixture of bead classes were deposited onto filters held in place by a disposable plexiglass device and the resultant arrays viewed under the fluorescent imaging setup.

NTIS

*Detection; Cancer; Assaying; Deoxyribonucleic Acid; Imaging Techniques; Immunoassay*

**20030057776** Sandia National Labs., Albuquerque, NM

**MIL-L-87177 Lubricant Bulletproofs Connectors Against Chemical and Fretting Corrosion**

Hanlon, J. T.; DeMarquis, G.; Taylor, R. D.; May 01, 2002; 256 pp.; In English

Report No.(s): DE2003-800972; SAND-2002-1454; No Copyright; Avail: Department of Energy Information Bridge

Electrical connectors corrode. Even our best SA and MC connectors finished with 50 to 100 microinches of gold over 50 to 100 microinches of nickel corrode. This work started because some, but not all, lots of connectors held in KC stores for a decade had been destroyed by pore corrosion (chemical corrosion). We have identified a MIL-L-87177 lubricant that absolutely stops chemical corrosion on SA connectors, even in the most severe environments. For commercial connectors which typically have thinner plating thicknesses, not only does the lubricant significantly retard effects of chemical corrosion, but also it greatly prolongs the fretting life. This report highlights the initial development history and use of the lubricant at Bell Labs and AT&T, and the Battelle studies and the USAF experience that lead to its deployment to stop dangerous connector corrosion on the F-16. We report the Sandia, HFM&T and Battelle development work, connector qualification, and material compatibility studies that demonstrate its usefulness and safety on JTA and WR systems. We will be applying MIL-L-87177 Connector Lubricant to all new connectors that go into KC stores. We recommend that it be applied to connectors on newly built cables and equipment as well as material that recycles through manufacturing locations from the field.

NTIS

*Electric Connectors; Fretting Corrosion; Lubricants; Plating; Solvents*

**20030057788** Lawrence Livermore National Lab., Livermore, CA, California Univ., Berkeley, CA, USA

**High-Resolution Broadband Spectral Interferometry**

Erskine, D. J.; Edelstein, J.; Aug. 09, 2002; 18 pp.; In English

Report No.(s): DE2003-15002891; UCRL-JC-147032; No Copyright; Avail: Department of Energy Information Bridge

We demonstrate solar spectra from a novel interferometric method for compact broadband high-resolution spectroscopy. The spectral interferometer (SI) is a hybrid instrument that uses a spectrometer to externally disperse the output of a fixed-delay interferometer. It also has been called an externally dispersed interferometer (EDI). The interferometer can be used with linear spectrometers for imaging spectroscopy or with echelle spectrometers for very broad-band coverage. EDIs heterodyning technique enhances the spectrometers response to high spectral-density features, increasing the effective resolution by factors of several while retaining its bandwidth. The method is extremely robust to instrumental insults such as focal spot size or displacement. The EDI uses no moving parts, such as purely interferometric FTS spectrometers, and can cover a much wider simultaneous bandpass than other internally dispersed interferometers (e.g. HHS or SHS).

NTIS

*Spectrometers; Interferometry*

**20030057861** Argonne National Lab., IL, USA

**Recovery of Entrained CSSX Solvent from Caustic Aqueous Raffinate Using Coalescers**

Pereira, C.; Arafat, H. A.; Falkenberg, J. R.; Regalbuto, M. C.; Vandegrift, G. F.; Nov. 2002; In English

Report No.(s): DE2003-807350; No Copyright; Avail: National Technical Information Service (NTIS)

A solvent was developed at Oak Ridge National laboratory (ORNL) for a caustic-side solvent extraction (CSSX) process that removes cesium from Savannah River Site (SRS) tank waste. After treatment, a small fraction of the solvent is entrained in the caustic raffinate at a level of 100-300 ppm, well above the solubilities for the various solvent components. Recovery of this solvent can produce a potential cost saving in excess of \$5M per annum based on a processing rate of 20 gpm. In this study we examined the issues associated with the use of a coalescer for solvent recovery and measured the physical properties of the solvent and simulant. The density, surface, and interfacial tension, and viscosity of the optimized solvent and a full-component SRS waste simulant were determined as a function of temperature. The entrainment of the solvent components in the SRS waste simulant during the operation of a four-stage 4-cm contactor unit was quantified based on chemical and volumetric analysis.

NTIS

*Decontamination; Purification; Waste Treatment; Radioactive Wastes*

**20030057919** Massachusetts Inst. of Tech., Cambridge, MA

**Quasi-static Tearing Tests of Metal Plating**

Woertz, Jeffrey C.; Sep. 2002; 129 pp.; In English

Contract(s)/Grant(s): N62271-97-G-0026

Report No.(s): AD-A410822; No Copyright; Avail: CASI; A07, Hardcopy

Great effort is being focused on making the next generation of naval combatant ships more resistant to the effects of close-aboard explosions. The examination of the deformation modes in blast-loaded metal plating suggests that a physical model can be developed to simulate the force vs. displacement history produced by an impinging shock wave during the holing phase. Similar approaches have been successfully used to approximate damage due to grounding and ballistic penetrators. In this case, the deformation of the clamped plate is modeled in two stages: (1) dishing, which leads to dishing and (2) radial crack propagation, which results in petalling. In the first stage, a thin geometrically-scaled (0.90 mm, 1.15 mm, and 1.40 mm thick by 300 mm square) mild steel sheets are dished inward using spherical indenters of radii 20 mm, 50 mm, and 75 mm. The sheets have an average tensile strength of 317 MPa and a Rockwell Superficial Hardness Number of 72 (H(N15T)72). This portion of the test approximates the initial material stretching done by a spherical wave at various standoff distances. The spherical indenter produces a circular hole, which simulates the disk of material normally ejected as a blast front penetrates a plate section. As the material reaches a critical necking thickness at the edges of the hole, radial cracks form creating petals. During the second stage, an oblique conical punch is used to simulate the expanding wave front, which drives open the petals, causing the cracks to propagate towards the plate's clamped boundaries. By measuring the resultant forces and minimizing the effects of friction, the total bending and membrane work can be reasonably estimated. Ultimately, the approximate blast damage for a given ship's hull may be related to a given charge size and standoff distance.

DTIC

*Bending; Crack Propagation; Deformation; Displacement; Metal Sheets; Rockwell Hardness*

**20030057939** William J. Hughes Technical Center, Atlantic City, NJ

**Paint and Bead Durability Study**

Cyrus, H. M.; Mar. 2003; In English

Report No.(s): PB2003-105017; No Copyright; Avail: National Technical Information Service (NTIS)

This study was undertaken to evaluate paint and bead durability in four areas: water emulsion paint performance, glass bead performance, application thickness of paint effectiveness, and cementitious pavement marking materials. A series of airport pavement markings were placed at the William J. Hughes Technical Center and Atlantic City International Airport, Atlantic City, New Jersey, for evaluation. Results from the testing showed that HD-21A Rohm and Haas water emulsion paint had the superior performance since it held the beads in place better; Type III (1.9 Index of Refraction (IOR)) airport beads had the best retro-reflectivity, initially and over time. All four new beads had higher retro-reflectivity than the 1.5 IOR highway bead but not as high as the 1.9 IOR Airport bead. The four new beads that were used in this study were 1.5 IOR Visibead A (L-511), 1.5 IOR Visibead B (L-511 Millennium), 1.5 IOR Megalux A (Airport and Highway High Quality and High Performance Drop-On), and 1.5 IOR Megalux B (Airport 'Beacon' High Quality and High Performance). The Lumimark cementitious pavement marking material was not evaluated because the concrete mixture was out of date, causing the concrete to flake. Even though it was not evaluated, immediately after installing this product, the beads sank into the cementitious material, causing very low retro-reflective readings. Therefore, the process still needs some refinement. The PermaStripe cementitious pavement marking material, which is being evaluated by the U.S. Air Force and U.S. Army Corps of Engineers at Tyndall Air Force Base, is still under investigation and, therefore, is not ready for commercial application. At present, the PermaStripe product is hand applied with a squeegee. A paint hand-sprayer had been modified but is in the prototype stage. PermaStripe also needs to address the issue of very low retro-reflectivity readings.

NTIS

*Durability; Paints; Glass Coatings*

**20030057943** Lawrence Livermore National Lab., Livermore, CA

**Calculation of Pourbaix Diagrams for C22 in Various Well Water Chemistries**

Kaufman, L.; Oct. 02, 2002; 30 pp.; In English

Report No.(s): DE2003-15003151; UCRL-JC-150606; No Copyright; Avail: Department of Energy Information Bridge

Design and Fabrication of the Waste Package for the Yucca Mountain Waste Package represents a formidable challenge of the total knowledge that exists today concerning the properties of a wide variety of materials systems. During the past few years considerable successes have been achieved by employing the techniques of the new 'Computational Thermodynamics' to address some of the most critical problems of phase stability with substantial success. In particular phase stability in Alloy C22 which is a complex 10 component alloy in order to define the temperature dependence of the solidification, welding, heat treatment and transformation kinetics of the condensed liquid, Fe, Sigma, P-Phase and Ni<sub>3</sub>Cr phases are very well described when the modern CT software and databases are applied. The present report provides a description of current progress in the application of this technique to define and detail the corrosion behavior of C-22 by using the Thermo-Calc software and data bases to apply the classic methods devised in the last century by Marcell Pourbaix to C-22 in Simulated J-13 well waters (SAW) simulated acidic waters, SCW, simulated concentrated water and (BSW). The advantages of such a development is that it could provide substantial insight into methods for predicting corrosion behavior in critical components of the Waste Package that will have to function predictably for many tens of thousands of years.

NTIS

*Copper; Water; Wells; Thermochemical Properties; Diagrams*

**20030057996** Oklahoma State Univ., Stillwater, OK

**Theoretical Chemical Dynamics Studies of the Decomposition of Cyclic Nitramines**

Thompson, Donald L.; Jun. 30, 2002; 6 pp.; In English

Contract(s)/Grant(s): DAAD19-01-1-0022

Report No.(s): AD-A411234; ARO-41629.3-CH; No Copyright; Avail: CASI; [A02](#), Hardcopy

Research performed over the period April 1, 2001 - June 30, 2002 supported by the U.S. Army Research Office (Contract No.: DAAD19-01-1-0022) is described. This research program is concerned with the development of theoretical and computational methods and studies fundamental processes in energetic materials. The work during this report period focused on the following: (1) Molecular dynamics simulations of liquid nitromethane. (2) Simulations of the photodissociation of methyl nitrite on Ag (111). (3) Semiclassical calculations of dissociation, below and above the barrier, of HN<sub>2</sub>, with and

without rotational energy. (4) Adsorption, Diffusion, and Dissociation of CO on Fe(100). (5) Classical dynamics simulations of the unimolecular decomposition of TNAZ.

DTIC

*Physical Properties; Nitramine Propellants*

**20030058007** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Cornell Univ., Ithaca, NY, USA

**Indium Nitride: A Narrow Gap Semiconductor**

Wu, J.; Walukiewicz, W.; Yu, K. M.; Ager, J. W.; Haller, E. E.; 2002; 12 pp.; In English

Report No.(s): DE2002-803858; No Copyright; Avail: Department of Energy Information Bridge

No abstract available

NTIS

*Optical Properties; Gallium Compounds; Crystal Growth; Indium Compounds; Nitrides*

**20030058080** Pennsylvania State Univ., University Park, PA

**Molecular Fabrication of Nanoscale Composites**

Winograd, Nicholas; Feb. 2003; 21 pp.; In English

Contract(s)/Grant(s): N00014-91-J-1410

Report No.(s): AD-A411276; No Copyright; Avail: CASI; [A03](#), Hardcopy

The central aim of our work was to gain a fundamental understanding of the interaction of metal atoms with organic monolayers. This information is crucial to the burgeoning fields of molecular and organic electronics so that low power electronic devices can easily be designed. These systems are relevant not only for molecular/organic electronics but also in organometallic and polymer chemistry.

DTIC

*Composite Materials; Fabrication; Nanostructure (Characteristics); Molecular Electronics*

**20030058742** Eltron Research, Inc., Boulder, CO

**Low-Temperature Catalytic Oxidation of Airborne Organic Materials**

Roark, Shane E.; Cabrera, Jimena; Milazzo, Michael C.; White, James H.; Wander, Joseph D.; Jan. 2002; 13 pp.; In English

Contract(s)/Grant(s): F08637-99-C-6004

Report No.(s): AD-A411573; AFRL-ML-TY-TP-2002-4521; No Copyright; Avail: CASI; [A03](#), Hardcopy

Eltron Research Inc. has developed multi-component metal oxide catalysts for destruction of volatile organic compounds (VOCs) in air at low temperatures. The goal for this work is to produce a simple, cost-effective technology for reducing the concentration of VOCs in air to acceptable levels before the air is released into the atmosphere or recirculated. Specific applications include ventilated work spaces for spray painting and engine maintenance (degreasing and fuel line repair), indoor air decontamination, dry cleaning, food processing (grills and deep fryers), fume hoods, residential use, and solvent-intensive industrial processes. The components of the catalysts were chosen based on their anticipated oxygen surface mobility, moisture tolerance, multiple oxidation states, and documented activity for oxidation reactions. Catalyst powders and monolith-supported catalysts were screened for conversion of 1-butanol, toluene, and MEK to carbon dioxide and water. The concentrations of VOCs in the feedstream were maintained at  $\sim 100$  ppm, and the space velocity was  $\sim 6,000$  hr<sup>-1</sup>. Catalysts highlighted in this document generated complete conversion of 1-butanol to CO<sub>2</sub> at 150C, 69% conversion at 100 C, and 15% conversion at 80C. For toluene, complete conversion was achieved at 200C, and greater than 30% conversion at 150C. Catalysts deposited onto cordierite monoliths retained their composition and activity, and were stable in humid air. However, sulfur- and phosphorous-containing compounds quickly poisoned these catalysts through formation of sulfates and phosphates.

DTIC

*Catalysts; Metal Oxides; Volatile Organic Compounds; Oxidation; Air Quality*

**20030058891** Subaru Telescope, Hilo, HI, USA

**Fine Particle Production by Spray Pyrolysis Method**

Suto, H.; Ohara, S.; Fukui, T.; Koike, C.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 220-223; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Syntheses of several oxide particles were conducted by the spray pyrolysis method at Japan Fine Ceramics Center aiming to produce spherical particles and to obtain their optical characters free from ambiguity of unknown shape distribution of



particles. Our preliminary results are presented for the four oxide particles, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, Mg<sub>2</sub>SiO<sub>4</sub>, and TiO<sub>2</sub>.

Author

*Sprayers; Pyrolysis; Particle Production; Silicon Dioxide; Aluminum Oxides; Titanium Oxides*

**20030058976** Air Force Research Lab., Wright-Patterson AFB, OH

**Laser Cladding on Carbon-Carbon Composites**

Eric, John J.; Hull, Robert J.; Dec. 2002; 45 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-4347

Report No.(s): AD-A411861; AFRL-ML-WP-TR-2003-4011; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report describes the results of experiments on laser cladding a variety of protective coatings onto carbon-carbon substrates as oxidation-protection coatings. The work was performed using a 12-kW flattop CO<sub>2</sub> laser and a powder delivery system to inject the material to be deposited into the laser beam at the surface of the sample to be coated. The laser beam is delivered by a series of optics to the substrate, where it is focused to an approximately 1.3-cm-diameter spot size. Most of the test cases used 6 kW/sq cm to clad the coating material to the substrate surface. Coating materials included powdered aluminum, nickel chromium alloy, gray alumina ceramic, and a magnesium oxide/zirconium oxide ceramic. Mixed results were obtained, with the alumina providing a slightly better cladding, based on visual appearance and micrographic views.

DTIC

*Carbon-Carbon Composites; Cladding; Laser Beams; Protective Coatings*

**20030059043** California Univ., Davis, CA

**Synthesis and Behavior of Nanostructured Coatings Using Thermal Spraying**

Lavernia, E. J.; Jan. 22, 2003; 9 pp.; In English

Contract(s)/Grant(s): N00014-94-1-0017

Report No.(s): AD-A411113; No Copyright; Avail: CASI; [A02](#), Hardcopy

Potential applications of thermal spraying coatings span the entire spectrum of technology, from thermal barrier coatings for turbine blades to wear resistant rotating parts. The goal of this research program was to synthesize and characterize nanostructured thermal spraying coatings. The specific objectives were as follows: (1) to synthesize nanostructured powders for fabrication of nanostructured thermal spraying coatings; (2) to improve the spray technology for spraying nanostructured powders; and (3) to characterize the nanostructured materials (powder as well as coatings) for structure, composition, properties, and performance. One of the program's accomplishments was the successful synthesis of diverse nanostructured feedstock powders using mechanical milling in different media. Chemical composition and structural analyses were performed for the powders milled for a pre-determined interval so that the milling process and behavior of resultant powder was monitored and optimized. Another accomplishment was the 20% increase in hardness and 28% increase in wear resistance in nanostructured Cr<sub>3</sub>C<sub>2</sub>-NiCr coatings. Nanostructured powders and conventional powders were thermally sprayed and their behavior compared using a High Velocity Oxygen Fuels (HVOF) facility equipped with an inflight powder diagnostics system. A third accomplishment was the characterization of the nanostructured coatings in terms of hardness, wear-resistance, and microstructures using Nanoidentor, SEM, X-ray diffraction, and TEM. On the basis of the feedback from analysis of the physical properties of the coatings, the spraying parameters were modified and optimum spraying conditions were reached for an individual nanostructured powder. That is, techniques for synthesizing nanostructured WC-18Co coatings containing a low amount of non-WC carbide phases were developed as were thermal treatment techniques to further improve the physical performance of such coatings.

DTIC

*Synthesis (Chemistry); Nanostructures (Devices); HvoF Thermal Spraying; Fabrication; Ceramic Coatings*

## 24

### COMPOSITE MATERIALS

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

**20030057858** Rhode Island Univ., Kingston, RI, USA

**Durability and Performance of Novel Concrete-Cenosphere Composites in Extreme Environments**

Shukla, A.; Bose, A.; Lee, K. W.; Kovolyna, E.; Barbare, N.; Feb. 2003; 68 pp.; In English

Report No.(s): PB2003-104217; No Copyright; Avail: CASI; [A04](#), Hardcopy

A study has been conducted to further understand the performance of a lightweight concrete containing cenospheres

instead of sand as the fine aggregate. Specifically the strength at low temperature, resistance to repeated freeze-thaw cycles and the effect of silane coating on cenosphere in concrete were investigated. The study is a continuation of a previous research project titled 'Processing and Characterization of a Lightweight Concrete using Cenospheres' in which a lightweight concrete was processed by replacing sand with cenospheres on a volume basis. The admixture silica fume was used (7%) to help enhance the interfacial properties between the cenospheres and cement matrix. The mechanical properties including compressive strength, tensile strength, flexural strength and fracture toughness were tested at 0 deg C. The compressive strength increased by 30% at 0 deg C when compared to the room temperature value. Virtually no deterioration was found after 300 freeze-thaw cycles. The moisture absorption capacity of cenospheres was observed to be 18-times greater than sand used in normal concrete. Water absorption by cenosphere concrete was greater than the normal concrete. Drying phenomenon of cenospheres, sand, cenosphere concrete and the normal concrete was also studied.

NTIS

*Concretes; Composite Materials; Aggregates; Life (Durability)*

**20030057879** Cambridge Univ., Cambridge

**Dynamic Deformation Properties of Energetic Composite Materials**

Field, John E.; Walley, S. M.; Sivior, C. R.; Proud, W. G.; Dec. 2002; 66 pp.; In English

Contract(s)/Grant(s): F61775-01-WE056

Report No.(s): AD-A410839; No Copyright; Avail: CASI; A04, Hardcopy

This report outlines the mechanical, optical and microscopic techniques available in the Physics and Chemistry of Solids (POS) Fracture and Shock Physics group, Cavendish Laboratory, Cambridge, for studying the impact and high strain rate properties of materials. Results are presented for high strain rate stress-strain response of PBX, with effect of particle size and temperature. Results are presented on studies of ultrafines and conventional PETN and RDX.

DTIC

*Dynamic Characteristics; Composite Materials; Deformation; Fracturing*

**20030057928** Colorado Univ., Boulder, CO, USA

**Behavior of Fiber-Reinforced Polymer Reinforcement in Low Temperature Environmental Climates**

Cusson, R.; Xi, Y.; Dec. 2002; In English

Report No.(s): PB2003-105052; No Copyright; Avail: National Technical Information Service (NTIS)

Fiber-reinforced polymers (FRP) have been shown to be excellent construction materials in low temperature environments due to their low thermal conductivity to strength ratio, and high strength to density ratio. However, in cold weather climates, high residual stresses can build up within the fibrous composite material due to different coefficients of thermal expansion of the constituent materials. In regions where the environmental temperature may vary from day to day, microcracking and void generation can accentuate these residual stresses. This report focuses on the effects of combined loading history and environmental exposure on the durability of carbon and glass Fiber-reinforced polymer reinforcement bars. Specifically, degradations of FRP bars due to coupled freeze-thaw cycling, tension, and tensile fatigue loading are experimentally investigated. After a series of cyclic environmental preconditioning and mechanical loading, the degradation and variable loading rate dependency of GFRP bars are evaluated from several aspects: strength degradation due to freeze-thaw cycling, static and dynamic tensile strength, elongation, Young's modulus, displacement stiffness, fatigue strength, and failure mode analysis including bar grip failures.

NTIS

*Glass Fiber Reinforced Plastics; Low Temperature Environments; Composite Materials; Tensile Strength; High Strength; Thermal Conductivity*

**20030058020** Lawrence Livermore National Lab., Livermore, CA

**Preparation of Multilayered Materials in Cross-Section for In Situ TEM Tensile Deformation Studies**

Wall, M. A.; Barbee, T. W.; May 13, 1997; 14 pp.; In English

Report No.(s): DE2003-16378; UCRL-JC-123975-REV-1; No Copyright; Avail: Department of Energy Information Bridge

The success of in-situ transmission electron microscopy experimentation is often dictated by proper specimen preparation. We report here a novel technique permitting the production of cross-sectioned tensile specimens of multilayered films for in-situ deformation studies. Of primary importance in the development of this technique is the production of an electron transparent micro-gauge section using focused ion beam technology. This micro-gauge section predetermines the position at

which plastic deformation is initiated; crack nucleation, growth and failure are then subsequently observed.  
NTIS

*Transmission Electron Microscopy; Thin Films; Plastic Deformation; Tensile Deformation*

**20030058033** Manitoba Univ., Winnipeg, Manitoba, Canada

**Mathematical Framework for Problems of Unbounded Lattices**

Guo, Benqi; Nov. 2002; 58 pp.; In English

Contract(s)/Grant(s): DAAD19-99-01-0239

Report No.(s): AD-A411074; ARO-40152.2-CI; No Copyright; Avail: CASI; [A04](#), Hardcopy

This final progress report summarizes the progresses of our research in the period 1999-2002. Starting with problems of periodic lattices in entire spaces, and we focus on the mathematical framework for problems of unstructured lattice in unbounded domains without absolute terms. In this framework, the existence and uniqueness of solution for the problem without absolute terms in entire and half spaces  $R^d$  and  $R^d_+$ ,  $d = 1, 2, 3$  are proved in energy spaces. For unstructured lattices, new methodology and approach have been developed successfully, i.e. extension of grid functions by linear interpolation, which is essential to the some embedding results in discrete Sobolev spaces. These embeddings lead to the proof of existence of solutions.

DTIC

*Analysis (Mathematics); Interpolation; Domains; Proving*

**20030058695** Army Engineer Research and Development Center, USA

**Design of Fiber-Reinforced Polymer Materials for Seismic Rehabilitation of Infilled Concrete Structures**

Al-Chaar, Ghassan K.; Lamb, Gregory E.; Dec. 2002; 84 pp.; In English

Report No.(s): AD-A411018; ERDC/CERL-TR-02-33; No Copyright; Avail: CASI; [A05](#), Hardcopy

Of the government buildings located in high- or moderate-risk seismic zones, more than half were found vulnerable to damage during an earthquake. One rehabilitation technique that addresses vulnerabilities in both the masonry infills and in nonductile concrete frames is using fiber-reinforced polymer (FRP). An experimental program was conducted on reinforced concrete (RIC) frames infilled with masonry. Based on this research and related research in the field, this report was developed to provide in-depth guidelines for engineers and practitioners on how to evaluate the strength and stiffness of RIC members and masonry-infilled frames strengthened with FRP. The report's information was compiled and written following a logical sequence intended to help the engineer in the evaluation process. The second chapter outlines the steps that must be followed to obtain all the required material and geometrical properties of the structure to be evaluated. The following chapters present the load and deformation characteristics of RIC members strengthened with FRP. Next, the in-plane strength and stiffness evaluation procedures are shown for the lateral-force resisting system consisting of in-filled frames rehabilitated with FRP. The illustrative example in Appendix A summarizes the entire evaluation process, and Appendix B is a commentary on selected sections of the report.

DTIC

*Concrete Structures; Fiber Composites; Earthquake Resistant Structures; Earthquake Resistance; Reinforcing Materials; Concretes*

**20030058841** State Univ. of New York, Stony Brook, NY, USA

**Ultra-Reliability Evaluation Based on Multi-Property Degradation Mechanisms**

Nakamura, Toshio; Singh, Raman P.; Jan. 2002; 16 pp.; In English

Contract(s)/Grant(s): DAAD19-00-1-0558

Report No.(s): AD-A412210; ARO-41591-MS.3; No Copyright; Avail: CASI; [A03](#), Hardcopy

The reliability of composite materials when exposed to multiple degradation environments was characterized. First, a new procedure based on inverse analysis and experimental measurements was established to characterize the transient moisture diffusion process in composites as a function of relative humidity and temperature. This procedure accounted for the heterogeneous microstructure in considerable detail, and was utilized to obtain the diffusivity and the maximum moisture content of the epoxy phase, and to determine stress distributions in the composite. In addition, high-grade composite laminates were exposed to various environmental conditions to characterize synergistic mechanisms of degradation. It was observed that the environmental factors such as UV radiation and condensation act synergistically to produce extensive material degradation. Mechanical testing was employed to determine the effects of such degradation on properties such as modulus, strength, and residual modulus under fatigue. Finally, a new technique based on optical fiber sensors was designed to detect and quantify

embedded delamination and damage states via smart post-processing of measured data. This task required formulation of various inverse methods to process data to quantify unknown parameters. The results from this research have been made available to the composites community via numerous publications and presentations.

DTIC

*Degradation; Composite Materials; Reliability; Fiber Composites*

**20030058949** NASA Langley Research Center, Hampton, VA, USA

**On the Use of Accelerated Test Methods for Characterization of Advanced Composite Materials**

Gates, Thomas S.; May 2003; 55 pp.; In English

Contract(s)/Grant(s): 706-63-51-51

Report No.(s): NASA/TP-2003-212407; L-18289; NAS 1.60:212407; No Copyright; Avail: CASI; [A04](#), Hardcopy

A rational approach to the problem of accelerated testing for material characterization of advanced polymer matrix composites is discussed. The experimental and analytical methods provided should be viewed as a set of tools useful in the screening of material systems for long-term engineering properties in aerospace applications. Consideration is given to long-term exposure in extreme environments that include elevated temperature, reduced temperature, moisture, oxygen, and mechanical load. Analytical formulations useful for predictive models that are based on the principles of time-based superposition are presented. The need for reproducible mechanisms, indicator properties, and real-time data are outlined as well as the methodologies for determining specific aging mechanisms.

Author

*Polymer Matrix Composites; Accelerated Life Tests; Microstructure; Life (Durability); Aging (Materials); Mechanical Properties; Aerospace Engineering*

**20030059008** Texas Univ., Austin, TX, USA

**Research Report: Inspecting FRP Composite Structures with Nondestructive Testing**

Fowler, T.; Kinra, V. K.; Maslov, K.; Moon, T. J.; Oct. 2001; 152 pp.; In English

Report No.(s): PB2003-103761; RR-1892-1; No Copyright; Avail: CASI; [A08](#), Hardcopy

Structural plastics and composites such as fiber reinforced polymers (FRP) represent a broad class of materials finding increased use in bridge and highway related applications. These materials offer important advantages, including corrosion resistance and formability. A number of bridge-related research and construction projects involving composites have begun at TxDOT and in other states and countries in the recent years, demonstrating the rapidly expanding use and interest in these materials. As the use of composites is implemented in TxDOT structures, TxDOT must conduct quality assurance testing to ensure structural integrity of the products, much in the same way TxDOT already does with steel and composite structures. Nondestructive testing, especially the acoustic emission method (AE) offers great promise for inspecting FRP structures to ensure integrity. AE testing is used very successfully in quality assurance testing of pressure vessels, and research is needed to adapt this method to the type of composite structures that will be used in highway applications and to consider other methods that might be suitable to structural composites.

NTIS

*Fiber Composites; Polymer Matrix Composites; Structural Engineering*

**20030059051** Federal Aviation Administration, Washington, DC

**Guidelines for the Development of Process Specifications, Instructions, and Controls for the Fabrication of Fiber-Reinforced Polymer Composites**

Mar. 2003; 58 pp.; In English

Report No.(s): PB2003-104285; DOT/FAA/AR-02/110; No Copyright; Avail: CASI; [A04](#), Hardcopy

This document provides (1) a set of guidelines for the development of process specifications for the fabrication of continuous fiber-reinforced polymer composite laminate test panels used in the generation of mechanical properties and (2) an approach for the validation of composite fabrication processes used during the certification of composite aircraft structure. These guidelines were prepared by a team of industry experts. Guidelines are given based on processes and sound engineering practices currently used within the aerospace industry. This report is intended to advance the work that has been done through previous Federal Aviation Administration programs such as the Advanced General Aviation Transport Experiment. These programs have established methodology for developing statistical-based databases and their standardization. The guidelines found in this document are meant to be a documentation of current knowledge and application of sound engineering principles to the composite laminate fabrication process. It is envisioned that these guidelines would be used to develop process

specifications, work instructions (planning), sections within material specifications, and certification and qualification test plans.

NTIS

*Fiber Composites; Polymers; Fabrication*

## 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*.

**20030057741** Iowa State Univ. of Science and Technology, Ames, IA, USA

#### **Dopants and Doping Level Dependence of the Structure and Magnetic Properties of the Eu(Ba(sub 1-x) LR(sub x))(sub 2) Cu(sub 3)O(sub 7 and delta) System**

Lin, Y.; 2001; 84 pp.; In English

Report No.(s): DE2003-804165; No Copyright; Avail: Department of Energy Information Bridge

Eu(Ba(sub 1-x)Nd(sub x))(sub 2)Cu(sub 3)O(sub 7 plus delta) were systematically studied in order to understand how the valence of the rare earth elements, ionic sizes and magnetic moment affect the crystal structure and magnetic and electrical properties. Differential thermal analyses were carried out to check the phase purity, X-ray data were least-squares fitted to determine the lattice parameters, and DC-SQUID magnetometry was used to characterize the superconducting properties. These results showed that the crystallography is consistent with other EuLR123ss series, LR=La,Pr,Eu. The lattice parameters vary with the ionic radii of the rare earth ions.

NTIS

*Magnetic Properties; Doped Crystals; Crystallography; Rare Earth Elements; Thermal Analysis; Electrical Properties; Europium Compounds*

**20030057834** Maryland Univ., College Park, MD, USA, City Univ. of New York, NY, USA

#### **Application of CFD Modeling to Room Fire Growth on Walls**

Liang, K. M.; Ma, T.; Quintiere, J. G.; Rouson, D.; Apr. 2003; 142 pp.; In English

Report No.(s): PB2003-104563; No Copyright; Avail: CASI; A07, Hardcopy

An evaluation of the NIST FDS model was conducted with particular attention for its use in predicting flame spread on surfaces. Over the course of this investigation the computational model changed from combustion depicted by particles to a mixture fraction based combination model. The study pertains to version 2.0 released on December 4, 2001. Three aspects were considered in the study. First, the authors studied the evaluation of the code to predict a combusting plume. Second, the code was applied to a fire plume adjacent to a vertical wall, and then flame spread on the wall. Third, a complementary investigation of an improved algorithm for convective heat transfer at a surface was developed. The first two studies resulted in M.S. theses. Damian Rouson of CCNY performed the third study. The thesis by Ma on the axi-symmetric plume was previously transmitted and will not be included here. However, a recently accepted paper, based on the thesis with updated results is included.

NTIS

*Fires; Computational Fluid Dynamics; Flame Propagation; Rooms; Walls*

**20030057849** Los Alamos National Lab., NM, California Univ., Davis, CA, USA

#### **Fundamental Thermodynamics of Actinide-Bearing Mineral Waste Forms**

Williamson, M. A.; Putnam, R. L.; 2002; 142 pp.; In English

Report No.(s): DE2002-781717; No Copyright; Avail: Department of Energy Information Bridge

The end of the Cold War raised the need for the technical community to be concerned with the disposition of surplus nuclear weapon material. The USA Department of Energy has determined that surplus weapons plutonium belonging to the USA will be either burned as a mixed-oxide fuel (MOX) or incorporated into a ceramic material and then placed in a geologic repository. The form of that ceramic material is a solid solution between four end member phases. The stability and behavior of plutonium in the proposed ceramic end member materials has only begun to be understood. Our studies into the fundamental thermodynamics of actinide substitution into these phases have begun to provide a basis for technically sound solutions to the issue of a safe, secure, and environmentally acceptable waste material. Our work has found thermodynamic

trends that are beginning to be illuminated which can assist in better understanding the chemistry and phase equilibria of actinide substitution into the immobilization matrix.

NTIS

*Minerals; Thermodynamics; Actinide Series Compounds; Radioactive Wastes*

**20030057869** Pacific Northwest National Lab., Richland, WA, USA

**Analysis of Hazardous Biological Materials by MALDI Mass Spectrometry**

Wahl, K. L.; Jarman, K. H.; Valentine, N. B.; Kingsley, M. T.; Petersen, C. E.; Dec. 1999; 64 pp.; In English

Report No.(s): DE2003-15002705; PNNL-13099; No Copyright; Avail: Department of Energy Information Bridge

Matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS) is being developed as a rapid screening tool for pathogen identification. Advantages of MALDI-MS for biomolecule identification include rapid analysis time (4 min per sample analysis), low sample volume requirements (< 1 microL fluid), and the highly selective and specific nature of mass spectrometric analysis. Bacterial cells are identified by comparing MALDI-MS spectra obtained from cultured bacterial cells and simple microbial mixtures against a library of known MALDIMS spectral fingerprints of intact bacterial cells. Objectives of this research include (1) evaluation and standardization of a MALDI-MS analysis protocol, (2) reproducibility assessment of the MALDI-MS spectra and (3) feasibility demonstration of this approach for bacterial identification in the forensic sciences. Note that initial efforts have not attempted to reach the sensitivity limits of the MALDI-MS technique. In the research presented here, approximately 10 times to the 6th power cells are deposited onto the MALDI target slide. However, only about 10% of the sample is used to obtain the MALDI-MS spectra. Options to improve sensitivity and optimize this technique for complex samples are provided as recommendations for future work.

NTIS

*Mass Spectroscopy; Hazardous Wastes; Cells (Biology)*

**20030057898** Vanderbilt Univ., Nashville, TN

**A New Class of Highly Polar Liquid Crystals for Display Applications**

Kaszynski, Piotr; Jan. 30, 2003; 5 pp.; In English

Contract(s)/Grant(s): N00014-99-1-0854

Report No.(s): AD-A410958; No Copyright; Avail: CASI; [A01](#), Hardcopy

The subject of this project is the synthesis and characterization of a new class of molecular components for nematic-based liquid crystal displays that show good solubility in the nematic host and high efficiency at low doping level. The centerpiece of the design is the inorganic boron cluster CB<sub>11</sub>H<sub>12</sub>(-) which upon substitution with a positively charged group forms highly polar, UV transparent liquid crystal materials.

DTIC

*Liquid Crystals; Display Devices; Boron; Inorganic Chemistry*

**20030057903** Lawrence Livermore National Lab., Livermore, CA

**Crevice Corrosion and Pitting of High-Level Waste Containers: A First Step Towards the Integration of Deterministic and Probabilistic Models**

Farmer, J. C.; 2002; 106 pp.; In English

Report No.(s): DE2003-16344; No Copyright; Avail: Department of Energy Information Bridge

An integrated predictive model is being developed to account for the effects of localized environmental conditions in crevices on pit initiation and propagation. A deterministic calculation is used to estimate the accumulation of hydrogen ions (pH suppression) in the crevice solution due to equilibrium hydrolysis reactions of dissolved metal. Pit initiation and growth within the crevice is dealt with by either a stochastic probability model, or an equivalent deterministic model. While the strategy presented here is very promising, the integrated model is not yet ready for accurate quantitative predictions. Empirical expressions for the rate of penetration based upon experimental crevice corrosion data should be used in the interim period, until the integrated model can be refined. Both approaches are discussed.

NTIS

*Corrosion; Radioactive Wastes; Storage Tanks; Waste Disposal*

**20030057923** Air Force Research Lab., Edwards AFB, CA, USA

**Swirl Coaxial Injector Development**

Cohn, R. K.; Strakey, P. A.; Bates, R. W.; Talley, D. G.; Muss, J. A.; Dec. 27, 2002; 15 pp.; In English

Contract(s)/Grant(s): Proj-3058

Report No.(s): AD-A410862; AFRL-PR-ED-TP-2002-324; No Copyright; Avail: CASI; [A03](#), Hardcopy

Sierra Engineering and the Air Force Research Laboratory Propulsion Directorate, have undertaken a program to develop gas-centered, swirl coaxial injectors. This injector design will be used in the multi-element Advanced Fuels Tester (AFT) engine to test a variety of hydrocarbon propellants. As part of this program, a design methodology is being developed which will be applicable to future injector design efforts. The methodology combines cold flow data, acquired in the AFRL High Pressure Injector Flow facility, uni-element hot fire data, collected in AFRL Test Cell EC-1, and a computational effort conducted at University of Alabama-Birmingham, to identify key design features and sensitivities. Only results from the experimental effort will be presented in this work. Three different gas-centered swirl coaxial element concepts are being studied: a converging design, a diverging design, and a pre-filming design. The cold flow experiments demonstrated that all three classes of elements produced an extremely dense, solid cone spray, with the highest mass density in the center. The atomization of all of these injectors was excellent, producing mean drop sizes 1/3 to 1/4 of that typically measured for shear coaxial elements operating under similar conditions. Uni-element hot fire testing has found that the converging designs produce  $C^*$  efficiencies in excess of 90% over a wide-range of mixture ratios and pressure conditions. Near the design pressure, efficiencies exceeding 96% have been measured. In the diverging designs, a chamber oscillation of near 200 Hz has been noted. The cause of this oscillation is under investigation.

DTIC

*Injectors; Propellants; High Pressure; Fuels; Engine Tests; Swirling*

**20030057936** Air Force Research Lab., Edwards AFB, CA, USA

**Evaluation of DSMC Dissociation Models through Comparison to Measured Cross Sections**

Wysong, Ingrid J.; Dressler, Rainer A.; Chiu, Y. H.; Boyd, Iain D.; Apr. 16, 2001; 29 pp.; In English  
Contract(s)/Grant(s): Proj-2308

Report No.(s): AD-A410919; AFRL-PR-ED-TP-2001-088; No Copyright; Avail: CASI; [A03](#), Hardcopy

Recent measurements of collision-induced dissociation (CID) cross sections for  $\text{Ar}^2(+)\text{-Ar}$  collisions for vibrationally cold and hot cases are utilized to test and compare several CID models that have been proposed for the direct simulation Monte Carlo (DSMC) technique. The idea that the CID process is strongly favored by vibrational energy is discussed relative to the various models. The Ar data do not show any vibrational favoring of the CID cross sections. It is shown that some DSMC CID models have much more physically realistic behavior in terms of their cross sections than others.

DTIC

*Computerized Simulation; Monte Carlo Method; Evaluation; Argon; Cross Sections*

**20030057942** Lawrence Livermore National Lab., Livermore, CA, Krispin Technologies, Inc., Rockville, MD, USA

**Spherical Combustion Layer in a TNT Explosion**

Kuhl, A. L.; Ferguson, R. E.; Dec. 09, 2001; In English

Report No.(s): DE2003-15002894; UCRL-JC-143658; No Copyright; Avail: National Technical Information Service (NTIS)

A theoretical model of combustion in spherical TNT explosions at large Reynolds, Peclet and Damkhler numbers is described. A key feature of the model is that combustion is treated as material transformations in the Le Chatelier plane, rather than 'heat release'. In the limit considered here, combustion is concentrated on thin exothermic sheets (boundaries between fuel and oxidizer). The products expand along the sheet, thereby inducing vorticity on either side of the sheet that continues to feed the process. The results illustrate the linking between turbulence (vorticity) and exothermicity (dilatation) in the limit of fast chemistry thereby demonstrating the controlling role that fluid dynamics plays in such problems.

NTIS

*Combustion; Mathematical Models; Trinitrotoluene*

**20030057962** North Carolina State Univ., Raleigh, NC

**Development of High-Sensitivity Nitride Solar-Blind Detectors and Detector Arrays Using Low-Dislocation-Density Nitride Surfaces**

Schetzina, J. F.; Mar. 2002; 62 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAD19-99-1-0010

Report No.(s): AD-A411053; ARO-39999.1-EL; No Copyright; Avail: CASI; [A04](#), Hardcopy

This work explored the application of III-V nitride semiconductors for optical detectors in the ultraviolet (UV) region of the electromagnetic spectrum. Metalorganic vapor phase epitaxy was used to synthesize thin film p-i-n photodiode structures on double side polished sapphire substrates. These structures were fabricated into photodiode devices using generally accepted techniques for dry etching and p and n-contact metallizations. Test devices were characterized which demonstrated quantum

efficiencies as high as 80%, along with extremely low dark currents; resulting in photodiode spectral detectivities as large as  $6 \times 10^{13} \text{ cm}^2 \text{ Hz}^{-1} \text{ W}^{-1}$ . Devices were designed and demonstrated for a series of detection regions ranging from 365 nm to 250 nm. Photodiode arrays were also fabricated and flip-chip bonded to silicon readout integrated circuits (ROICs) to form the basis of visible-blind and solar-blind UV digital cameras. These UV-specific digital arrays were tested using focal plane array hardware and software obtained from SE-IR, Inc.

DTIC

*Nitrides; Digital Cameras; Optical Measuring Instruments; Low Density Materials; Dislocations (Materials); Surface Properties*

**20030057971** Cambridge Univ., Cambridge

**Plasma-Propellant Interactions**

Proud, W. G.; Kalafatis, P.; Field, J. E.; Dec. 2002; 13 pp.; In English

Contract(s)/Grant(s): N68171-01-C-9016

Report No.(s): AD-A411201; RG-32402; R/D-9109-OH-01; No Copyright; Avail: CASI; A03, Hardcopy

This is the second in a series of reports on our research on Propellant-Plasma Interactions. The first report described our facilities for testing propellants at high pressures. This report covers the design, fabrication and testing of equipment for producing and measuring controlled electric induced plasma discharges in the vicinity of explosive compositions. The next report will include Environmental Scanning Electron Microscopy (ESEM) micrographs of explosive surfaces that have been subjected to discharges.

DTIC

*Explosives; Propellants; Scanning Electron Microscopy*

**20030057988** California Inst. of Tech., Pasadena, CA

**The Molecular Basis of Humic Acid Reduction and its Role in Microbiologically Influenced Corrosion**

Newman, Dianne K.; Mar. 10, 2003; 4 pp.; In English

Contract(s)/Grant(s): N00014-00-1-0083

Report No.(s): AD-A411255; No Copyright; Avail: CASI; A01, Hardcopy

Transposon mutagenesis was used to make mutants in *Shewanella oneidensis* strain MR-1. Two separate genetic screens were performed: the first identified mutants that are defective in their ability to reduce AQDS (a proxy for humic acid), the second identified mutants that are defective in their ability to make biofilms on steel chips. The mutants were subjected to a variety of tests to verify their phenotypes and further characterize their properties. The site of insertion of the transposon was determined. Select mutants defective in either humic acid reduction or biofilm formation were compared with respect to their ability to promote the corrosion of mild steel using electrochemical impedance spectroscopy. The principle results from this study were: 1.) the discovery that bacteria produce their own extracellular electron shuttles that can transfer electrons to iron minerals, and 2.) that iron reduction can protect steel from corrosion.

DTIC

*Corrosion; Bacteria; Microbiology; Heterocyclic Compounds*

**20030058009** Praxair, Inc., Tarrytown, NY

**Dilute Oxygen Combustion. Phase 3 Report**

Riley, M. F.; May 2000; 46 pp.; In English

Report No.(s): DE2002-805679; No Copyright; Avail: Department of Energy Information Bridge

Dilute Oxygen Combustion (DOC) burners have been successfully installed and operated in the reheat furnace at Auburn Steel Co., Inc., Auburn, NY, under Phase 3 of the Dilute Oxygen Combustion project. Two new preheat zones were created employing a total of eight 6.5 MMBtu/hr capacity burners. The preheat zones provide a 30 percent increase in maximum furnace production rate, from 75 tph to 100 tph. The fuel rate is essentially unchanged, with the fuel savings expected from oxy-fuel combustion being offset by higher flue gas temperatures. When allowance is made for the high nitrogen level and high gas phase temperature in the furnace, measured NO<sub>x</sub> emissions are in line with laboratory data on DOC burners developed in Phase 1 of the project. Burner performance has been good, and there have been no operating or maintenance problems. The DOC system continues to be used as part of Auburn Steel's standard reheat furnace practice.

NTIS

*Combustion Products; Combustion Efficiency; Combustion Chambers; Manufacturing; Gas Temperature*



**20030058071** Naval Postgraduate School, Monterey, CA

**A Numerical Study of Combined Convective and Radiative Heat Transfer in a Rocket Engine Combustion Chamber**

Savur, Mehmet K.; Dec. 2002; 98 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411021; No Copyright; Avail: CASI; [A05](#), Hardcopy

A numerical study was conducted to predict the combined convective and radiative heat transfer rates on the walls of a small aspect ratio cylinder representative of the scaled model of a rocket engine combustion chamber. A high-temperature, high-pressure environment was simulated in the cylinder, with gas velocities at low subsonic levels typical of the conditions leading to the entrance of the nozzle section of a rocket engine. The composition of the gases in the cylinder was determined from the TEP program for the burning of rocket fuel at typical values of the O/F ratio. The thrust of the study was to determine the radiative contribution to the heat transfer rate from the hot participating chamber gases to the cooler wall. The calculations were carried out using the commercial CFD package CFDACE, and were first benchmarked against known results in the literature for the simpler case of gray chamber walls and a gray participating medium. The non-gray computations were subsequently carried out using gas absorption coefficient values obtained from the exponential wide band model with the help of the fire-modeling program, RADCAL. The effect of different chamber wall temperatures and gas compositions were examined. The main findings of the study are that the radiative contributions at the high gas temperatures being considered are comparable to the convective values, and strongly spectral in nature. In addition these radiative fluxes were found to be least sensitive to the wall temperature and chamber pressure in the range considered. Furthermore, this radiative contribution reaches a maximum at a unique optimal optical thickness of the gas that lies within the extremes of the optically thin and thick limiting cases.

DTIC

*Combustion Chambers; Rocket Engines*

**20030058073** North Carolina State Univ., Raleigh, NC, USA

**Chemical Beam Epitaxy of Indium Nitride Using Seeded Supersonic Beams of Ammonia and Trimethyl-Indium**

Lamb, Harold H.; Jun. 2002; 12 pp.; In English

Contract(s)/Grant(s): N00014-01-1-0003

Report No.(s): AD-A411024; No Copyright; Avail: CASI; [A03](#), Hardcopy

Low-temperature growth of indium nitride (InN) films on gallium NITRIDE(OO01) substrates was achieved by supersonic jet epitaxy using ammonia (NH<sub>3</sub>) and trimethyl-indium (TMIn). Unfortunately, there was no indication of a reaction pathway involving TM In and NH<sub>3</sub> that results in InN growth at temperatures less than approximately 500C. We infer that NH<sub>3</sub> decomposition is the rate-limiting step in InN growth using NH<sub>3</sub> and elemental In or TM In. Highly selective generation of ground-state nitrogen atoms for growth was accomplished using a radio-frequency (rf) discharge supersonic jet source. The rf discharge supersonic jet source was characterized by optical emission spectroscopy and time-of-flight appearance potential mass spectrometry.

DTIC

*Nitrides; Ammonia; Indium; Crystal Growth; Chemical Reactions*

**20030058096** State Univ. of New York, Stony Brook, NY, USA

**Defects in SiC Single Crystals and Their Influence on Device Performance**

Dudley, Michael; Feb. 4, 2003; 40 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0392

Report No.(s): AD-A411043; ARO-37560.10-MS; No Copyright; Avail: CASI; [A03](#), Hardcopy

This extensive program of research aims to apply the techniques of Synchrotron White Beam X-ray Topography (SWBXT), Nomarski Optical Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy (TEM), and I-V characteristic Probing to the detailed analysis of defect structures in SiC single Crystals of various polytypes, and to determine how these defect structures can influence the performance of various kinds of device manufactures therefrom. Results obtained so far indicate that devices without screw dislocations exhibited excellent characteristics, with no detectable leakage current prior to breakdown, a sharp breakdown I-V knee, and no visible concentration of breakdown current. In contrast, devices that contained at least one elementary screw dislocation exhibited a 5% to 35% reduction in breakdown voltage, a softer breakdown I-V knee, and visible microplasmas at the sites of the screw dislocations. In addition a new strategy for preparing defect free 3C epilayers on 4H substrates was investigated. The success of this strategy was assessed using SWBXT, and results obtained to date reveal that high quality, polytype controlled 3C could be grown. The scope of the project was modified to encompass parallel studies of the influence of defect microstructure on the performance of resonators made from single crystals of the novel piezoelectric materials Langasite, Langanite and Langatate. Early results have indicated the presence of

growth striations, dislocations and precipitates. The influence of these defects on device performance is being systematically studied.

DTIC

*Single Crystals; Crystal Defects; Silicon Carbides; Screw Dislocations*

**20030058099** Naval Postgraduate School, Monterey, CA

**Initiator Diffraction Limits for Pulse Detonation Engine Operation**

Werner, Steven P.; Dec. 2002; 62 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-02-2-0153

Report No.(s): AD-A411011; No Copyright; Avail: CASI; [A04](#), Hardcopy

Operational characteristics of a valveless pulse detonation engine system are being characterized by both experimental and computational efforts. The detonation diffraction process from a small 'initiator' combustor to a larger diameter main combustor in a continuous airflow configuration was evaluated during multi-cycle operation of a pulse detonation engine. The multi-cycle detonation experiments were performed on an axisymmetric engine geometry operating on both ethylene and propane fuel/air mixtures. The new design explored the effect of forward relief area on performance and its ability to isolate the detonation products from the incoming air flow during cyclic operation. The use of a small fuel-oxygen initiator to initiate a fuel/air detonation in a larger main combustor has been achieved and has demonstrated the benefit of generating an overdriven detonation condition near the diffraction plane for enhanced transmission to a larger combustor. Mach reflections have been observed on the outer wall downstream of the diffraction plane for the two-dimensional geometry and appear to be the primary re-initiation mechanisms or the re-established fuel-air detonations for this geometry. Multi-cycle tests have successfully evaluated initiator/main combustor diameter ratios of up to 1.58 and are expected to continue through 2.0.

DTIC

*Pulse Detonation Engines; Combustion Chambers; Initiators (Explosives); Diffraction*

**20030058749** Pratt and Whitney Aircraft, West Palm Beach, FL, USA

**Design, Fabrication and Test of a Full Scale Copper Tubular Combustion Chamber**

Cooley, Christine; Fentress, Steve; Jennings, T.; Jul. 10, 2002; 15 pp.; In English

Contract(s)/Grant(s): F04611-95-C-0123; Proj-1011

Report No.(s): AD-A410586; AFRL-PR-ED-TP-2002-110; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper presents the design fabrication and test of a full scale copper tubular combustion chamber as an enabling technology for future application in a high thrust upper-stage expander-cycle engine. The advanced expander combustor (AEC) was developed by Pratt & Whitney Space Propulsion under contract with the USA Air Force Research Laboratory (AFRL) to support the Integrated High Payoff Rocket Propulsion Technology (IHRPRT) initiative. The AEC copper tubular design combines high material thermal conductivity and large effective surface area in a structurally compliant coolant channel configuration to achieve significant heat pick-up from the combustion gases to the coolant AEC hot fire test data analysis confirmed the ability to achieve high thrust in an expander-cycle engine using a copper tubular construction. Heat transfer enhancement resulting from the tubular chamber liner construction was shown to be in the range of 29 to 46 percent at typical operating conditions compared to a smooth wall copper liner design. The technology developed during the AEC fabrication and test program is currently being used by Pratt & Whitney (P&W) in the development of the RL60, a high performance 60,000-lb thrust expander-cycle engine.

DTIC

*Combustion Chambers; Copper; Fabrication; Technology Utilization; Rocket Engine Design; Full Scale Tests*

**20030058755** Science Applications International Corp., Dayton, OH

**Microwave Treatment of Oxidizer Vapor**

Cha, Chang Y.; Provens, Timothy; Wright, Gary; Wander, Joseph D.; Jan. 2002; 14 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411580; AFRL-ML-TY-TP-2002-4520; No Copyright; Avail: CASI; [A03](#), Hardcopy

During fueling of liquid rockets, transfer of the propellant, hydrazine (and its monomethyl and 1,2-dimethyl derivatives), and of the oxidizer, dinitrogen tetroxide (N<sub>2</sub>O<sub>4</sub>) creates exhaust streams of nitrogen gas heavily contaminated with these constituents. Wet scrubbers provide ~60% removal of these contaminants, and combustion devices emit unacceptable amounts of NO<sub>x</sub> as byproducts of treatment. The Air Force Research Laboratory, Weapon Systems Logistics Branch (AFRL/MLQL) has developed a systematic assessment of needs for pollution prevention research within the space segment of Air Force

activities. The MLQL team has identified development of a Toxic Propellant Vapor Treatment process to improve on current scrubber technology for treatment of this exhaust as one of two specific, high-priority needs of common concern to several locations. Toward that goal, CHA Corporation is conducting a staged development effort leading to a field demonstration of a full-scale microwave reactor system to decompose both N<sub>2</sub>O<sub>4</sub> vapors and hydrazine vapors in SEPARATE nitrogen gas streams. We expect to carry the development through to deployment as an operational technology. During phase 1, we completed design optimization experiments and assembled a 5-IO-scfm prototype reactor system. Efficient reduction of NO<sub>x</sub> formed by dissociation of N<sub>2</sub>O<sub>4</sub> is realized by passage through a bed of carbon during microwave irradiation. To extend the lifetime of the carbon bed, which is consumed as a reductant in this process, we introduced a slight stoichiometric excess of alcohol upstream of the bed. This approach achieves consistent 99+% reduction of net NO<sub>x</sub> species over a range of irradiation power levels and residence times.

DTIC

*Pollution Control; Nitrogen Oxides; Exhaust Emission; Liquid Oxidizers; Exhaust Gases; Propellant Transfer*

**20030058765** Oklahoma State Univ., Stillwater, OK

**Theoretical Studies of Nitramine Crystals**

Thompson, Donald L.; Agrawal, Paras M.; Feb. 11, 2003; 3 pp.; In English

Contract(s)/Grant(s): DAAD19-00-1-0064

Report No.(s): AD-A411207; ARO-40675.1-CH; No Copyright; Avail: CASI; [A01](#), Hardcopy

Research performed over the period April 1, 2001 - September 30, 2002 supported by the U.S. Army Research Office is described. This research program is concerned with the development of theoretical methods and computer codes for simulating fundamental processes in energetic materials. The work is being carried out in collaboration with Dr. Betsy M. Rice at ARL. The work during this report period focused on the following: The development and demonstration of methods and computer codes for calculating rates of physical and chemical processes in many-atom systems by Monte Carlo variational transition-state theory. Specifically, we demonstrated the methods and codes by calculating rates of atomic diffusion on metal surfaces for comparison with data in the literature.

DTIC

*Nitramine Propellants; Computerized Simulation; Chemical Reactions; Computer Programming; Metal Crystals; Molecular Dynamics*

**20030058771** Air Force Research Lab., Edwards AFB, CA, USA

**Air Force Research Laboratory Propulsion Directorate, Propulsion Sciences and Advanced Concepts Division**

Levine, Jay; May 20, 1999; 19 pp.; In English

Contract(s)/Grant(s): AF Proj. 5503

Report No.(s): AD-A410924; AFRL-PR-ED-TP-99-0104; No Copyright; Avail: CASI; [A03](#), Hardcopy

Presentation slides for briefing on Air Force Research Laboratory, Propulsion Directorate, research and development projects.

DTIC

*Air Defense; Research And Development; Rocket Engines*

**20030058775** Air Force Research Lab., Edwards AFB, CA, USA

**Towards New Polynitrogen Species: The Search for Viable Precursors**

Christe, Karl; Haiges, Ralf; Schneider, Stefan; Schroer, Thorsten; Vij, Ashwani; Jan. 29, 2003; 28 pp.; In English

Contract(s)/Grant(s): Proj-2303

Report No.(s): AD-A410965; AFRL-PR-ED-VG-2003-025; No Copyright; Avail: CASI; [A03](#), Hardcopy

The presentation slides for the briefing concerning, Towards New Polynitrogen Species: The Search for Viable Precursors are presented.

DTIC

*Rocket Propellants; Polymers; Synthesis (Chemistry); Nitrogen*

**20030058783** Materials Research Society, Warrendale, PA

**Materials Research Society Symposium Proceedings; Volume 720. Materials Issues for Tunable RF and Microwave Devices III Held in San Francisco, California on April 2-3, 2002**

Tidrow, Steven C.; Horwitz, James S.; Xi, Xiaoxing; Levy, Jeremy; Apr. 3, 2002; 215 pp.; In English

Contract(s)/Grant(s): N00014-02-1-0540

Report No.(s): AD-A410712; No Copyright; Avail: CASI; [A10](#), Hardcopy

The purpose of this symposium was to bring together researchers from a broad range of disciplines to discuss the challenges facing the implementation of an affordable tunable RF and microwave device technology. Low cost, tunable, microwave devices will have a tremendous impact on a variety of commercial and military systems, including, but not limited to, tunable band-select filters for wireless communications, phase shifters and true time delay devices for electronic scanning antennas, tunable radiating structures for frequency hopping, and tunable transformers to reduce RF impedance mismatch. The papers of this proceedings discuss a wide range of topics from materials issues through devices and even a system level demonstration of electronic beam steering. Specific materials issues discussed are: new tunable materials; issues of tunability, preparation and optimization of bulk and thin film properties; materials, surface, and interface characterization; evaluation of material loss and loss mechanisms; effects of microstructure; and temperature stability. At the device level, phase shifters are discussed and a new device concept for variable true time delay versus phase shift is introduced. At the system level, a paraelectric lens is used to demonstrate electronic beam steering of an antenna at 10 GHz with about 2 dB of loss.

DTIC

*Microwave Equipment; Ferroelectric Materials; Conferences; Tunable Filters; San Francisco (Ca); Composite Materials; Radio Frequencies*

**20030058799** Lawrence Livermore National Lab., Livermore, CA

#### **Zero Temperature Hope Calculations**

Rozsnyai, B. F.; Sep. 30, 2002; In English

Report No.(s): DE2003-15002786; UCRL-ID-149439; No Copyright; Avail: National Technical Information Service (NTIS)

The primary purpose of the HOPE code is to calculate opacities over a wide temperature and density range. It can also produce equation of state (EOS) data. Since the experimental data at the high temperature region are scarce, comparisons of predictions with the ample zero temperature data provide a valuable physics check of the code. In this report we show a selected few examples across the periodic table. The HOPE code is an 'average atom' (AA) Dirac-Slater self-consistent code.

NTIS

*Equations Of State; Opacity; Applications Programs (Computers)*

**20030058831** Oxford Univ., Oxford

#### **Euchem 2002 Molten Salts Conference, St. John's College, Oxford, UK, 1-6 September 2002**

Dec. 2, 2002; 130 pp.; In English

Report No.(s): AD-A412104; No Copyright; Avail: CASI; [A07](#), Hardcopy

The Final Proceedings for EUCHEM 2002 Molten Salts Conference, 1 September 2002 6 September 2002: (1) Chemistry and physics of high and low temperature molten salts; (2) Applications of above in energy storage and generation, materials synthesis and waste processing.

DTIC

*Molten Salts; Energy Storage; Inorganic Chemistry*

**20030058883** NASA Ames Research Center, Moffett Field, CA, USA

#### **Laboratory Calibration Studies in Support of ORGANICS on the International Space Station: Evolution of Organic Matter in Space**

Ruiterkamp, R.; Ehrenfreund, P.; Halasinski, T.; Salama, F.; Foing, B.; Schmidt, W.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 149-152; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper describes the scientific overview and current status of ORGANICS an exposure experiment performed on the International Space Station (ISS) to study the evolution of organic matter in space (PI: P. Ehrenfreund), with supporting laboratory experiments performed at NASA Ames. ORGANICS investigates the chemical evolution of samples submitted to long-duration exposure to space environment in near-Earth orbit. This experiment will provide information on the nature, evolution, and survival of carbon species in the interstellar medium (ISM) and in solar system targets.

Author

*Organic Materials; Aerospace Environments; Chemical Evolution; Spaceborne Experiments*

**20030058916** Colorado Univ., Boulder, CO, USA

**Laboratory Anion Chemistry: Implications for the DIBs, and a Potential Formation Mechanism for a Known Interstellar Molecule**

Eichelberger, B.; Barckholtz, C.; Stepanovic, M.; Bierbaum, V.; Snow, T.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 120-123; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-6758; No Copyright; Avail: CASI; [A01](#), Hardcopy

Due to recent interest in molecular anions as possible interstellar species, we have carried out several laboratory studies of anion chemistry. The reactions of the series  $C(\text{sub } n)(\text{sup } -)$ ; and  $C(\text{sub } n)H(\text{sup } -)$  with H and H<sub>2</sub> were studied to address the viability of such species in the diffuse interstellar medium and to address their ability to be carriers of the diffuse interstellar bands (DIBs). These same molecules were also reacted with N and O to show possible heteroatomic products.  $C(\text{sub } m)N(\text{sup } -)$  was a particularly stable product from the reaction of  $C(\text{sub } n)(\text{sup } -) + N$ .  $C_3N(\text{sup } -)$  was further reacted with H to study chemistry that could produce HC<sub>3</sub>N, a known interstellar species. The reactions were done in a flowing afterglow selected ion flow tube apparatus (FA-SIFT). The anions were generated in an electron impact or cold cathode discharge source and the anion of interest was then selected by a quadrupole mass filter. The selected ion was then reacted with the atomic or molecular species in the flow tube and products were detected by another quadrupole. While the  $C(\text{sub } n)(\text{sup } -)$  species do not appear to be viable DIB carriers, their possible presence could provide a mechanism for the formation of known heteroatomic neutral molecules detected in the interstellar medium (ISM).

Author

*Ion Atom Interactions; Anions; Diffuse Interstellar Bands; Interstellar Matter*

**20030058934** SRI International Corp., Menlo Park, CA, USA

**Low-Temperature Hydrocarbon Photochemistry: CH<sub>3</sub> + CH<sub>3</sub> Recombination in Giant Planet Atmospheres**

Smith, Gregory P.; Huestis, David L.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 258-259; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Planetary emissions of the methyl radical CH<sub>3</sub> were observed for the first time in 1998 on Saturn and Neptune by the ISO (Infrared Space Observatory) mission satellite. CH<sub>3</sub> is produced by VUV photolysis of CH<sub>4</sub> and is the key photochemical intermediate leading complex organic molecules on the giant planets and moons. The CH<sub>3</sub> emissions from Saturn were unexpectedly weak. A suggested remedy is to increase the rate of the recombination reaction  $CH_3 + CH_3 + H_2 \rightarrow C_2H_6 + H_2$  at 140 K to a value at least 10 times that measured at room temperature in rare gases, but within the range of disagreeing theoretical expressions at low temperature. We are performing laboratory experiments at low temperature and very low pressure. The experiments are supported by RRKM theoretical modeling that is calibrated using the extensive combustion literature.

Author

*Reaction Kinetics; Recombination Reactions; Planetary Atmospheres; Photochemical Reactions; Methyl Compounds*

**20030058946** General Atomics Co., San Diego, CA, USA

**GA SCWO Development Summary Report**

Elliott, J. P.; Hazlebeck, D. A.; Downey, K. W.; Sep. 26, 2002; 60 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F08635-92-C-0075; F08637-97-C-6023

Report No.(s): AD-A411124; GA-TR-629018/B; AFRL-ML-TY-TR-2003-4517; No Copyright; Avail: CASI; [A04](#), Hardcopy

For the past 8 years the Air Force Research Laboratory at Tyndall Air Force Base has contracted hydrothermal oxidation projects with General Atomics. These projects were initially focused on large rocket motor disposal, then more generally on energetics, DOD wastes, and most recently on resource recovery. Each project has documentation tailored to the specific project requirements and objectives; however, none of the documentation fully conveyed the technology evolution which occurred or communicated the rationale for that evolution. That is the purpose of this report.

DTIC

*Supercritical Fluids; Oxidation; Hydrothermal Systems; Solid Propellant Rocket Engines*

**20030058964** Engineering Research and Consulting, Inc., Edwards AFB, CA, USA

**Kinetic Studies of UV/Vis-Chemiluminescence in the CH + O<sub>2</sub> Gas Phase Reaction**

Vaghjiani, Ghanshyam L.; Feb. 19, 2003; 8 pp.; In English

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

Report No.(s): AD-A412562; AFRL-PR-ED-TP-2003-039; No Copyright; Avail: CASI; [A02](#), Hardcopy

CO uv/vis-chemiluminescence has been observed for the first time in the 248-nm photodissociation of a trace amount of bromoform (CHBr<sub>3</sub>) vapor present in an excess of O<sub>2</sub> and in diluent helium carrier gas at 2 torr and at 298 K. The integrated intensities of the time-resolved chemiluminescence traces due to characteristic CO(A-X), CO(a-X) and CO(d-a) vibronic emissions showed quadratic dependence on the 248-nm photolysis laser fluence used. The decay kinetics of these chemiluminences was studied as a function of added H<sub>2</sub>, D<sub>2</sub>, N<sub>2</sub>, CH<sub>4</sub>, O<sub>2</sub> and CHBr<sub>3</sub>, and comparisons made to the behavior of the concurrently recorded OH(A-X)-chemiluminescence in the system. The CH(X<sup>2</sup>I) + O<sub>2</sub> reaction has previously been identified as the main source for the OH(A-X) emissions in such photolyses.

DTIC

*Reaction Kinetics; Radicals*

**20030058979** Air Force Research Lab., Edwards AFB, CA, USA

**On the Existence of FN<sub>5</sub>: A Theoretical and Experimental Study**

Netzloff, Heather M.; Gordon, Mark S.; Christe, Karl; Wilson, William W.; Vij, Ashwani; Feb. 11, 2003; 38 pp.; In English  
Contract(s)/Grant(s): Proj-DARP

Report No.(s): AD-A412561; AFRL-PR-ED-TP-2003-035; No Copyright; Avail: CASI; [A03](#), Hardcopy

The possible existence of FN(5) was studied by ab initio electronic structure theory. Calculations were carried out at the MP2/6-31+G(d) and CCSD(T) /aug-cc-pVDZ levels of theory for the N(5)+AsF(6) ion pair and its decomposition to FN(5) and AsF(5). Six different vibrationally stable isomers of FN(5) were identified. Intrinsic reaction coordinate (IRC) and dynamic reaction path (DRP) calculations were used to study the isomerization of FN(5) and its decomposition to FN(3) and N(2). A Rice-Ramsperger-Kassel-Marcus (RRKM) analysis was performed, indicating upper limits to the lifetimes of the FN<sub>5</sub> isomers in the nanosecond range. These theoretical predictions were confirmed by an experimental study of the thermolyses of N(5)AsF(6) and N<sub>5</sub>(2)SnF(6) and the displacement of FN(5) from N(5)SbF(6) with CsF, using FT-IR spectroscopy. In accord with the theoretical predictions, the primary reaction product FN(5) could - not be observed, but its decomposition products FN(3), F(2)N(2), and NF(3) were identified.

DTIC

*Nitrogen Compounds; Physical Properties*

**20030059002** National Yang-Ming Univ., Taipei, Taiwan

**Measurement of Ferric Ion Diffusion Coefficient in Fricke-Infused Agarose Gel From MR Image Intensity Changes**

Tseng, Yin-Jiun; Chu, Woei-Chyn; Huang, Sung-Cheng; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A412079; No Copyright; Avail: CASI; [A01](#), Hardcopy

A mathematical modeling was adopted to calculate the ferric ion diffusion coefficient based on the radiation induced magnetic resonance (MR) image intensity change in Fricke-agarose gels. A fast magnetic resonance imaging acquisition technique was employed to avoid the smearing of acquired data due to diffusion over an extended period of time. Our results showed that for a Fricke-agarose gel contained 1mM ammonium ferrous sulfate, 1% agarose, 1mM sodium chloride and 50mM sulfuric acid, its ferric ion diffusion coefficient is  $1.31 \times 10^{-2} \text{cm}^2 \text{h}^{-1}$  in room temperature. This value falls within the  $1 \times 10^{-2} \text{cm}^2 \text{h}^{-1}$  range obtained by previous studies under varying concentrations of gel ingredients.

DTIC

*Diffusion Coefficient; Ferric Ions; Magnetic Resonance; Gels; Sodium Chlorides*

## 26

### METALS AND METALLIC MATERIALS

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

**20030057884** Florida Univ., Shalimar, FL

**Surface Layer Thermodynamics of Steel Penetrators at High and Very High Sliding Velocities**

Klepaczko, Janusz R.; Jun. 2001; 78 pp.; In English

Report No.(s): AD-A410907; AFRL-MN-EG-TR-2001-7076; No Copyright; Avail: CASI; [A05](#), Hardcopy

One of the most difficult problems in the mechanics of kinetic energy projectiles penetrating geological or cementitious target materials is a proper understanding of the frictional properties between the projectile surface and the target. The model developed in this study is limited to a simple definition of the state of the projectile surface as a set of uniformly distributed micro-asperities with the same active height,  $h = 20$  microns, which are subject to fast adiabatic shearing. Although the heat conduction equation has not been solved numerically in this study, a useful approximation of the evolution of temperature in

the bulk material was applied. This approximation permitted finding the closed form solution for the homologous bulk temperature, at different sliding conditions. Because evolution of the bulk temperature could be estimated, it also permitted finding the evolution of the coefficient of friction as a function of the sliding velocity. For every definition of the coefficient of friction a substantial decrease of the resistance to sliding at increasing velocities has been found. An open question remains as to the role of the hydrostatic pressure. For example, the experimental data suggest that at constant velocity the coefficient of friction will diminish as a function of pressure. Thus, an advantage of the model presented here is that hydrostatic pressure can be taken into consideration in a correct way. Albeit implementation of the friction model in the form of Equation into numerical codes is rather too early, preliminary trials should be recommended.

DTIC

*Conductive Heat Transfer; Friction Factor; Kinetic Energy; Penetrants; Steels*

**20030057896** Naval Air Warfare Center, Patuxent River, MD

**Corrosion Preventive Compounds for Corrosion Prevention/Mitigation (Aermet 100 Steel)**

Lee, Eun U.; Sanders, Henry C.; Jan. 29, 2003; 29 pp.; In English; Original contains color illustrations

Report No.(s): AD-A410911; NAWCADPAX/TR-2002/243; No Copyright; Avail: CASI; A03, Hardcopy

The role of corrosion preventive compound (CPC) in corrosion specifically general corrosion and a localized corrosion: stress corrosion cracking (SCC) and hydrogen embrittlement of AerMet 100 steel was investigated in 3.5% NaCl solution. Eighteen CPCs were evaluated for the effectiveness and persistency in corrosion prevention/mitigation, determining the essential parameters: open circuit potential, effective period, and threshold stress intensity for stress corrosion cracking (K<sub>ISCC</sub>). It was found that: (1) CPC ZC-OIO is most effective and persistent in prevention/mitigation of general corrosion, respectively, (2) Carwell AR500 and Omega 2775 are best in that of SCC, and (3) Break Free SMX is optimum in that of hydrogen embrittlement.

DTIC

*Corrosion Prevention; Stress Corrosion Cracking; Compounds*

**20030057899** Department of Energy, Albany, OR, USA

**Effect of Silicon and Aluminum Additions on the Oxidation Resistance of Lean Chromium Stainless Steels**

Dunning, J. S.; Alman, D. E.; Rawers, J. C.; 2002; 12 pp.; In English

Report No.(s): DE2003-803216; No Copyright; Avail: Department of Energy Information Bridge

The effect of Si and Al additions on the oxidation of lean chromium austenitic stainless steels has been studied. A baseline composition of Fe-16Cr-16Ni-2Mn-1Mo was selected to allow combined Si and Al additions of up to 5 wt. pct. in a fully austenitic alloy. The baseline composition was selected using a net Cr equivalent equation to predict the onset of G-ferrite formation in austenite. Cyclic oxidation tests in air for 1000 hours were carried out on alloys with Si only or combined Si and Al additions in the temperature range 700 C to 800 C. Oxidation resistance of alloys with Si only additions were outstanding, particularly at 800 C. It was evident that different rate controlling mechanisms for oxidation were operative at 700 C and 800 C in the Si alloys. In addition, Si alloys pre-oxidized at 800 C, showed a zero weight gain in subsequent testing for 1000 hours at 700 C. The rate controlling mechanism in alloys with combined Si and Al addition for oxidation at 800 C was also different than alloys with Si only. SEM and ESCA analysis of the oxide films and base material at the oxide/base metal interface were conducted to study potential rate controlling mechanisms.

NTIS

*Stainless Steels; Silicon; Aluminum; Oxidation*

**20030057909** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Impurity Effects on Pore Formation at Al(sub 2)O(sub 3)/Alloy Interfaces**

Hou, P. Y.; 2002; In English

Report No.(s): DE2003-807406; No Copyright; Avail: National Technical Information Service (NTIS)

The adhesion of Al(sub 2)O(sub 3) scales on commercial grade alloys that do not contain a reactive element is usually poor due to the presence of 10-50 wppm of sulfur impurity, and/or of pores that formed at the scale/alloy interface. Sulfur is usually believed to segregate to the interface to weaken the interfacial bonding and to stabilize interfacial pores. By using field emission scanning Auger microscopy, the distribution of sulfur on pores and on oxide imprinted areas at Al(sub 2)O(sub 3)/FeAl interfaces was precisely determined. Interfacial pore growth as a function of oxidation time was obtained from scanning electron microscopy (SEM) and atomic force microscopy (AFM) analyses. The effects of sulfur segregation, surface

impurity and reactive elements on pore nucleation and growth are discussed.

NTIS

*Alloys; Impurities*

**20030057944** Iowa State Univ. of Science and Technology, Ames, IA, Brookhaven National Lab., Upton, NY, Hanoi Univ., Viet Nam, National Center for Scientific Research of Vietnam, Hanoi, Viet Nam

**Effect of Pre-Alloying Condition on the Bulk Amorphous Alloy Nd(60)Fe(30)Al(10)**

O'Conner, A. S.; Lewis, L. H.; McCallum, R. W.; Dennis, K. W.; Kraamer, M. J.; 2002; 12 pp.; In English

Report No.(s): DE2003-760966; BNL-67257; No Copyright; Avail: Department of Energy Information Bridge

Bulk metallic glasses are materials that require only modest cooling rates to obtain amorphous solids directly from the melt. Nd(sub 60)Fe(sub 30)Al(sub 10) has been reported to be a ferromagnetic bulk metallic glass that exhibits high coercivity, a combination unlike conventional Nd-based amorphous magnetic alloys. To clarify the relationship between short-range order and high coercivity in glassy Nd(sub 60)Fe(sub 30)Al(sub 10), experiments were performed to verify the existence of a homogeneous liquid state prior to rapid solidification. Alloys were prepared by various pre-alloying routes and then melt-spun. Arc-melted alloys were prepared for melt spinning using three different protocols involving: (1) alloying all three elements at once, (2) forming a Nd-Fe alloy which was subsequently alloyed with Al, and (3) forming a Fe-Al alloy for subsequent alloying with Nd. XRD, DTA, and magnetic measurement data from the resultant ribbons indicate significant differences in both the glassy fraction and the crystalline phase present in the as-spun material. These observed differences are attributed to the presence of highly stable nanoscopic aluminide-and/or silicide-phases, or motes, present in the melt prior to solidification. These motes would affect the short-range order and coercivity of the resultant glassy state and are anticipated to provide heterogeneous nucleation sites for crystallization.

NTIS

*Metallic Glasses; Alloying*

**20030058094** Air Force Inst. of Tech., Wright-Patterson AFB, OH

**Contact Fatigue: Life Prediction and Palliatives**

Conner, Brett P.; Aug. 20, 2002; 135 pp.; In English

Report No.(s): AD-A411008; AFIT-CI-02-778; No Copyright; Avail: CASI; A07, Hardcopy

Fretting fatigue is defined as damage resulting from small magnitude (0.5-50 microns) displacement between contacting bodies where at least one of the bodies has an applied bulk stress. The applicability and limits of a fracture mechanics based life prediction is explored. Comparisons are made against highly controlled experiments and less controlled but more realistic experiments using a novel dovetail attachment fixture. Surface engineering approaches are examined from a mechanics perspective. Using a new tool, depth sensing indentation, the mechanical properties of an aluminum bronze coating are determined. Fretting fatigue experiments are performed on specimens coated with aluminum bronze and on specimens treated with low plasticity burnishing. Low plasticity burnishing is a new method of introducing beneficial compressive residual stresses without significant cold work at the surface. A mechanics based approach to the selection of palliatives is addressed.

DTIC

*Metal Coatings; Metal Fatigue; Fracture Mechanics*

**20030058854** Fermi National Accelerator Lab., Batavia, IL, USA

**Lithium: Measurement of Young's Modulus and Yield Strength**

Schultz, R.; Oct. 2002; 10 pp.; In English

Report No.(s): DE2003-804180; FERMILAB-TM-2191; No Copyright; Avail: Department of Energy Information Bridge

The Lithium Collection Lens is used for anti-proton collection. In analyzing the structural behavior during operation, various material properties of lithium are often needed. Properties such as density, coefficient of thermal expansion, thermal conductivity, specific heat, compressibility, etc. are well known. However, to the authors knowledge there is only one published source for Young's Modulus. This paper reviews the results from the testing of Young's Modulus and the yield strength of lithium at room temperature.

NTIS

*Lithium; Modulus Of Elasticity; Yield Strength*

**20030059011** Lawrence Livermore National Lab., Livermore, CA

**Stress Corrosion Cracking Behavior of Alloy 22 in Multi-Ionic Aqueous Environments**

King, K. J.; Estill, J. C.; Rebak, R. B.; Jul. 2002; 18 pp.; In English

Report No.(s): DE2003-802596; No Copyright; Avail: Department of Energy Information Bridge



The US Department of Energy is characterizing a potential repository site for nuclear waste in Yucca Mountain (NV). In its current design, the nuclear waste containers consist of a double metallic layer. The external layer would be made of NO6022 or Alloy 22 (Ni-22Cr-13Mo-3W-3Fe). Since over their lifetime, the containers may be exposed to multi-ionic aqueous environments, a potential degradation mode of the outer layer could be environmentally assisted cracking (EAC) or stress corrosion cracking (SCC). In general, Alloy 22 is extremely resistant to SCC, especially in concentrated chloride solutions. Current results obtained through slow strain rate testing (SSRT) shows that Alloy 22 may suffer SCC in simulated concentrated water (SCW) at applied potentials approximately 400 mV more anodic than the corrosion potential (Econ).

NTIS

*Nickel Alloys; Stress Corrosion Cracking; Aluminum Alloys*

**20030059014** Missouri Univ., Rolla, MO, USA

**Development of Submerged Entry Nozzles that Resist Clogging**

Smith, J. D.; Peaslee, K. D.; 2002; 162 pp.; In English

Report No.(s): DE2002-805824; No Copyright; Avail: Department of Energy Information Bridge

Accretion formation and the associated clogging of SEN's is a major problem for the steel industry leading to decreased strand speed, premature changing of SEN's or strand termination and the associated reductions in productivity, consistency, and steel quality. The program to evaluate potentially clog resistant materials was initiated at the University of Missouri-Rolla. The main objective of the research effort was to identify combinations of steelmaking and refractory practices that would yield improved accretion resistance for tundish nozzles and submerged entry nozzles.

NTIS

*Refractory Materials; Plugging; Steels; Manufacturing; Nozzles*

## 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*.

**20030057850** Alaska Univ., Fairbanks, AK, USA

**Oxygen Transport Ceramic Membranes**

Bandopadhyay, S.; Nagabhushana, N.; Jul. 2002; 24 pp.; In English

Report No.(s): DE2002-803193; No Copyright; Avail: Department of Energy Information Bridge

In the present quarter, oxygen transport perovskite ceramic membranes are evaluated for strength and fracture in oxygen gradient conditions. Oxygen gradients are created in tubular membranes by insulating the inner surface from the reducing environment by platinum foils. Fracture in these test conditions is observed to have a gradient in trans and inter-granular fracture as opposed to pure trans-granular fracture observed in homogenous conditions. Fracture gradients are reasoned to be due to oxygen gradient set up in the membrane, variation in stoichiometry across the thickness and due to varying decomposition of the parent perovskite. The studies are useful in predicting fracture criterion in actual reactor conditions and in understanding the initial evolution of fracture processes.

NTIS

*Ceramics; Gradients; Oxygen; Perovskites; Mechanical Properties*

**20030057863** Swedish Defence Research Establishment, Tumba

**Final Report - Strategic Competence Project - Gradient and Matrix Materials**

Oskarsson, M.; May 2002; 16 pp.; In Swedish

Report No.(s): PB2003-104344; FOI-R-0514-SE; No Copyright; Avail: CASI; [A03](#), Hardcopy

This final report describes the purpose to perform what has been achieved and the future for the internal financed strategic competence project-Gradient and matrix materials.

NTIS

*Composite Materials; Gradients; Matrix Materials*

**20030058056** Wichita State Univ., Wichita, KS

**Shear Stress-Strain Data for Structural Adhesives**

Tomblin, John; Seneviratne, Waruna; Escobar, Paulo; Yoon-Khian, Yap; Nov. 2002; 60 pp.; In English  
Report No.(s): AD-A411505; DOT/FAA/AR-02/97; No Copyright; Avail: CASI; A04, Hardcopy

The main objective of this investigation was to generate characteristic shear responses for several adhesives used for aerospace structural bonding applications. The shear responses consisted of shear stress-strain curves obtained by standardized tests and characterizing subsequent failure modes at three different environmental conditions. Six of these adhesives were film and the remaining were paste adhesive. In addition, the effects of heat and humidity on the apparent shear strength, shear modulus, and failure modes of each adhesive were investigated by testing at elevated temperatures with humidity-conditioned specimens. The characteristic shear responses were generated using the ASTM D 5656 thick adherend test method. The primary purpose of this report was to make this data available for use in future design and modeling efforts.

DTIC

*Shear Properties; Adhesives*

**20030058727** Purdue Univ., West Lafayette, IN

**Lightweight Layered Materials/Structures for Damage Tolerant Armor**

Sun, C. T.; Bowman, K. J.; Doyle, J. F.; Espinosa, H.; Trumble, K. P.; Feb. 2003; 36 pp.; In English  
Contract(s)/Grant(s): DAAH04-96-1-0331

Report No.(s): AD-A411496; ARO-35895.27-MS-MUR; No Copyright; Avail: CASI; A03, Hardcopy

The overall objective of this MURI program was to develop a new class of lightweight armor materials in the form of layered ceramics and metal ceramic composites. This entailed developing novel processing techniques, extensive dynamic experimental evaluations and modeling as well as new analysis and experimental methods. The research program consisted of four major areas: manufacture of layered ceramics and ceramic metal composites for armor, constitutive modeling and damage mechanisms, ballistic penetration experiment and simulation, and development of advanced experimental and computational methods. Briefly, in the processing area, two versatile routes for production of layered and graded multilayer ceramics have been developed: sequential centrifugal casting and lamination of tape-cast ceramics. In the mechanics and modeling area, microstructural effects on the response and failure in heterogeneous materials under dynamic loads were studied and modeled. New experimental methods were developed with the aid of inverse methods in conjunction with the FEA. Improved computer codes for simulation of projectile penetration were achieved.

DTIC

*Armor; Ceramic Matrix Composites; Microstructure; Dynamic Loads; Ceramics*

**20030058756** Air Force Research Lab., Edwards AFB, CA, USA

**The Preparation and Properties of Polymer/Nanoparticle Blends Using POSS (TM)**

Blanski, Rusty L.; Phillips, Shawn H.; Lee, Andre Y.; Jun. 11, 2001; 10 pp.; In English  
Contract(s)/Grant(s): Proj-2303

Report No.(s): AD-A410607; AFRL/PRS-ED-TP-2001-133; No Copyright; Avail: CASI; A02, Hardcopy

The synthesis of nanoparticle/polymer blends has expanded greatly in recent years. When the nanoparticles are ceramic, these blend materials have the advantage of combining a ceramic-type material with an organic polymer that can result in a material that may bridge the performance gap between the two systems. The Air Force Research Laboratory in collaboration with Michigan State University has been working with Polyhedral Oligomeric Silsesquioxanes (POSS) to enhance the performance characteristics of polymers. One aspect of this program is the preparation of POSS (TM)/polymer materials using traditional blending techniques. The authors have shown that simply changing the organic functionality around the POSS (TM) molecule can lead to POSS (TM) dispersion in a wide array of polymers, including polyethylene, polypropylene, polystyrene, polycarbonate, SB rubber, and many other polymers. In several cases the authors have been able to maintain clarity of the polymer after dispersion. By altering the organic side groups of POSS (TM) compounds to more compatible groups, one can fully disperse the POSS (TM) molecules into high molecular weight polystyrene and, in the case of StyrenylPOSS (TM)/polystyrene film, an increase of 30% in the surface hardness is observed. Future work will focus on the use of POSS (TM) as a flame retardant. While vinyl 8T8 is not miscible in polystyrene, a partially functionalized vinyl 8T8 with aromatic groups should be. The concept of partial cross metathesis with vinyl 8T8 and styrene has been proven, and future work will focus on blends of these POSS (TM) compounds. Another possibility is the use of vinyl nTn as a reactive blendable with resins.

DTIC

*Nanoparticles; Polymer Blends; Ceramics; Plastics; Oligomers*

**20030058779** Media and Process Technology, Inc., Pittsburgh, PA

**CO(2) Selective Ceramic Membrane for Water-Gas Shift Reaction with Concomitant Recovery of CO(2)**

Liu, P. K. T.; Aug. 01, 2002; 26 pp.; In English

Report No.(s): DE2003-803844; No Copyright; Avail: Department of Energy Information Bridge

As part of our optimization effort, we have conducted a comprehensive study to investigate the morphology and crystal growth kinetics of hydrotalcite powder formation. Based upon the information obtained from this study, we resumed the membrane optimization activities. Although the selectivity of the membrane remains in the Knudsen regime, the permeance decreases along with the number of impregnation. Thus, the permeance could be reduced to a minimum through repeated impregnation. Then, the membrane can be sealed with chemical vapor deposition technique. More characterization results on the membranes prepared will be available in the next quarterly report.

NTIS

*Membranes; Carbon Dioxide; Crystal Growth; Reaction Kinetics*

**20030058811** Swedish Defence Research Establishment, Tumba

**(2)O(3) och TiB(2) Baserade Material (Evaluation of the Mechanical Properties of SPS-Manufactured Al<sub>2</sub>O<sub>3</sub> and TiB<sub>2</sub> Based Materials)**

Pettersson, A.; Pettersson, P.; Mar. 2002; 26 pp.; In Swedish

Report No.(s): PB2003-103235; FOI-R-0406-SE; No Copyright; Avail: CASI; A03, Hardcopy

The mechanical properties have been tested for submicron Al<sub>2</sub>O<sub>3</sub>, Al<sub>2</sub>O<sub>3</sub> with 25 vol% SiC whiskers and (Ti)<sub>0.05</sub>(TiB<sub>2</sub>)<sub>0.95</sub> through Vickers hardness, fracture toughness and 4-point bending strength. A fractographic investigation was made on the samples that were subjected to 4-point bending strength testing. All the materials show similar mechanical properties as the commercial materials. Addition of a small amount of titanium to TiB<sub>2</sub>-materials ((Ti)<sub>0.05</sub>(TiB<sub>2</sub>)<sub>0.95</sub>) to increase the sinterability gave equal or even better properties than monophasic TiB<sub>2</sub>. The bending strength results gave a relatively high standard deviation, which partly can be explained by the influence of the surface finish, which also has been confirmed through the fractography analysis. The work has been performed in cooperation with the project Light Weight Armor.

NTIS

*Weapons; Flexural Strength; Titanium Borides; Fracture Strength*

## 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*.

**20030057763** University of Wyoming Research Corp., Laramie. Western Research Inst

**Fractionation of Lignocellulosic Biomass for Fuel-Grade Ethanol Production**

Guffey, F. D.; Wingerson, R. C.; Oct. 2002; 28 pp.; In English

Report No.(s): DE2003-807155; WRI-02-R019; No Copyright; Avail: Department of Energy Information Bridge

PureVision Technology, Inc. (PureVision) of Fort Lupton, Colorado is developing a process for the conversion of lignocellulosic biomass into fuel-grade ethanol and specialty chemicals in order to enhance national energy security, rural economies, and environmental quality. Lignocellulosic-containing plants are those types of biomass that include wood, agricultural residues, and paper wastes. Lignocellulose is composed of the biopolymers cellulose, hemicellulose, and lignin. Cellulose, a polymer of glucose, is the component in lignocellulose that has potential for the production of fuel-grade ethanol by direct fermentation of the glucose. However, enzymatic hydrolysis of lignocellulose and raw cellulose into glucose is hindered by the presence of lignin. The cellulase enzyme, which hydrolyzes cellulose to glucose, becomes irreversibly bound to lignin. This requires using the enzyme in reagent quantities rather than in catalytic concentration. The extensive use of this enzyme is expensive and adversely affects the economics of ethanol production. PureVision has approached this problem by developing a biomass fractionator to pretreat the lignocellulose to yield a highly pure cellulose fraction. The biomass fractionator is based on sequentially treating the biomass with hot water, hot alkaline solutions, and polishing the cellulose fraction with a wet alkaline oxidation step. In September 2001 PureVision and Western Research Institute (WRI) initiated a jointly sponsored research project with the U.S. Department of Energy (DOE) to evaluate their pretreatment technology, develop an understanding of the chemistry, and provide the data required to design and fabricate a one- to two-ton/day

pilot-scale unit. The efforts during the first year of this program completed the design, fabrication, and shakedown of a bench-scale reactor system and evaluated the fractionation of corn stover. The results from the evaluation of corn stover have shown that water hydrolysis prior to alkaline hydrolysis may be beneficial in removing hemicellulose and lignin from the feedstock. In addition, alkaline hydrolysis has been shown to remove a significant portion of the hemicellulose and lignin. The resulting cellulose can be exposed to a finishing step with wet alkaline oxidation to remove the remaining lignin. The final product is a highly pure cellulose fraction containing less than 1% of the native lignin with an overall yield in excess of 85% of the native cellulose. This report summarizes the results from the first year's effort to move the technology to commercialization.

NTIS

*Cellulose; Biopolymers; Biomass; Ethyl Alcohol; Fuel Production; Technology Utilization*

**20030057827** Lawrence Livermore National Lab., Livermore, CA

**Level 1 V. & V. Test Problem 10: Escape of High Explosive Products**

Dykema, P.; Brandon, S.; Bolstad, J.; Woods, T.; Klein, R.; Sep. 17, 2002; 28 pp.; In English

Report No.(s): DE2003-15003131; UCRL-ID-150418; No Copyright; Avail: Department of Energy Information Bridge

The Escape of High Explosive (HE) Products test is a hydrodynamics only problem designed to test the codes ability to model the propagation of an unsupported, HE detonation wave. An ideal gas is used to model the HE. The detonation products expand to the right and interact at the left with a constant velocity piston. The choice of  $\gamma = 3.0$  and a careful selection of the piston velocity produces straight-line characteristics and makes possible the calculation of the exact solution. This problem tests the calculation of flow near a cavitation front where large gradients exist and is particularly difficult because both sets of characteristics become coincident at the front.

NTIS

*Hydrodynamics; Explosives*

**20030057845** Swedish Defence Research Establishment, Tumba

**New Mathematical Model for the Relation between Stand-off and Penetration of Shaped Charge Jets**

Wijk, G.; Jan. 2002; 28 pp.; In English

Report No.(s): PB2003-103209; FOI-R-0361-SE; No Copyright; Avail: CASI; A03, Hardcopy

A new mathematical model describing the penetration capacity of a SC (Shaped Charge) jet is proposed. This model should be easier to use than the old models in computer programs for assessment of effects and vulnerability of complex targets caused by SC warheads, especially regarding the modeling of the effects of BAD (Behind Armor Debris) that is ejected from armor shields perforated by SC jets. Since the BAD modeling also requires a model for the diameter of the hole produced by the jet such a model is also proposed. Finally the manner in which the stand-off relation should be used to calculate penetration of several spaced target plates is described.

NTIS

*Shaped Charges; Mathematical Models; Computer Programs*

**20030057872** National Renewable Energy Lab., Golden, CO

**Look Back at the U.S. Department of Energy's Aquatic Species Program; Biodiesel from Algae**

Sheehan, J.; Dunahay, T.; Benemann, J.; Roessler, P.; Jul. 1998; In English

Report No.(s): DE2003-15003040; NREL/TP-580-24190; No Copyright; Avail: National Technical Information Service (NTIS)

From 1978 to 1996, the U.S. Department of Energys Office of Fuels Development funded a program to develop renewable transportation fuels from algae. The main focus of the program, know as the Aquatic Species Program (or ASP) was the production of biodiesel from high lipid-content algae grown in ponds, utilizing waste CO<sub>2</sub> from coal fired power plants. Over the almost two decades of this program, tremendous advances were made in the science of manipulating the metabolism of algae and the engineering of microalgae algae production systems.

NTIS

*Algae; Renewable Energy*

**20030057883** Air Force Research Lab., Edwards AFB, CA, USA

**Hydrocarbon Fuels Optimization**

Mills, Jeffrey D.; Aug. 22, 2001; 39 pp.; In English

Contract(s)/Grant(s): Proj-2303

Report No.(s): AD-A410750; AFRL-PR-ED-TP-2001-173; No Copyright; Avail: CASI; A03, Hardcopy

Hydrocarbon fuel performance in rockets is systematically considered using standard equilibrium, isentropic, one-dimensional computer codes with a new web-based interface. For reference engine conditions the optimized specific impulse depends only upon the mass-normalized (specific) enthalpy content and the hydrogen-to-carbon ratio. In this context promising families of strained and unsaturated high-energy hydrocarbon fuels, with special emphasis upon those currently under development by in-house researchers, are insightfully compared and justified. A variety of simple, mission-tailored metrics approximating payload mass gains and the relative importance of fuel density are considered with special application to similar kerosene fuels. In this way it is possible to begin to simply, if approximately, quantify some of the performance trade-offs among the relevant liquid-fuel physical and chemical properties and to easily screen a great number of possible fuels as a foundation for calculations employing more sophisticated and realistic rocket models.

DTIC

*Hydrocarbon Fuels; Rocket Propellants; Liquid Fuels; Human-Computer Interface*

**20030057904** Lawrence Livermore National Lab., Livermore, CA

**Laminar Burn Rates of Gun Propellants Measured in the High-Pressure Strand Burner**

Reaugh, J. E.; Maienschein, J. L.; Chandler, J. B.; Oct. 1997; 14 pp.; In English

Report No.(s): DE2003-16347; UCRL-JC-127556; No Copyright; Avail: Department of Energy Information Bridge

The pressure dependence of the laminar burn rate of gun propellants plays a role in the design and behavior of high-performance guns. We have begun a program to investigate the effects of processing variables on the laminar burn rates, using our high-pressure strand burner to measure these rates at pressures exceeding 700 MPa. We have burned JA2 and M43 propellant samples, provided by Dr. Arpad Juhasz, ARL, from propellant lots previously used in round-robin tests. Our results at room temperature are in accord with other measurements. In addition, we present results measured for propellant that has been preheated to 50 degrees C before burning. We used our thermochemical equilibrium code, CHEETAH, to help interpret the simultaneous pressure and temperature measurements taken during the testing, and show examples of its use. It has been modified to provide performance measures and equations of state for the products that are familiar to the gun-propellant community users of BLAKE.

NTIS

*Nitro Compounds; Chemical Explosions*

**20030058773** Air Force Research Lab., Edwards AFB, CA

**Material Applications Research Within the Propulsion Directorate of the Air Force Research Laboratory**

Phillips, Shawn H.; Jan. 27, 2003; 35 pp.; In English

Contract(s)/Grant(s): Proj-4847

Report No.(s): AD-A410953; AFRL-PR-ED-VG-2003-017; AFRL-PR-ED-VG-2003-017; No Copyright; Avail: CASI; [A03](#), Hardcopy

Viewgraphs for presentation on materials research and development conducted by the Air Force Research Lab Propulsion Directorate, Edwards AFB, California, and its subdivisions.

DTIC

*Research And Development; Ceramic Matrix Composites; Polymers; Air Defense; Rocket Propellants*

**20030058793** Westinghouse Electric Corp., Pittsburgh, PA, USA

**Optimization of Advanced Filter Systems. Option I Program-Bench-Scale Testing for the Resolution of Technical Issues**

Newby, R. A.; Bruck, G. J.; Lippert, T. E.; Smeltzer, E. E.; Stampahar, M. E.; Jun. 2002; 150 pp.; In English

Report No.(s): DE2002-803192; No Copyright; Avail: Department of Energy Information Bridge

Two advanced, hot gas, barrier filter system concepts have been proposed by the Siemens Westinghouse Power Corporation to improve the reliability and availability of barrier filter systems in applications such as PFBC and IGCC power generation. The two hot gas, barrier filter system concepts, the inverted candle filter system and the sheet filter system, were the focus of bench-scale testing, data evaluations, and commercial cost evaluations to assess their feasibility as viable barrier filter systems. The program results show that the inverted candle filter system has high potential to be a highly reliable, commercially successful, hot gas, barrier filter system. Some types of thin-walled, standard candle filter elements can be used directly as inverted candle filter elements, and the development of a new type of filter element is not a requirement of this technology. Six types of inverted candle filter elements were procured and assessed in the program in cold flow and high-temperature test campaigns.

NTIS

*Cold Flow Tests; Coal Gasification; Fluidized Bed Processors; High Temperature Gases; Filters*

**20030058826** Southwest Research Inst., San Antonio, TX

**Technical Path Evaluation for High Efficiency, Low Emission Natural Gas Engine**

Callahan, Timothy J.; Dodge, Lee G.; Roberts, Charles E.; Stovell, Chad H.; Bourn, Gary D.; May 2002; 163 pp.; In English; Original contains color illustrations

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

Report No.(s): AD-A412039; TFLRF-363; No Copyright; Avail: CASI; [A08](#), Hardcopy

The work presented in this report was partially funded by the Department of Energy, Office of Power Technology and National Energy Technology Laboratory (NETL), through TACOM under the Advanced Reciprocating Engine Systems (ARES) cooperative research program for stationary, natural gas engines used for power generation. The program goal was to identify engine technology to achieve 50 percent brake thermal efficiency and 5 ppm NO(x) for stationary engines. Members of the program were Caterpillar, Cooper Energy Services, Cummins Engine Company, Waukesha Engine Division, Southern California Gas, Woodward Governor, Altronic, Federal Mogul, Gas Research Institute, and the Department of Energy. Research concentrated on developing technical solutions to combustion barriers (knock and misfire), exhaust after treatment, and power density limitations. The research results are organized under the following topics: (a) Evaluation of Technical Paths to Achieve High Efficiency and Low Emissions Natural Gas Engines. (b) Knock Modeling and Mitigation for Large Bore Natural Gas Engines. (c) Evaluation of Technologies for Achieving High BMEP Levels in Natural Gas Engines. (d) Microfine Water Spray Injection for Knock and NO(x) Control in Natural Gas Engines. (e) Micro Ignition Technology Evaluation. (f) Evaluation of Aftertreatment Technology for Lean-Burn Natural Gas Engines. Research efforts are documented in this report for each of the above areas. This report covers the ARES project from, September 1998 through May 2002.

DTIC

*Nitrogen Oxides; Natural Gas; Evaluation; Effectiveness; Emission; Gas Turbines; Piston Engines; Performance Tests*

### 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*.

**20030057799** Economics and Statistics Administration, Washington, DC, USA, Bureau of the Census, Washington, DC, USA

**Economic Census 1997: Manufacturing, Industry Series. All Other Miscellaneous Manufacturing**

October 1999; 42 pp.; In English

Report No.(s): PB2003-104135; EC97M-3399R; No Copyright; Avail: CASI; [A03](#), Hardcopy

The economic census is the major source of facts about the structure and functioning of the Nation's economy. It provides essential information of government, business, industry, and the general public. Title 13 of the USA Code (Section 131, 191, and 224) directs the Census Bureau to take the economic census every 5 years, covering years ending in 2 and 7. The economic census furnishes an important part of the framework for such composite measures as the gross domestic product estimates, input/output measures, production and price indexes, and other statistical series that measure short-term changes in economic conditions.

NTIS

*Economic Factors; Industries; Commerce*

**20030057854** Lawrence Livermore National Lab., Livermore, CA

**Precision Hole Drilling Using a Polychromatic, Bi-Modal Technique**

Friedman, H.; 2002; 10 pp.; In English

Report No.(s): DE2003-15002788; UCRL-ID-146727; No Copyright; Avail: Department of Energy Information Bridge

Rapid drilling of precision, submillimeter holes is needed for many industrial products including turbine blades, aircraft wings and fuel injectors. Recent results using ultra-short pulsed lasers shows promise but problems remain associated with poor beam quality, unexplained phenomena associated with deep holes and the difficult task of scaling these lasers to high average powers. This effort makes use of results obtained with inexpensive Diode Pumped Solid State Lasers operating in the near infrared (1064 nm) and the second harmonic (532 nm) to drill precision submillimeter holes with arbitrary shapes in metals and ceramics.

NTIS

*Solid State Lasers; Laser Machining*

**20030057907** Brookhaven National Lab., Upton, NY

**Thermal Regain from Displacement of Duct Leakage within Insulation**

Andrews, J. W.; May 2002; 24 pp.; In English

Report No.(s): DE2003-806193; BNL-69412; No Copyright; Avail: Department of Energy Information Bridge

This report investigates the possibility that energy losses due to air leakage from ducts in small buildings might be reduced if the leaked air is constrained to flow within the insulation to a point upstream or downstream of the initial leakage point. The idea is that the leakage air might warm (or, in the air-conditioning mode, cool) the insulation and thereby retard heat conduction from (or to) the duct. Any such reduction in conductive losses could be credited against the lost energy from the leak itself. Theoretical calculations carried out in this work indicate that such a 'thermal regain' effect could recover, in the heating mode, up to half the heat contained in the leaking air, and in the cooling mode, up to 75% of the sensible cooling in the leak. In most actual cases, a smaller amount of regain would be expected.

NTIS

*Ducts; Leakage; Buildings*

**20030057924** Fluor Daniel Hanford, Inc., Richland, WA, USA

**FPF HVAC System Component Index**

Mar. 30, 2000; 16 pp.; In English

Report No.(s): DE2003-801851; HNF-5186; No Copyright; Avail: Department of Energy Information Bridge

This document lists safety class (SC) and safety significant (SS) components for the Heating Ventilation Air Conditioning (HVAC) and specifies the critical characteristics for Commercial Grade Items (CGI), as required by HNF-PRO-268 and HNF-PRO-18 19. These are the minimum specifications that the equipment must meet in order to properly perform its safety function. There may be several manufacturers or models that meet the critical characteristics for any one item. The Plutonium Finishing Plant (FPF) HVAC System includes sub-systems 25A through 25K. Specific system boundaries and justifications are contained in HNF-SD-CP-SDD-005, Definition and Means of Maintaining the Ventilation System Confinement Portion of the FPF Safety Envelope. The procurement requirements associated with the system necessitates procurement of some system equipment as Commercial Grade Items in accordance with HNF- PRO-268, Control of Purchased Items and Services.

NTIS

*Indexes (Documentation); Heating Equipment; Air Conditioning Equipment; Components*

**20030058012** Lawrence Livermore National Lab., Livermore, CA

**Science and Technology Review: Imaging with High-Energy Neutrons**

May 2001; In English

Report No.(s): DE2003-791649; No Copyright; Avail: National Technical Information Service (NTIS)

This issue contains the following articles: (1) 'Advanced Technology for Stockpile Stewardship.' (2) 'Uncovering Hidden Defects with Neutrons'--High-energy neutrons can effectively image heavily shielded objects that are essentially opaque to x rays. (3) 'The Human in the Mouse Mirror.' Comparative genomics may help us to better understand our genetic heritage and evolution, or why humans are human and mice are mice. (4) 'The NIF Target Chamber--Ready for the Challenge.' Good progress is being made on the construction of the world's largest laser. (5) 'Indoor Testing Begins Soon at Site 300.' The world's largest explosives chamber nears completion.

NTIS

*Lasers; Research Facilities; Laser Targets*

**20030058788** Naval Postgraduate School, Monterey, CA, USA

**The Performance of Reduction of Total Ownership Cost (R-TOC) Pilot Programs**

Demir, Huseyin; Dec. 2002; 76 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411582; No Copyright; Avail: CASI; A05, Hardcopy

In April 1998 within the initiation of Section 912c studies (PM Oversight of Life Cycle Support) DoD expanded the responsibilities of Program Managers for designing and producing new weapon systems to include more accountability for the TOC of the systems including O&S (Operation and Support) costs. At a December 1998 DSAC (Defense Systems Affordability Council) each service agreed to provide 10 program names for the 912c study. DoD would continue to track all 30 service pilot programs as R-TOC programs. This thesis analyzes the utilization of Reduction of Total Ownership Costs (R-TOC) pilot programs in DoD Services. It identifies the lessons learned from the R-TOC pilot programs and the obstacles encountered to promote efficient reductions in the Total Ownership Costs of DoD weapon systems. It also makes

recommendations for DoD leadership to establish a more efficient R-TOC environment. The conclusion is that the performance of R-TOC is efficient because it forces PMs to consider TOC in their programs and helps to identify obstacles and encourages saving initiatives. Although further progress will be captured by blocking the inhibitors identified in Chapter IV, OSD should continue advocating R-TOC.

DTIC

*Weapon Systems; Defense Program; Pilot Training; Cost Reduction*

**20030058804** Lawrence Livermore National Lab., Livermore, CA

**Science and Technology Review: R and D in the Superblock**

Mar. 2001; In English

Report No.(s): DE2003-791647; No Copyright; Avail: National Technical Information Service (NTIS)

This issue contains the following articles: (1) 'Safety and Security Are Enhanced by Understanding Plutonium.' (2) 'Inside the Superblock.' This area of Lawrence Livermore is home to one of just two US plutonium research and development facilities for defense. (3) 'Exploring the Fundamental Limits of Simulations'. Some of the nation's leading computer simulation experts gathered at Lawrence Livermore to discuss the common barriers facing their craft. (4) 'Plutonium Up Close... Way Close.' An examination of stockpile plutonium at the atomic level indicates so far, so good. (5) 'Shocked and Stressed, Metals Get Stronger.' Laser peening yields stronger, corrosion-resistant metals.

NTIS

*Computerized Simulation; Plutonium; Peening*

**20030058805** Lawrence Livermore National Lab., Livermore, CA

**Science and Technology Review: Simulations Push the Boundaries of Bioscience**

Apr. 2001; In English

Report No.(s): DE2003-791648; No Copyright; Avail: National Technical Information Service (NTIS)

This issue contains the following articles: (1) 'Computer Modeling Advances Bioscience.' (2) 'A New Kind of Biological Research.' Researchers are using advanced computer simulations to reveal the mechanisms of a host of biological phenomena. (3) 'The World's Most Accurate Lathe.' Used to make large mirrors for the National Aeronautical and Space Administration and the Department of Defense, Livermore's Large Optics Diamond Turning Machine is over 1,000 times more accurate than a conventional machine tool. (4) 'Leading the Attack on Cancer.' Scientists from Lawrence Livermore and the University of California at Davis Cancer Center are collaborating on research to find better ways to prevent, detect, diagnose, and treat cancer. (5) 'Electronic Memory Goes High Rise.' Stackable magnetic random access memory may improve computer performance.

NTIS

*Bioengineering; Computerized Simulation; Biological Models (Mathematics)*

**20030058953** Aerospace Corp., El Segundo, CA, USA

**Lines Shapes of Atomic-Candle-Type Rabi Resonances**

Camparo, J. C.; Coffey, J. G.; Sickmiller, B.; Presser, A.; Dec. 31, 2002; 15 pp.; In English

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

Report No.(s): AD-A412333; TR-2003(8555)-1; SMC-TR-03-10; No Copyright; Avail: CASI; [A03](#), Hardcopy

When atoms interact with a phase-modulated field, the probability of finding the atom in the excited-state oscillates at the second harmonic of the modulation frequency,  $2\omega$  (sub m). The amplitude of this oscillating probability is a resonant function of the Rabi frequency  $\Omega$ , and this is termed a beta Rabi resonance. In this work, we examine the line shape of the beta Rabi-resonance both theoretically and experimentally. We find that a small-signal theory of the beta-Rabi-resonance condition captures much of the line shape's character, and, in particular, that the resonance's 'line Q' (i.e.,  $2\delta\Omega$  (sub  $1/2$ )/ $\Omega$ ) is proportional to the modulation frequency. This result can be applied to the atomic candle, where beta Rabi resonances are employed to stabilize field strength. Considering our results in the context of developing an optical atomic candle, we find that a free-running diode laser's intensity noise could be improved by orders of magnitude using the atomic candle concept.

DTIC

*Atoms; Atomic Clocks; Electromagnetic Fields*



**20030059044** Deutsches Elektronen-Synchrotron, Hamburg, Germany, Fermi National Accelerator Lab., Batavia, IL, USA, Stanford Linear Accelerator Center, Stanford, CA, USA

**Detailed Summary of the Working Group on Environmental Control (T6)**

Bialowons, W.; Laughton, C.; Seryi, A.; Nov. 2002; 18 pp.; In English

Report No.(s): DE2003-804899; FERMILAB-CONF-01/440; No Copyright; Avail: Department of Energy Information Bridge

For the next generation of large accelerators, the civil engineering of accelerator tunnels and associated underground buildings will be a major component of the technical challenge of constructing such machines. Between a sixth and a half of the total costs of these machines must be used for the civil engineering. Because of the large physical scales of these machines the engineering will be required to be as cost-effective as possible and because the considered beam sizes are of nanometer scale, issues such as structural and thermal stability, ground motion and artificial sources of vibration in the environment will need to be carefully studied. The working group concentrated on tunneling, ground motion, stability, alignment and environmental issues.

NTIS

*Accelerators; Tunnels; Underground Structures; Construction; Structural Engineering*

**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*.

**20030057890** Center for Mathematics and Computer Science, Amsterdam

**Note on the GI/GI/1 Queue with LCFS-PR Observed at Arbitrary Times**

Nunez Queija, R.; Sep. 30, 2000; 16 pp.; In English

Report No.(s): PB2003-103146; PNA-R0009; No Copyright; Avail: CASI; [A03](#), Hardcopy

Consider the GI/GI/1 queue with the Last-Come First-Served Preemptive-resume service discipline. We give intuitive explanations for (i) the geometric nature of the stationary queue length distribution and (ii) the mutual independence of the residual service requirements of the customers in the queue, both considered at arbitrary time points. These distributions have previously been established in the literature by either first considering the system at arrival instants or using balance equations. Our direct arguments provide further understanding of (i) and (ii).

NTIS

*Queueing Theory; Mathematical Models; Independent Variables*

**20030057935** Swedish Defence Research Establishment, Stockholm, Sweden

**Network Centric Warfare Assessment - Preliminary Study**

Alser, L.; Aksberg, J.; Hoestbeck, L.; Lundgren, L.; Pelo, J.; Jan. 2002; 72 pp.; In Swedish

Report No.(s): PB2003-103202; FOI-R-0338-SE; No Copyright; Avail: CASI; [A04](#), Hardcopy

Studies about Network Centric Warfare, NCW, are in progress in the project FoRMA at FOI, NCW describes a system for warfare, where the functions are separated into different platforms and at the same time are working together, through a network that is realized by information technology. The working group NCW was formed in May 2001 and the task was to develop and apply methods to assess armed combat in net-centric environment. The issue when analyzing NCW should be if NCW is possible and what limitations and advantages NCW can provide compared to Platform Centric Warfare. The purpose of the preliminary study report is to describe the way of working and show the results of the preliminary study. At the same time it will serve as a common base for the group and it's further work. Interesting scenarios for which the authors later want to investigate the possibility to use NCW are studied. Scenarios are describes for a fixed target, tank, fighter aircraft, surface combatant and an underwater case. Trivial networks between Command and Control, Sensors and Shooters are introduced. A possible structure for a general network is shown, which can be used for studying characteristics and effects of a network consisting of a number of different components. Some well-known modeling methods are mentioned in the report. They can be of importance when finding a method for modeling the scenarios, which describe NCW.

NTIS

*Computer Networks; Military Operations; Command And Control; Communication Networks*

**20030057965** Columbia Univ., New York, NY

**Supporting QOS in Mobile Networks**

Campbell, Andrew T.; Schwartz, Mischa; Jan. 31, 2002; 30 pp.; In English

Contract(s)/Grant(s): DAAD19-99-1-0287

Report No.(s): AD-A411151; ARO-39009.1-CI; No Copyright; Avail: CASI; [A03](#), Hardcopy

Research includes new 'stateful' and 'stateless' quality of service (QOS) architectures, services, and algorithms for the delivery of audio, video, and web data over mobile ad hoc networks (MANETs). Major research contributions include the design, development, analysis, and evaluation of three new protocols that address the problem of MANET QOS at different points in the solution space. The INSIGNIA protocol represents a new 'stateful' QOS architecture that requires per-flow soft-state reservations suitable for multimedia communications are set-up and maintained in the network using in-band signaling techniques. The SWAN (Stateless Wireless Ad hoc Networks) protocol represents a departure from per-flow reservations and is based on a stateless approach that cannot offer the same level of QOS performance as INSIGNIA but better scales to support very large numbers of nodes. The Hotspot Mitigation Protocol (HMP) interacts with the MANET routing protocols to redirect new 'routes' away from hotspot and congestion-prone areas, therefore, avoiding any further build up of traffic intensity in hotspot regions. Each protocol developed by the project is evaluated using a combination of analysis, simulation and results from experimental wireless testbed deployment. The protocol software from the testbeds and ns simulator extensions is publicly available as open source from the web.

DTIC

*Protocol (Computers); Communication Networks*

**20030058005** Swedish Defence Research Establishment, Linköping, Sweden

**Ground Sensor Nets and Intelligent Agents: A System Architecture for a Network Based Sensor System**

Jungert, E.; Walter, J.; Sep. 2001; 26 pp.; In Swedish

Report No.(s): PB2003-103206; FOI-R-0317-SE; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report describes the intelligent agent concept and the use of intelligent agents in complex systems. International research activities focusing on intelligent agents in sensor systems will also be discussed. More specifically, the report also describes how these agents can be used in unattended ground sensor-nets (UGS).

NTIS

*Complex Systems; Systems Engineering; Artificial Intelligence; Ground Stations*

**20030058077** Army Research Lab., Aberdeen Proving Ground, MD

**Agent-Based Modeling of a Network-Centric Battle Team Operating Within an Information Operations Environment**

Ruth, Brian G.; Eckart, J. D.; Feb. 2003; 130 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411990; ARL-TR-2913; No Copyright; Avail: CASI; [A07](#), Hardcopy

A model developed to analyze the emergent behavior of a network-centric battle team undergoing hostile information operations (IO) stress events is presented. Networked battlefield platforms are modeled as mobile semi-autonomous agents that operate within a cellular automata (CA) lattice. The CA form a discrete spatially extended dynamical system consisting of a parallel networked lattice of computational cells in two dimensions. A software framework that combines CA-based agents with a genetic algorithm was developed in order to explore the dynamics of two opposing but 'coevolving' units of networked combat agents. Simulation results using two variants of the CA-based combat agent model, both of which include IO stress in the form of radio frequency communications jamming, are analyzed and discussed.

DTIC

*Models; Automata Theory; Wireless Communication; Combat; Networks*

**20030058082** California Univ., Santa Barbara, CA

**Communications in the Digital Battlefield: Fundamental Problems in the Design of Heterogeneous Networks**

Madhow, Upamanyu; Nov. 4, 2002; 5 pp.; In English

Contract(s)/Grant(s): DAAD19-00-1-0567

Report No.(s): AD-A412225; ARO-41600.10-CL; No Copyright; Avail: CASI; [A01](#), Hardcopy

A number of key problems in wireless communication, ranging from the physical layer to the data transport layer, were investigated. The key results are as follows: (a) A new Quality of Service (QoS) framework, and new schedulers, were developed for supporting heavy-tailed Internet traffic over wireless, without conservative resource provisioning. Related results include analysis and design prescriptions for supporting TCP over wireless, and joint scheduling and link layer

optimization for support of real-time traffic over wireless. (b) New techniques in multiuser detection, interference suppression and equalization were invented. These include the patented Differential Minimum Mean Squared Error (DMMSE) technology that is a promising approach for the design of anti-jam GPS receivers. (c) A framework was developed for efficient noncoherent communication over time varying channels, using joint channel and data estimation rather than suboptimal pilot-based channel estimation followed by demodulation and decoding. Fundamental information-theoretic limits for time-varying channels were developed.

DTIC

*Radiotelephones; Military Operations; Communication Networks*

**20030058084** Air Force Research Lab., Hanscom AFB, MA, USA

**Space Fed Subarrays Using a Displaced Feed**

Mailloux, Robert J.; Jan. 1994; 20 pp.; In English

Report No.(s): AD-A411090; No Copyright; Avail: CASI; [A03](#), Hardcopy

A multiple beam (transform) feed for a phase-scanned lens has the desirable property of forming subarrays for the insertion of time delays across the large aperture. However, at certain scan angles and particular frequencies the multiple beam feed can have a focus at its front face. This phenomenon can be unacceptable when transmit amplifiers are used at this location since it requires that all power be provided from a few or even a single feed port. This paper presents a procedure for defocusing the feed to avoid the large dynamic range problem and spread the required power among a larger fraction of feed elements.

DTIC

*Phased Arrays; Defocusing; Dynamic Range; Antenna Feeds; Multibeam Antennas*

**20030058840** New Mexico State Univ., Las Cruces, NM

**Techniques for Preprocessing Speech Signals for More Effective Audio Interfaces**

DeLeon, Phillip L.; Dec. 2001; 99 pp.; In English

Contract(s)/Grant(s): F41624-99-1-0001; Proj-7184

Report No.(s): AD-A412195; AFRL-HE-WP-TR-2002-0184; No Copyright; Avail: CASI; [A05](#), Hardcopy

A user receiving instructions from various speech sources may be overwhelmed when these sources are speaking simultaneously in an unfavorable acoustical and noisy environment. In such a case, the user is required to separate the various sources from the mixture in order to make the speech intelligible. If no one source dominates or the mixing occurs for a sustained period of time, the human user may become mentally and physically overloaded resulting in fatigue and thus failing to separate the various speech sources into intelligible signals. In the case of the speech recognizer, recognition accuracy may be degraded to unacceptable levels. In this final report in research into methods for blind enhancement and separation of mixtures of speech signals, we present our results from further development and refinement of Frequency Domain, Second-Order Statistics-based decorrelation algorithms and in particular the Multi-resolution Frequency-Domain algorithm. These results include modifications to the algorithm for better performance at reduced cost, implementation, and performance evaluation under a wide set of noise and acoustic environments. Finally, we report on the development of a publically-available database specifically designed for evaluating various speech enhancement/separation algorithms.

DTIC

*Speech Recognition; Preprocessing; Human-Computer Interface*

**20030058948** Naval Postgraduate School, Monterey, CA

**Narrowband Filtering Effects on Frequency-Hopped Signals**

Waters, Kevin A.; Dec. 2002; 52 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411062; No Copyright; Avail: CASI; [A04](#), Hardcopy

This thesis explored a low complexity solution to remove follower, narrowband tone jamming signals which are randomly dispersed within the bandwidth of a hop without causing non-linear phase distortions in a frequency-hopping (FH) system. Forward and reverse processed narrow stopband, elliptical infinite impulse response (IIR) filters were designed and applied to known audio and digital data. Analysis focused on narrowband filtering one hop of a FH signal in the absence of noise. The results were compared with the output of equivalent finite impulse response (FIR) filters and equivalent forward processed 11k filters. This analysis demonstrates the effectiveness of forward and reverse narrow bandstop 11k filtering to eliminate unwanted tone jamming signals while preserving the phase of the received FH signal. These results also suggest that a FH

system with narrow bandstop filtering can operate reliably in the presence of a high power tone jamming signal.  
DTIC

*Frequency Hopping; Narrowband; Signal Processing; Fir Filters*

**20030058999** National Telecommunications and Information Administration, Washington, DC

**Proceedings of the International Symposium on Advanced Radio Technologies**

Allen, J. W.; Brown, T. X.; Mar. 2003; 144 pp.; In English; International Symposium on Advanced Radio Technologies, 4-7 Mar. 2003

Report No.(s): PB2003-103363; NTIA/PUB/SP-03-401; No Copyright; Avail: CASI; A07, Hardcopy

The International Symposium on Advanced Radio Technologies (ISART) brings together business leaders, technical researchers, government regulators, and policy makers to discuss not just the current and emerging state of radio technology, but also how government policy, government regulations, and economic and business forces shape the telecommunications industry. These proceedings are a collection of the technical papers presented at the conference.

NTIS

*Conferences; Radio Communication; Radio Electronics*

### 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*.

**20030057800** Lawrence Livermore National Lab., Livermore, CA

**Advances in Low-Defect Multilayers for EUVL Mask Blanks**

Folta, J. A.; Davidson, J. C.; Larson, C. C.; Walton, C. C.; Kearney, P. A.; Apr. 15, 2002; 16 pp.; In English

Report No.(s): DE2003-15003025; UCRL-JC-148057; No Copyright; Avail: Department of Energy Information Bridge

Low-defect multilayer coatings are required to fabricate mask blanks for Extreme Ultraviolet Lithography (EUVL). The mask blanks consist of high reflectance EUV multilayers on low thermal expansion substrates. A defect density of 0.0025 printable defects/cm<sup>2</sup> for both the mask substrate and the multilayer is required to provide a mask blank yield of 60%. Current low defect multilayer coating technology allows repeated coating-added defect levels of 0.05/cm<sup>2</sup> for defects greater than 90 nm polystyrene latex sphere (PSL) equivalent size for lots of 20 substrates. Extended clean operation of the coating system at levels below 0.08/cm<sup>2</sup> for 3 months of operation has also been achieved. Two substrates with zero added defects in the quality area have been fabricated, providing an existence proof that ultra low defect coatings are possible.

NTIS

*Lithography; Masking; Protective Coatings*

**20030057851** Lawrence Livermore National Lab., Livermore, CA

**Test of the nbAI Insert and ITER Central Solenoid Model Coil**

Okuno, K.; Koizumi, N.; Sugimoto, M.; Isono, T.; Hamada, K.; July 29, 2002; 10 pp.; In English

Report No.(s): DE2003-15002769; UCRL-JC-149390; No Copyright; Avail: Department of Energy Information Bridge

The Central Solenoid Model Coil (CSMC) was designed and built by an ITER collaboration in 1993-2001. Three heavily instrumented Inserts have been also built for testing in the background field of the CSMC. The Nb3AI Insert was designed and built by Japan to explore the feasibility of an alternative to Nb3Sn superconductor for fusion magnets. The Nb3AI Insert coil was tested in the CSMC Test Facility at the Japan Atomic Energy Research Institute, Naka, Japan in March-May 2002. It was the third Insert tested in this facility under this program. The Nb3AI Insert coil was charged successfully without training in the background field of the CSMC to the design current of 46 kA at 13 T peak field and later was successfully charged up to 60 kA in 12.5 T field. This paper presents the test results overview.

NTIS

*Solenoids; Energy Technology; Superconductors (Materials); Test Facilities; Electric Coils*

**20030057862** Department of Energy, Washington, DC, USA, Florida Univ., Gainesville, FL, USA, California Univ., Santa Barbara, CA, USA

**Application of GPR in Florida for Detecting Forensic Burials**

Koppenjan, S. K.; Schultz, J. J.; Falsetti, A. B.; Collins, M. E.; Ono, S.; 2001; In English

Report No.(s): DE2003-807364; No Copyright; Avail: National Technical Information Service (NTIS)

A study was performed at the University of Florida to measure ground penetrating radar (GPR) performance for detecting forensic burials. In controlled scenarios, 24 burials were constructed with pig cadavers. Two soils were utilized to represent two of the most common soil orders in Florida: an Entisol and an Ultisol. Graves were monitored on a monthly basis for time periods up to 21 months with grid data acquired with pulsed and swept-frequency GPR systems incorporating several different frequency antennas. A small subset of the graves was excavated to assess decomposition and relate to the GPR images during the test. The grave anomalies in the GPR depth profiles became less distinctive over time due to body decomposition and settling of the disturbed soil (backfill) as it compacted. Soil type was a major factor. Grave anomalies became more difficult to recognize over time for deep targets that were within clay. Forensic targets that were in sandy soil were recognized for the duration of this study. Time elapsed imagery will be presented to elucidate the changes, or lack thereof, of grave anomalies over the duration of this study. Further analysis was performed using Synthetic Aperture Radar (SAR) reconstruction of images in 2-D and 3-D.

NTIS

*Ground Penetrating Radar; Change Detection*

**20030057972** Catania Univ., Italy

**Development of MOEMS and Smart Systems Based on Transparent Metals**

Baglio, Salvatore; Oct. 2002; 16 pp.; In English

Contract(s)/Grant(s): N68171-01-M-5865

Report No.(s): AD-A411208; R/D-9067-EE-01; No Copyright; Avail: CASI; **A03**, Hardcopy

This final interim report includes a statement of the problem studied, a summary of the most important results obtained during the development of the work and in the last four months, after the realization and the characterization of the designed MOEMS prototypes. A detailed description of the etching procedures techniques at the laboratories of CNM, Spain is reported together with the simulations and the experimental measures made at the laboratories of AMSAM-RD-WS-ST, Huntsville AL, USA. A theoretical models of the final transducer is considered thus showing a very high optical sensitivity with respect to the displacement of the realized micro-suspended plates, where the PBG structures will be deposited in the next future.

DTIC

*Electromechanical Devices; Smart Structures; Smart Materials; Electro-Optics*

**20030057981** Naval Postgraduate School, Monterey, CA

**Spacecraft Power Beaming and Solar Cell Annealing Using High-Energy Lasers**

Luce, Richard C., Jr.; Dec. 2002; 94 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411165; No Copyright; Avail: CASI; **A05**, Hardcopy

Satellite lifetime is often limited by degradation of the electrical power subsystem--radiation-damaged solar arrays and failed batteries. Being able to beam power from terrestrial sites could alleviate this limitation, extending the lifetime of billions of dollars of satellite assets, as well as providing additional energy for electric propulsion that can be used for stationkeeping and orbital changes. In addition, laboratory research at the Naval Postgraduate School (NPS) has shown the potential to anneal damaged solar cells using lasers. This thesis describes that research, preliminary work performed lasing a representative solar panel array, and a proposed on-orbit experiment to demonstrate the relevant concepts by lasing PAN SAT, an NPS-built and operated spacecraft. The preliminary work done at Maui involved lasing a PAN SAT silicon photovoltaic array using a 975 nm% Yb:YAG source at output power levels of 7 W, 14 W and 21 W. These results matched those obtained under near-AMO conditions atop Mount Haleakala (for the 7 W case) and extrapolated to match predicted output levels. Enough data points were collected at each power level to generate an I-V curve for the panel, identifying the open circuit voltage, short circuit current, and maximum power points. The efficiency of the panel varied from 13,1% (as expected for monochromatic light) at 7 W to 11, 3% at 21 W due to uniform heating of the cells. These results represent a 'ground truth' baseline from which further research can continue.

DTIC

*Annealing; Solar Cells; Electric Current; Electric Potential; Pulsed Lasers*

**20030058022** Lawrence Livermore National Lab., Livermore, CA

**Electrostatic Comb Drive for Vertical Actuation**

Lee, A. P.; McConaghy, C. F.; Krulevitch, P. A.; Campbell, E. W.; Sommagren, G. E.; Jul. 10, 1997; 18 pp.; In English  
Report No.(s): DE2003-16389; UCRL-JC-127771; No Copyright; Avail: Department of Energy Information Bridge

The electrostatic comb finger drive has become an integral design for microsensors and microactuator applications. This paper reports on utilizing the levitation effect of comb fingers to design vertical-to-the-substrate actuation for interferometric applications. For typical polysilicon comb drives with 2 micrometers gaps between the stationary and moving fingers, as well as between the microstructures and the substrate, The equilibrium position is nominally 1-2 micrometers above the stationary comb fingers. This distance is ideal for many phase shifting interferometric applications. Theoretical calculations of the vertical actuation characteristics are compared with the experimental results, and a general design guideline is derived from these results. The suspension flexure stiffnesses, gravity forces, squeeze film damping, and comb finger thicknesses are parameters investigated which affect the displacement curve of the vertical microactuator. By designing a parallel plate capacitor between the suspended mass and the substrate, in situ position sensing can be used to control the vertical movement, providing a total feedback-controlled system. Fundamentals of various capacitive position sensing techniques are discussed. Experimental verification is carried out by a Zygo distance measurement interferometer.

NTIS

*Levitation; Actuators; Position Sensing; Vertical Orientation; Actuation*

**20030058049** Naval Postgraduate School, Monterey, CA

**Design of Microstrip Patch Antenna for the NPSAT1**

Erel, Mahmut; Dec. 2002; 82 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411274; No Copyright; Avail: CASI; [A05](#), Hardcopy

This thesis presents the design of two circularly polarized patch antennas for operation at 1.767 GHz and at 2.207 GHz (for receiving and transmitting respectively) on NPSAT1 satellite. The design requirements for the antennas include a VSWR of less than or equal to 2:1 for 50 Ohm reference impedance. The study includes the development of a three-dimensional antenna model, antenna simulation and analysis of results based on various outputs of the CST Microwave Studio Finite Difference Time Domain (FDTD) software package.

DTIC

*Computer Programs; Strip Transmission Lines; Microstrip Antennas; Patch Antennas*

**20030058696** Michigan Univ., Ann Arbor, MI

**Low Energy Electronics Design for Mobile Platforms**

East, J.; Hero, A.; Katehi, L.; Lafortune, S.; Mazumder, P.; Dec. 3, 2002; 19 pp.; In English

Contract(s)/Grant(s): DAAH04-96-1-0377

Report No.(s): AD-A412914; ARO-35890.1-EL-MUR; No Copyright; Avail: CASI; [A03](#), Hardcopy

In order to address the need for low-energy electronics design for mobile platforms in future Army communication systems a multidisciplinary effort is needed to investigate system and component design, simulation and optimization techniques. The emphasis in this research project is on the optimization, from a systems perspective, of energy requirements for a given performance level incorporating realistic models of device and circuit characteristics and energy consumption. The objectives of our project are to carry out detailed investigations to determine the best possible approaches and design methodologies to achieve significant energy reduction in a mobile platform performing various functions including communications, surveillance, detection, diagnostics and GPS direction finding.

DTIC

*Design Optimization; Performance Prediction; Energy Requirements*

**20030058725** Naval Postgraduate School, Monterey, CA

**Costs and Benefits of Using Fuel Cells for Stationary Power Generation at Marine Corps Logistics Base Barstow Maintenance Center**

Schandler, Phillip J.; Dec. 2002; 94 pp.; In English

Report No.(s): AD-A411015; No Copyright; Avail: CASI; [A05](#), Hardcopy

We compare the costs and benefits of using two types of fuel cell power generation systems versus Southern California Edison to provide the base electricity load for the Marine Corps Logistics Base Barstow Maintenance Center. The results indicate that the break-even point is not likely to occur before year eight and under certain conditions may not occur at all

during the 20-year program life cycle. The results do indicate a pollution reduction from fuel cells, but the reduction would not have any measurable impact on the nation's air quality.

DTIC

*Electricity; Electric Generators; Fuel Cells*

**20030058726** Gerhard-Mercator Univ., Duisburg, Germany

**LED-Based Micro Display for an Intraocular Vision Aid (IOVA)**

Puettjer, D.; Praemassing, F.; Buss, R.; Jaeger, D.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A411475; No Copyright; Avail: CASI; [A01](#), Hardcopy

In this Paper a micro display for an intraocular vision aid (IOVA) projecting an image of the environment onto the retina is presented, The display comprises an image of an array made out of single LED pixels, It is connected to a CMOS driver circuit using flip-chip technique, Since micro lenses have to be integrated into the substrate material for proper image projection onto the retina the generated light has to pass the substrate, Thus, only semiconductors with adequate large band gap energies are suitable, This paper discusses the principle of GaAsP material systems for an LED-based micro display applied to an implantable vision aid.

DTIC

*Eye (Anatomy); Light Emitting Diodes; Prosthetic Devices; Enhanced Vision*

**20030058731** Oakland Univ., Rochester, MI

**A Cost-Effective Amplifier for Electromagnetic Field Strength Measurement**

Rusek, A.; Oakley, B.; Bachrouche, H.; El Shaar, B.; Liu, J.; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412240; No Copyright; Avail: CASI; [A01](#), Hardcopy

Problems associated with high sensitivity electromagnetic radiation measurements arise when low levels of broadband radiated emissions are to be detected. Such measurements require expensive and sensitive equipment operating in a broad range of frequencies. This paper presents an inexpensive broadband amplifier designed to increase the overall gain of a measurement system consisting of a 50 ohm broadband antenna coupled to a 50 ohm input spectrum analyzer. Addition of the amplifier increases system gain by nearly 30 dB with insignificant degradation in the signal-to-noise ratio. The bandwidth of the system exceeds 1000 MHz, with the frequency ranging between 30MHz and 2.2GHz.

DTIC

*Electromagnetic Fields; Cost Effectiveness; Amplifiers*

**20030058747** Naval Postgraduate School, Monterey, CA

**3D Visualization of an Invariant Display Strategy for Hyperspectral Imagery**

Kim, Kang S.; Dec. 2002; 106 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411383; No Copyright; Avail: CASI; [A06](#), Hardcopy

Spectral imagery provides multi-dimensional data, which are difficult to display in standard three-color image formats. Tyo, et al. (2001) propose an invariant display strategy to address this problem. This approach is to mimic the dynamics of human perception. The dimensionality of the data are reduced by using a Principal Component (PC) transformation, and then displayed by making use of a Hue, Saturation, and Value (HSV) display transform. This study addresses the PC transformation strategy, looks for a global eigenvector via visualization of HSV color space information, and examines the suggested algorithm to provide the most intuitive display. The user interface created in this thesis is capable of computing the necessarily implementation of the proposed strategy, viewing selected Region of Interest (ROI) in HSV color space model in 3D, and viewing the 2D resultant image.

DTIC

*Display Devices; Imaging Techniques*

**20030058797** Brookhaven National Lab., Upton, NY, Hebrew Univ. of Jerusalem, Rehovot, Israel, Argonne National Lab., IL, USA, Washington Univ., Seattle, WA, USA

**Direct Determination of the Stacking Order in Gd<sub>2</sub>O<sub>3</sub> Epi-Layers on GaAs**

Yacoby, Y.; Sowwan, M.; Pindak, R.; Cross, J.; Walko, D.; 2002; 12 pp.; In English

Report No.(s): DE2002-806194; BNL-69489; No Copyright; Avail: Department of Energy Information Bridge

We have used Coherent Bragg Rod Analysis (COBRA) to investigate the atomic structure of a 5.6 nm thick Gd(sub

2)O(sub 3) film epitaxially grown on a (100) GaAs substrate. COBRA is a method to directly obtain the structure of systems periodic in two-dimensions by determining the complex scattering factors along the substrate Bragg rods. The system electron density and atomic structure are obtained by Fourier transforming the complex scattering factors into real space. The results show that the stacking order of the first seven Gd(sub 2)O(sub 3) film layers resembles the stacking order of Ga and As layers in GaAs then changes to the stacking order of cubic bulk Gd(sub 2)O(sub 3). This behavior is distinctly different from the measured stacking order in a 2.7 nm thick Gd(sub 2)O(sub 3) in which the GaAs stacking order persists throughout the entire film.

NTIS

*Epitaxy; Gallium Arsenides; Crystal Defects; Thick Films; Semiconducting Films*

**20030058817** Michigan Univ., Ann Arbor, MI

**Circuitry for a Wireless Microsystem for Neural Recording Microprobes**

Yu, Hao; Najafi, Khalil; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412093; No Copyright; Avail: CASI; [A01](#), Hardcopy

Integrated circuits for use in a wireless microsystem used in neural recording is described, The implantable microsystem will be powered and transmit digitized data using RF telemetry. Recorded neural signals are amplified, multiplexed, digitized using a 2nd order sigma-delta modulator, and then transmitted to the outside world by an on-chip transmitter, The circuit is designed using a standard 1.5 microns CMOS process, Several circuit blocks have been designed, fabricated and show to operate as expected.

DTIC

*Integrated Circuits; Neurophysiology; Micromachining*

**20030058820** Naval Research Lab., Washington, DC

**A Review of the Development of Multiple-Beam Klystrons and TWTs**

Nusinovich, Gregory S.; Levush, Baruch; Abe, David K.; Mar. 17, 2003; 45 pp.; In English

Report No.(s): AD-A412186; NRL/MR/6840--03-8673; No Copyright; Avail: CASI; [A03](#), Hardcopy

This memorandum summarizes the current (as of 2002) development status of microwave and millimeter-wave amplifiers based on multiple electron beam technology. A brief historical perspective of multiple-beam amplifier (MBA) research and development in the U.S. and abroad is presented covering the period from 1940 to 2002. Based on material gathered from conference and workshop presentations and recent open-literature journal publications, we summarize the current state-of-the-art in MBA device performance in Russia, France, and the Peoples' Republic of China. In addition, we develop a set of scaling analyses comparing multiple-beam klystron performance with single-beam Mystron performance, including voltage, power, bandwidth, magnetic field, and dimensional scaling.

DTIC

*Power Amplifiers; Klystrons; Magnetic Fields*

**20030058823** Pennsylvania State Univ., University Park, PA

**An Equivalent-Circuit Model for Flexural-Disk Transducers**

Gabrielson, Thomas B.; Jan. 29, 2003; 121 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-00-1-0177

Report No.(s): AD-A412252; TR-03-003; No Copyright; Avail: CASI; [A06](#), Hardcopy

The goal of this project was to develop a set of analysis tools for performance prediction of flexural-disk acoustic projectors. The emphasis is on analytically based formulations designed to merge the physics of the flexure-disk structure with typical operational requirements of frequency, source level, bandwidth, and operating depth. While finite element analysis coupled with acoustic radiation models would be used to refine designs, analytical models permit isolation of the major effects of essential design variables. By developing an understanding of the transducer performance, the effectiveness of various strategies for flexural-disk designs can be evaluated. The model described in this report covers both center-supported and edge-supported structures and two and three-layer configurations.

DTIC

*Equivalent Circuits; Piezoelectric Transducers*



**20030058825** Notre Dame Univ., IN

**Electromigration and Local Field Effects in Mesoscopic Interconnects**

Bernstein, Gary; May 14, 1999; 11 pp.; In English

Contract(s)/Grant(s): F49620-95-1-0063; Proj-2305

Report No.(s): AD-A412254; AFRL-SR-AR-TR-03-0082; No Copyright; Avail: CASI; [A03](#), Hardcopy

Samples were fabricated by the same processes as the previous ones, but with triangular e-beam pads. Validity of the test structure was first examined. After stressing groups of 40 nm and 50 nm wide lines, samples were checked in the FESEM. In the tested samples, most of the lines failed inside the lines and their pads were intact, and a small portion failed in the pads. The test results show that the new structure can withstand the high current density and survive the bamboo test lines. It is normal that a certain percentage of the failures took place in the pads section. Upon examination of the failure sites, it was found that the sites were always damaged, probably by arcing. Voids were never found within the lines. There is a possible explanation for the damage where voids are expected. In the wide lines, where voids commonly form due to EM damage, at the final stage of EM, current is concentrated into a very small cross-sectional area, catastrophic damage occurs and the relatively large volume of metal at both sides of the void can be a good heat sink and conduct the heat away in time, leaving a voided open circuit failure. But in the very narrow lines, current density is very high, while the line does not have good dissipation of the heat generated at the final catastrophic stage, resulting in arcing damage at the moment of the open circuit occurs. At present, we don't have direct evidence of what actually happens at the failure sites. Direct in situ observation will help to get more information about it.

DTIC

*Electron Scattering; Integrated Circuits; Failure Analysis*

**20030058846** Rensselaer Polytechnic Inst., Troy, NY

**Computer Aided Design Tools for Mixed Electronic/Photonic VLSI**

Shur, Michael S.; Feb. 14, 2002; 7 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0319

Report No.(s): AD-A412234; ARO-38879.2-EL; No Copyright; Avail: CASI; [A02](#), Hardcopy

In this project, we have developed the physics-based models for photonic elements (sources, detectors and interconnects), expressed these in terms of electrical equivalents, and implemented them in the new Photonic SPICE. This transformation between the optical and the electrical dimensions have been performed in such a way that all effects of optical emission, propagation and detection are reproduced by their electronic counterparts. The physics-based models have been checked against experimental results.

DTIC

*Computer Aided Design; Very Large Scale Integration; Photonics; Electronics*

**20030058850** Hawaii Univ., Honolulu, HI, USA

**Active and Reconfigurable Photonic-Bandgap Structures**

Shiroma, Wayne A.; Chiao, Jung-Chih; Mar. 10, 2002; 16 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0475

Report No.(s): AD-A411049; ARO-39135.18-EL-H; No Copyright; Avail: CASI; [A03](#), Hardcopy

Progress is reported for several interrelated projects that integrate the areas of quasi-optical electronics, photonic-bandgap (PBG) structures, and microelectromechanical systems (MEMS). These include quasi-optical arrays integrated with photonic-bandgap structures for generation, reception, mixing, linearization, and retrodirection of signals; several beam-steering arrays using reconfigurable PBG ground planes, quasi-optical grids, and reconfigurable elements; and MEMS components for reconfigurable transceivers.

DTIC

*Photonics; Energy Gaps (Solid State); Microelectromechanical Systems; Electronics*

**20030058851** Naval Postgraduate School, Monterey, CA

**Optimizing Electric Grid Design Under Asymmetric Threat**

Salmeron, J.; Wood, K.; Baldick, R.; Feb. 2003; 38 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411052; NPS-OR-03-002; No Copyright; Avail: CASI; [A03](#), Hardcopy

This research develops analytical techniques to help improve the security of electric power grids subject to disruptions caused by terrorist attacks (and even by natural disasters). Our new bilevel mathematical models and optimization techniques

identify critical system components (e. g., transmission lines, generators, transformers, and other power system elements) by creating maximally disruptive attack plans for terrorists who are assumed to have limited offensive resources. Results for standard, reliability-benchmark, test networks are presented. We also discuss trilevel models for actually selecting a set of budget-limited system upgrades that minimizes the potential for disruption.

DTIC

*Security; Mathematical Models; Asymmetry; Threat Evaluation; Electric Power*

**20030058852** California Univ., San Diego, La Jolla, CA

**Optical Interconnects for Smart Antenna Driver-Receiver-Switch System for Wireless Communication**

Esener, Sadik; Dec. 2002; 12 pp.; In English

Contract(s)/Grant(s): DAAD19-00-1-0495

Report No.(s): AD-A412178; No Copyright; Avail: CASI; [A03](#), Hardcopy

The scope of this work is to study the possibility of utilizing devices operating at 0.3THz-30THz for telecommunication applications in general and for interconnects within the box, in particular, for example for Smart Antenna Driver-Receiver-Switch System for Wireless Communication. Our approach in the period covered by this report has been to organize brain-storming sessions within our group to develop potential application areas that could take advantage of interfacing optical interconnects with THz devices within the context of the scope of the program. To this date we have come up with two novel concepts: one to utilize 30THz optical sources for point to point free space optical communication and the second to use two-coupled cavity VCSEL structure for THz modulation. We have also pursued the analysis of a Smart antenna driver for wireless communication to derive the potential benefits of optical interconnects for this application.

DTIC

*Radiotelephones; Wireless Communication; Telecommunication; Optical Interconnects; Antenna Arrays; Switches*

**20030058858** Stanford Univ., Stanford, CA

**Impact Damage Identification of Composite Structures with Built-in Piezoelectric Sensor/Actuator Networks**

Wang, Calvin S.; Park, J. H.; Chang, Fu-Kuo; Jan. 1999; 36 pp.; In English

Contract(s)/Grant(s): DAAD19-99-1-0238

Report No.(s): AD-A412408; ARO-38974.1-EG; No Copyright; Avail: CASI; [A03](#), Hardcopy

An investigation was performed to develop a self-diagnostic technique using a built-in piezoelectric wafer network to detect damage and to identify the extent of the damage in fiber-reinforced composite plates resulting from foreign-object impact. The principle of the technique was to use built-in piezoelectric wafers as actuators to generate stress waves and also use the neighboring piezoelectric wafers as sensors to receive the propagating waves. The difference in sensor measurements before and after the introduction or impact damage, referred to as scatter, contains information about the location and size of site impact damage. Accordingly, the proposed technique. consists of signal generation, signal processing, and damage identification. In the first part of the study, focus was on thin to moderately thick composites where identifying damage in the thickness direction was ignored and only a single piezoelectric wafer network through the composite plates was used. Diagnostic signals were selected for built-in piezoelectric actuators to generate appropriate Lamb waves to enhance the sensitivity of the sensor measurement to damage and to minimize signal noises due to environments. A signal-processing scheme composed of a smooth filtering and a joint time-frequency analysis was utilized to overcome noise interference and convert sensor measurements into sensor and scatter spectrograms in the time-frequency domain.

DTIC

*Composite Structures; Actuators; Impact Loads; Impact Damage; Identifying; Damage; Piezoelectric Actuators*

**20030058862** Naval Research Lab., Washington, DC

**Antenna Coupling/Isolation Analysis: Generation to 3-D**

Medgyesi-Mitschang, L. N.; Feb. 20, 2003; 16 pp.; In English

Report No.(s): AD-A412442; NRL/MR/5050-03-8655; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report summarizes a generalized formulation for three-dimensional antenna coupling and isolation problems. The formulation is developed for a generic transmit/receive configuration. The formulation is based on representing the boundary conditions arising in the problem by using integro-differential representations of Maxwell's equations. To streamline the derivations, integral operators are introduced. The resulting system of coupled equations for the electric and magnetic fields is solved using the Method of Moments (MM) technique. Specifically, the Galerkin variant of this technique is adopted here, resulting in a symmetric system matrix for the problem. The formulation discussed here is specialized to the two-domain case.

This refers to problems where the antenna or array is embedded in a conducting surface constituting one domain. The second domain is an intervening region that is penetrable. Depending on the nature of the penetrable region, it provides the isolation or coupling between the transmit or receive antennas and arrays. The resulting generalized formulation has been implemented with computer software that is an adaptation of the MM-based CARLOS code. Discussion of the associated numerical implementation and software are documented elsewhere and omitted from this report.

DTIC

*Antenna Couplers; Three Dimensional Models; Coupling; Boundary Conditions*

**20030058939** Naval Postgraduate School, Monterey, CA

**Performance Evaluation of a Cooperative Diversity Enhanced Ad Hoc Network**

Tope, Michael A.; Dec. 2002; 94 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411054; No Copyright; Avail: CASI; [A05](#), Hardcopy

Currently wireless multi-hop ad hoc networks utilize protocols that relay packets of data node-by-node along a path connecting the source node to the sink node. This thesis describes a new methodology called 'Cooperative Diversity' where information is relayed from the source to the sink via clusters of neighboring nodes. We first describe a routing protocol to establish spatially diversified paths through a field of randomly dispersed nodes. Second, an idealized configuration called the 'Synthetic Waveguide' is introduced and its information theoretic channel capacity is developed. Third, we derive an outage model based channel capacity for the synthetic waveguide operating with a low forwarding latency. The low latency channel capacity is far different from that predicted by traditional channel capacity. Next, a simple modulation called stuttered simulcast is introduced and shown to approach the performance of an optimal distributed space-time code. Finally, a Monte Carlo simulation of the cooperative diversity routing protocol confines its superior performance in regions of operational interest.

DTIC

*Waveguides; Computer Networks; Wireless Communication; Channel Capacity; Methodology; Performance Tests*

**20030058945** Naval Postgraduate School, Monterey, CA

**Management of Microcircuit Obsolescence in a Pre-Production ACAT-ID Missile Program**

Pearce, William S.; Dec. 2002; 106 pp.; In English

Report No.(s): AD-A411108; No Copyright; Avail: CASI; [A06](#), Hardcopy

Microelectronic piece-part component obsolescence problems are prevalent and costly across all Department of Defense (DoD) weapon systems, both new and legacy. The issue is driven by the high turnover in electronic components, limited DoD influence upon component manufacturers, poor obsolescence management at both Program Office and Command levels, and a lack of understanding of the analysis tools and design techniques available to the Program Manager (PM) to help mitigate problems. The issue of microcircuit obsolescence affecting a pre-production, Acquisition Category (ACAT)-ID, Missile program is of particular interest due to their ability to transition from pre-production into full rate production, without a major redesign due to microcircuit obsolescence. The DoD and other Governmental agencies, along with commercial industries, are investigating numerous ways to reduce the increasing costs associated with obsolescence. This thesis incorporates this information to provide both the pre-production AC AT-ID Missile Weapon System Program Managers and the U.S. Army Aviation and Missile Command (AMCOM) guidance in addressing microcircuit obsolescence challenges from a management perspective.

DTIC

*Microelectronics; Weapon Systems; Electronic Equipment; Missile Control*

**20030058952** New Mexico Univ., Albuquerque, NM

**Optoelectronics Research Center**

Brueck, Steven R.; Hersee, Stephen D.; Jain, Ravinder K.; Krishna, Sanjay; Lester, Luke F.; Feb. 19, 2003; 633 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F49620-99-1-0330

Report No.(s): AD-A412394; FT31523X; AFRL-SR-AR-TR-03-0077; No Copyright; Avail: CASI; [A99](#), Hardcopy

The AFOSR Optoelectronics Research Center has maintained a broadly based program at the forefront of optoelectronics with efforts in linear and nonlinear materials, device processing, device design, and in device integration. Examples of materials and structures are quantum dots, superlattices, digital alloys, and strained-layer semiconductors, and new nonlinear materials. Processing developments relate to smaller dimensions and improved techniques for the selective deposition,

modification and removal of materials. Improved devices, based both on semiconductors and on fibers, have also resulted from increased understanding of the underlying device and material physics and from innovative approaches to device design and synthesis.

DTIC

*Electro-Optics; Optical Materials; Fiber Optics; Nanotechnology; Semiconductor Lasers*

**20030058960** California Univ., Los Angeles, CA

**Modular Micromachined Si Heat Removal (MOMS Heat Removal): Electronic Integration and System Test**

Brown, Elliott R.; Jan. 2, 2003; 52 pp.; In English

Contract(s)/Grant(s): DAAD19-99-1-0157

Report No.(s): AD-A412415; ARO-40069.14-EL; No Copyright; Avail: CASI; [A04](#), Hardcopy

The UCLA group headed by Dr. Elliott Brown and the Rockwell Scientific group headed by Dr. Michael Shaw conducted extensive research for the DARPA HERETIC Program on the integration of two heat-removal approaches with power electronic devices, (1) micro heat pipes and (2) micro spray nozzles. Two types of power devices were investigated: (1) insulated-gated bipolar transistors (IGBTs), and (2) laterally-diffused (LD) MOSFETs. Heat pipes were found to provide little or no advantage over conventional copper-based heat spreaders in both device applications. But spray nozzles made by micromachining were found to improve the heat removal of both device types through three key innovations: (1) careful design of the micronozzle to provide jets directly on the heat generating areas of the devices, (2) the use of water for the spraying to take advantage of its combination of high thermal conductivity and high latent heat of vaporization, and (3) coating the top surface of the devices prior to spraying with a conformal dielectric (Parylene C) to prevent shorting by the water. Once the spray nozzles were successfully combined with the power devices, the integrated packages were used in two system demonstrations: (1) the IGBTs in an all-solid-state motor drive, and (2) the LD-MOSFETs in a 60-W (base-station grade) RF power amplifier. Each is described below: (1) Solid-State Motor Drive. Our conventionally machined steel nozzle provided a low-pressure water spray cooling of the IGBT surfaces within a solid-state motor drive operating under speed control of a motor load. Significant challenges included the packaging of a nozzle array design in a high-power module (>650 W dissipation) that operated with high standoff voltages ( $V(\text{sub rms}) \wedge 325 \text{ VAC}$ ).

DTIC

*Removal; Electronic Equipment; Integrated Circuits; Silicon; Heat; Micromachining*

**20030058961** University of Southern California, Los Angeles, CA, USA

**The High Voltage Workshop and Power Modulator Conference (2002)**

Gundersen, Martin A.; Feb. 2003; 25 pp.; In English

Contract(s)/Grant(s): F49620-02-1-0116

Report No.(s): AD-A412440; AFRL-SR-AR-TR-03-0073; No Copyright; Avail: CASI; [A03](#), Hardcopy

The 2002 International Power Modulator Conference was a grand success! Over 240 people attended and they contributed over 150 papers for publication. The conference served as host to nine exhibitors who displayed their latest high technology products.

DTIC

*Pulse Modulation; High Voltages; Conferences*

**20030058970** Hewlett-Packard Labs., Palo Alto, CA

**Microelectromechanical (MEMS)-Based Data Storage**

Hartwell, Peter; Yoon, Uija; Tien, Norman C.; Hunt, Charles E.; Feb. 2003; 101 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F30602-98-3-0232; Proj-E117

Report No.(s): AD-A411620; AFRL-IF-RS-TR-2003-28; No Copyright; Avail: CASI; [A06](#), Hardcopy

This project developed and demonstrated design and fabrication technologies required to enable mass production of MEMS micromovers and electrostatic motors required to actuate these structures, including suspension systems of unprecedented high aspect ratio by Hewlett Packard. Single and multiple level electrical interconnect fabrication techniques were developed and refined by Cornell University. A technique to fabricate large arrays of field emission tips was developed by U.C. Davis.

DTIC

*Fabrication; Microelectromechanical Systems; Data Storage; Electrostatics*

**20030058992** Defence Research and Development Canada, Ottawa, Ontario, Canada

**MEMS-Based Light Valves for Ultra-High Resolution Projection Displays**

Picard, F.; Campillo, C.; Niall, Keith K.; Larouche, C.; Jerominek, H.; Dec. 2002; 32 pp.; In English  
Report No.(s): AD-A412187; DRDC-TR-2002-141; No Copyright; Avail: CASI; A03, Hardcopy

Ultra-high resolution projectors will improve the visual systems of military flight simulators dramatically. There are changes in aspect angle and aspect rate which fixed-wing fighter pilots can discriminate at long standoff distances, but which cannot be displayed with adequate resolution by the visual systems of contemporary flight simulators. At present the limit of display resolution is fixed by the capacity of the display's projector. This issue is being addressed by INO, DRDC, and their partners working toward the development of a new light-modulating micromirror MEMS (MicroElectroMechanical Systems). This unique device incorporates 25 micrometers x 25 micrometer microbridges acting as flexible micromirrors. Each micromirror corresponds to one pixel of an image and is capable of modulating light intensity in analog fashion, with switching speeds in the range of 5 microseconds. A linear array of micromirrors is combined with a scanning system, a microlaser light source and a Schlieren-type optical system to produce a 256 grey-level image. The result is a MOEMS (microOptoElectroMechanical Systems)-based system that can write thousands of image lines at a frame rate of 60 Hz. Finite-element analyses have been performed to describe mechanical properties of the micromirrors. Several examples will be given from both static and dynamic electromechanical simulation. The micromirror fabrication process will be summarized. The physical characteristics of the micromirrors will be reported, including their response time and damage threshold. Finally, future plans will be described, including the development of 2000 x 1 linear pixel arrays with the associated control electronics.

DTIC

*High Resolution; Display Devices; Microelectromechanical Systems; Mirrors*

**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*.

**20030057748** Lawrence Livermore National Lab., Livermore, CA

**Rayleigh-Taylor Instability Growth Experiments in a Cylindrically Convergent Geometry**

Weir, S. T.; Chandler, E. A.; Goodwin, B. T.; Jun. 11, 1997; 14 pp.; In English

Report No.(s): DE2003-16394; UCRL-JC-127668; No Copyright; Avail: Department of Energy Information Bridge

Convergent geometry Rayleigh-Taylor experiments have been performed with a 122-point detonation initiation system on cylinders having sinusoidal perturbations on the outer surface ranging from mode-6 to mode-36. Experiments were performed with various perturbation mode numbers, perturbation amplitudes, and ring accelerations. Feedthrough perturbation growth on the inner surface was observed in several experiments, and in one experiment the feedthrough perturbation underwent a phase inversion. These experimental results were found to be in good agreement with linear, small-amplitude analysis of feedthrough growth in an incompressible, cylindrically convergent geometry.

NTIS

*Convergence; Detonation Waves; Initiation; Taylor Instability*

**20030057750** Lawrence Livermore National Lab., Livermore, CA

**Chemical Reaction and Equilibration Mechanisms in Detonation Waves**

Tarver, C. M.; Jul. 1997; 12 pp.; In English

Report No.(s): DE2003-16400; UCRL-JC-126562; No Copyright; Avail: Department of Energy Information Bridge

Experimental and theoretical evidence for the nonequilibrium Zeldovich-von Neumann-Doring (NEZND) theory of self-sustaining detonation is presented. High density, high temperature transition state theory is used to calculate unimolecular reaction rate constants for the initial decomposition of gaseous norbornene, liquid nitromethane, and solid, single crystal pentaerythritol tetranitrate as functions of shock temperature. The calculated rate constants are compared to those derived from experimental induction time measurements at various shock and detonation states. Uncertainties in the calculated shock and von Neumann spike temperatures are the main drawbacks to calculating these reaction rates. Nanosecond measurements of the shock temperatures of unreacted explosives are necessary to reduce these uncertainties.

NTIS

*Chemical Reactions; Decomposition; Detonation Waves; Explosives; Reaction Kinetics*

**20030057889** Tennessee Univ. Space Inst., Tullahoma, TN

**Computation of Separating High Reynolds Number Incompressible Flows Using Uniform Cartesian Grids**

Steinhoff, John; Jul. 18, 2002; 82 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0316

Report No.(s): AD-A410942; ARO-38703.8-EG; No Copyright; Avail: CASI; [A05](#), Hardcopy

Most of the research done during the contract period is reported in the 'Interim Report' of March, 2002. This is included in section II. Other results, including a breakthrough that has led to a new, simpler, fully conservative Vorticity Confinement formulation will be discussed in section III. Results of the original formulation for blunt body flow, including comparisons with experiment, are described in section IV. A new, more effective way to treat the surface boundary layer that can be compared with other Vorticity Confinement separation results, such as dynamic stall, is presented in section V. A few of the publications produced during the contract period, which contain relevant material referred to in this report, are included as appendices.

DTIC

*Atmospheric Boundary Layer; Flow Velocity; High Reynolds Number; Separation*

**20030057929** Texas A&M Univ., College Station, TX, USA

**Laboratory Modeling of Hydraulic Dredges and Design of Dredge Carriage for Laboratory Facility**

Glover, Gordon J.; Dec. 2002; 192 pp.; In English

Report No.(s): AD-A410914; No Copyright; Avail: CASI; [A09](#), Hardcopy

The deepening and maintenance of the world's ports and navigable waterways has been an integral part of the world economy for centuries. In recent years, cutterhead and draghead hydraulic suction dredges have performed a majority of the dredging work. The ongoing design and testing of hydraulic dredges is important for maintaining efficient dredging operations within the limits set by increasing environmental regulations. The high cost of building and operating a hydraulic dredge makes field testing of full-scale prototypes very expensive and time consuming. Moreover, the testing conditions are generally difficult to control, and the natural unpredictability of the sea can render experimental results inconclusive. These factors substantiate the need for laboratory model testing of hydraulic dredging operations. The usefulness of any hydraulic model depends on the degree of geometric, kinematic, and dynamic similarity between the model and its prototype. The primary challenge in establishing useful similitude criteria for model dredge studies is proper kinematic scaling of the suction inlet velocity, average particle settling velocity, dredge swing velocity, and cutter rotational speed. Despite the inherent challenges, model studies of hydraulic dredge equipment have proven useful for obtaining qualitative results. The new Coastal Engineering Laboratory at Texas A&M university is equipped with model dredge testing facilities ideal for performing such experiments. The tow/dredge carriage has a fully adjustable dredge ladder, a 14.9 kW (20 hp) cutter drive, and a 2.54 cm (3 in) dredge pump. A Programmable Logic Controller (PLC) provides computer numerical control and real-time data collection and analysis during model dredging operations.

DTIC

*Cutters; Dredging; Dynamic Models; Field Tests; Hydraulic Equipment*

**20030057932** Swedish Defence Research Establishment, Stockholm

**EDGE. Navier-Stokes Solver for Unstructured Grids**

Eliasson, P.; Dec. 2001; 74 pp.; In English

Report No.(s): PB2003-103200; FOI-R-0298-SE; No Copyright; Avail: CASI; [A04](#), Hardcopy

This report describes the compressible Navier-Stokes solver EDGE for unstructured grids. The solver is based on an edge-based formulation for arbitrary elements and uses a node-centered finite-volume technique to solve the governing equations. Two spatial discretizations of the convection terms are described, compact discretizations of the thin-layer and fully viscous terms have been proposed and evaluated. The governing equations are integrated explicitly towards steady state with Runge-Kutta time integration. The convergence is accelerated with agglomeration multigrid and implicit residual smoothing.

NTIS

*Navier-Stokes Equation; Unstructured Grids (Mathematics); Computational Fluid Dynamics*

**20030057966** Maryland Univ., College Park, MD

**Active/Passive Structural Damping Control for Rotorcraft Systems**

Wereley, Norman M.; May 31, 2002; 111 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0339

Report No.(s): AD-A411152; ARO-38856.4-EG-YIP; No Copyright; Avail: CASI; [A06](#), Hardcopy

Our primary objective is to augment the aeromechanical stability of bearingless and articulated rotor systems. We will focus on two damping strategies: (1) dampers based on magnetorheological fluids, (2) Hybrid elastomeric-magnetorheological fluid-based dampers. The flexbeam and torque tube substructure of the model-scale rotor will incorporate adaptive dampers based on MRF technology. Key aspects of the damper design will be undertaken utilizing quasi-steady constitutive models. MR fluids exhibit a reversible change in yield stress as magnetic field is applied. This change in yield stress can be exploited in the design of a damper with an electromagnet. The key performance criterion will be the damping coefficient, or the field dependent damping over the damping in the absence of applied field. The test data will be used to validate analysis, and demonstrate utility of smart active/passive damping control concepts.

DTIC

*Damping; Rotary Wing Aircraft*

**20030058003** Washington Univ., Seattle, WA

**Automated Microfluidics for Genomics**

Meldrum, Deirdre R.; Pence, William H.; Moody, Stephen E.; Cunningham, David L.; Holl, Mark; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411131; No Copyright; Avail: CASI; [A01](#), Hardcopy

The Genomation Laboratory at the University of Washington is developing an automated fluid handling system called 'Acapella' to prepare microliter reactions for genomic analysis. The system prepares 5,000 samples in 8 hours for general-purpose chemistry analysis including DNA sequencing reaction preparation.

DTIC

*Automatic Control; Fluid Flow; Genome*

**20030058057** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese

**LES Investigation of Coherent Structures in Boundary Layers and Wakes. Volume II: Wake Around Square Cylinder**

Giammanco, R.; Benocci, C.; Dec. 2002; 180 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-99-1-0834

Report No.(s): AD-A412549; 2003-08; No Copyright; Avail: CASI; [A09](#), Hardcopy

Purpose of the present investigation is to assess the feasibility of simulating and studying coherent structures in turbulent shear layers, making use of Large Eddy Simulations (LES). Volume I of present report has described the general background, the main development and the results obtained for wall bounded turbulent flow, particularly the turbulent channel flow at equilibrium. The present Volume II is devoted to the study of the flow around an obstacle, in particular a cylinder with square cross section and infinite length in span-wise direction. This test case belongs to a completely different class of flow respect the one analyzed in Volume I, and it is a rather severe test case for the LES code. Most of the advanced features of the code were exploited, and different simulations were performed, to collect, whenever possible, sufficient data to draw conclusions and remarks. Differently from the case of channel flow, where the code has been extensively validated and analyzed in detail, down to the level of turbulent kinetic energy budget, the present flow constitutes a still active area of basic research. The higher complexity of the flow, the absence of a second direction of homogeneity, beside the span-wise direction, the existence of a dominant frequency in the flow, the necessity of employing upwinding discretization for advection terms and other numerical difficulties have led to such complexities of execution that only the very basic set of statistics (statistical moments of first and second order) were obtained. At the same time, limits and draw-backs for current LES code implementation have been outlined. Most of the efforts were devoted to reach a sufficient similarity in behavior between LES simulation and reference experimental data; this attempt has led to build grids not perfectly suited to analyze structures applying the criteria based on the gradient of velocity tensor introduced in Volume I.

DTIC

*Channel Flow; Computational Fluid Dynamics; Large Eddy Simulation; Turbulent Flow; Turbulent Wakes; Turbulent Boundary Layer; Cylinders*

**20030058093** Wyoming Univ., Laramie, WY

**Three-Dimensional Particle Image Velocimetry System**

Smith, Douglas R.; Jan. 15, 2003; 4 pp.; In English

Contract(s)/Grant(s): F49620-01-1-0247

Report No.(s): AD-A411006; AFRL-SR-AR-TR-03-0035; No Copyright; Avail: CASI; [A01](#), Hardcopy

The PIV instrumentation was requested to support two AFOSR-funded research projects. The first project is entitled

'Hybrid Control of Turbulent Jets' (Grant No. F49620-00-1-0255). The hybrid approach combines both passive and active control techniques to enhance the mixing characteristics of a turbulent jet flow. The second project is entitled 'A Study of the Formation and Scaling of a Synthetic Jet' (Grant No. F49620-01-1-0301). This project is examining the internal and external flow-fields in a synthetic jet actuator and aims at developing scaling laws and design rules for these actuators.

DTIC

*Particle Image Velocimetry; Turbulent Flow*

**20030058802** Lawrence Livermore National Lab., Livermore, CA

**Characterization of Surfaces and the Estimation of Shock Induced Vorticity**

Jameson, L.; Ray, J.; Peysner, T.; September 17, 2002; 42 pp.; In English

Report No.(s): DE2003-15002789; UCRL-ID-150039; No Copyright; Avail: Department of Energy Information Bridge

When shocks impinge on a surface separating fluids of two different densities, one observes the development and growth of various vortical structures. The flow induced by this Richtmyer-Meshkov (RM) instability depends on a variety of factors such as the shock strength, the density ratio of the fluids and the exact form of the surface perturbation. The most common way to model the form of the surface perturbation is through Fourier analysis which is suitable for large-scale sinusoidal structures and it's straightforward mathematically.

NTIS

*Fourier Analysis; Shock Waves; Flow Stability; Vortices*

**20030058859** Georgia Inst. of Tech., Atlanta, GA, USA

**G-jitter Effects on Transport and Pattern Formation**

Schatz, Michael F.; [2003]; 3 pp.; In English

Contract(s)/Grant(s): NAG3-2006; No Copyright; Avail: CASI; [A01](#), Hardcopy

The research performed under this grant has led to an number of new insights into two general categories of fluid flows in the presence of time-dependent acceleration, as outlined briefly below. These results have been widely communicated in the scientific community through seven presentations at international conferences (4 invited, 3 contributed), five published papers (4 journal articles and 1 conference proceeding), and images from the research featured on the cover of all 2003 editions of the research journal, Nonlinearity. The work performed under this proposal also contained a substantial educational component by contributed significantly to the scientific training of one postdoctoral associate, one Ph.D. student and five undergraduate researchers. One main area of focus in this research was convective flow with time-dependent acceleration. Convection is one class of behavior that can arise from g-jitter effects. Our research focused on studies of Rayleigh-Benard system, which is an important model for understanding thermal convection; studies of this problem in the presence of acceleration modulations provided insight into the nature of g-jitter induced flow and of the effects of modulation and noise on non-equilibrium pattern formation. Our experiments on vertically vibrated Rayleigh-Benard convection demonstrated the existence of two classes of pure flow patterns (synchronous & subharmonic) patterns that had long been predicted by theory but never before observed experimentally. Detailed studies of ranges of parameters where both classes of patterns exist simultaneously led to the discovery of a new type of patterns (called superlattices) in systems driven out of thermodynamic equilibrium.

Author

*Fluid Flow; Time Dependence; Flow Distribution; Rayleigh-Benard Convection; Computational Fluid Dynamics*

**20030058864** NASA Langley Research Center, Hampton, VA, USA

**Computational Aeroheating Predictions for Mars Lander Configurations**

Edquist, Karl T.; Alter, Stephen J.; [2003]; 12 pp.; In English; 36th AIAA Thermophysics Conference, 23-26 Jun. 2003, Orlando, FL, USA

Report No.(s): AIAA Paper 2003-3639; Copyright; Avail: CASI; [A03](#), Hardcopy

The proposed Mars Science Laboratory (MSL) mission is intended to deliver a large rover to the Martian surface within 10 km of the target site. This paper presents computational fluid dynamics (CFD) predictions of forebody heating rates for two MSL entry configurations with fixed aerodynamic trim tabs. Results are compared to heating on a 70-deg sphere-cone reference geometry. All three heatshield geometries are designed to trim hypersonically at a 16 deg angle of attack in order to generate the lift-to-drag ratio (LID) required for precision landing. Comparisons between CFD and tunnel data are generally in good agreement for each configuration, but the computations predict more flow separation and higher heating on a trim tab inclined 10 deg relative to the surface. CFD solutions at flight conditions were obtained using an 8-species Mars gas in



chemical and thermal non-equilibrium. Laminar and Baldwin-Lomax solutions were used to estimate the effects of the trim tabs and turbulence on heating. A tab extending smoothly from the heatshield flank is not predicted to increase laminar or turbulent heating rates above the reference levels. Laminar heating on a tab deflected 10 deg from the conical heatshield is influenced by flow separation and is up to 35% above the baseline heating rate. The turbulent solution on the inclined tab configuration predicts attached flow and a 43% heating increase above the reference level.

Author

*Mars Landing; Aerodynamic Heating; Computational Fluid Dynamics; Forebodies; Tabs (Control Surfaces)*

**20030058866** Iowa State Univ. of Science and Technology, Ames, IA, USA

**Parabolized Navier-Stokes Code for Computing Magneto-Hydrodynamic Flowfields**

Mehta, Unmeel B., Technical Monitor; Tannehill, J. C.; [2003]; 24 pp.; In English

Contract(s)/Grant(s): NCC2-5379; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report consists of two published papers, 'Computation of Magneto-hydrodynamic Flows Using an Iterative PNS Algorithm' and 'Numerical Simulation of Turbulent MHD Flows Using an Iterative PNS Algorithm'.

CASI

*Magneto-hydrodynamic Flow; Navier-Stokes Equation; Computational Fluid Dynamics; Turbulent Flow; Computerized Simulation; Algorithms; Flow Distribution*

**20030058950** NASA Langley Research Center, Hampton, VA, USA

**Experimental and Computational Investigation of Multiple Injection Ports in a Convergent-Divergent Nozzle for Fluidic Thrust Vectoring**

Waithé, Kenrick A.; Deere, Karen A.; [2003]; 14 pp.; In English; 21st AIAA Applied Aerodynamics Conference, 23-26 Jun. 2003, Orlando, FL, USA

Report No.(s): AIAA Paper 2003-3802; No Copyright; Avail: CASI; [A03](#), Hardcopy

A computational and experimental study was conducted to investigate the effects of multiple injection ports in a two-dimensional, convergent-divergent nozzle, for fluidic thrust vectoring. The concept of multiple injection ports was conceived to enhance the thrust vectoring capability of a convergent-divergent nozzle over that of a single injection port without increasing the secondary mass flow rate requirements. The experimental study was conducted at static conditions in the Jet Exit Test Facility of the 16-Foot Transonic Tunnel Complex at NASA Langley Research Center. Internal nozzle performance was obtained at nozzle pressure ratios up to 10 with secondary nozzle pressure ratios up to 1 for five configurations. The computational study was conducted using the Reynolds Averaged Navier-Stokes computational fluid dynamics code PAB3D with two-equation turbulence closure and linear Reynolds stress modeling. Internal nozzle performance was predicted for nozzle pressure ratios up to 10 with a secondary nozzle pressure ratio of 0.7 for two configurations. Results from the experimental study indicate a benefit to multiple injection ports in a convergent-divergent nozzle. In general, increasing the number of injection ports from one to two increased the pitch thrust vectoring capability without any thrust performance penalties at nozzle pressure ratios less than 4 with high secondary pressure ratios. Results from the computational study are in excellent agreement with experimental results and validates PAB3D as a tool for predicting internal nozzle performance of a two dimensional, convergent-divergent nozzle with multiple injection ports.

Author

*Convergent-Divergent Nozzles; Thrust Vector Control; Injection; Performance Tests*

**20030058963** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese

**Les Investigation of Coherent Structures in Boundary Layers and Wakes. Volume I: Investigation of Coherent Structure in an Attached Shear Layer**

Giammanco, R.; Benocci, C.; Dec. 2002; 261 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-99-1-0834

Report No.(s): AD-A412548; 2003-08; No Copyright; Avail: CASI; [A12](#), Hardcopy

Purpose of the present investigation was to assess the feasibility of simulating and studying coherent structures in turbulent shear layers, making use of Large Eddy Simulations (LES). The current investigation has been performed across a rather wide range of simulated flows and LES implementations, starting from an established and validated structured LES code based on finite differences and cartesian grids ending to an unstructured LES code under development. The use of the unstructured approach was considered necessary whenever complex geometries have to be analyzed, which cannot be handled by the structured code, regardless its advanced features (like multi-domain approach). The unstructured LES code was

developed in the frame of current GRANT, and it has undergone validation. The structured LES code, which had already validated over a wide range of flow configurations, was used to analyze the wake behind an obstacle, attempt which was not made before. Extensive studies were needed in the attempt to validate the code for this case. Given the wide scope of present report and the mass of data available from different LES codes, flows and structures, the work has been split between two work groups, the one devoted to the structured LES and the one devoted to the unstructured LES. In this frame it was found more practical to sub-divide the full report in three volumes: Volume I-- Investigation of Coherent Structures in an Attached Shear Layer; Volume II --Wake around square Cylinder; Volume III -- Unstructured LES.

DTIC

*Cylindrical Bodies; Boundary Layers*

**20030058978** Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese

**Les Investigation of Coherent Structures in Boundary Layers and Wakes. Volume III: Development of a Parallel Unstructured Grid Les Code**

Degrez, G.; Snyder, D.; Dec. 2002; 192 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-99-1-0834

Report No.(s): AD-A412550; 2003-08; No Copyright; Avail: CASI; [A09](#), Hardcopy

The purpose of the present investigation is to assess the feasibility of simulating and studying coherent structures in turbulent shear layers, making use of Large Eddy Simulations (LES). Volumes I and II were devoted to the investigation of coherent structures in LES solutions obtained using a structured-grid finite-difference code, first in an attached turbulent flow, and then in the wake behind a square cylinder. The structured grid code used in Parts I & II, despite its multi-domain capability, is limited in the domain geometries it can handle. The third part of the work was therefore devoted to the development of an unstructured grid LES code able to compute turbulent flows over arbitrary two-dimensional geometries. A combined finite-element/Fourier spectral space discretization scheme was selected, as it combines optimally the geometrical flexibility provided by the finite element scheme and the computational efficiency resulting from the decomposition in Fourier modes in the out-of-plane direction. Indeed, thanks to this decomposition, and a suitable treatment of the nonlinear convective terms, the 3D flow problem is transformed into a series of 2D problems in Fourier space, completely decoupled within each time step. In addition, the decoupling allows for an easy parallelization by partitioning the work in Fourier space rather than physical space. Also, the stabilized finite element technique selected for the in-plane discretization provides an accuracy superior to its finite volume counterpart on the same unstructured grid and for the same discretization stencil.

DTIC

*Boundary Layers; Turbulent Flow*

**20030059007** NASA Langley Research Center, Hampton, VA, USA

**X-33 Rev-F Turbulent Aeroheating Results From Test 6817 in NASA Langley 20-Inch Mach 6 Air Tunnel and Comparisons With Computations**

Hollis, Brian R.; Horvath, Thomas J.; Berry, Scott A.; June 2003; 71 pp.; In English

Contract(s)/Grant(s): WU 721-28-00-05

Report No.(s): NASA/TM-2003-211962; L-18293; NAS 1.15:211962; No Copyright; Avail: CASI; [A04](#), Hardcopy

Measurements and predictions of the X-33 turbulent aeroheating environment have been performed at Mach 6, perfect-gas air conditions. The purpose of this investigation was to compare measured turbulent aeroheating levels on smooth models, models with discrete trips, and models with arrays of bowed panels (which simulate bowed thermal protections system tiles) with each other and with predictions from two Navier-Stokes codes, LAURA and GASP. The wind tunnel testing was conducted at free stream Reynolds numbers based on length of  $1.8 \times 10^6$  to  $6.1 \times 10^6$  on 0.0132 scale X-33 models at a  $\theta = 40$ -deg. Turbulent flow was produced by the discrete trips and by the bowed panels at all but the lowest Reynolds number, but turbulent flow on the smooth model was produced only at the highest Reynolds number. Turbulent aeroheating levels on each of the three model types were measured using global phosphor thermography and were found to agree to within the estimated uncertainty (plus or minus 15%) of the experiment. Computations were performed at the wind tunnel free stream conditions using both codes. Turbulent aeroheating levels predicted using the LAURA code were generally 5%-10% lower than those from GASP, although both sets of predictions fell within the experimental accuracy of the wind tunnel data.

Author

*X-33 Reusable Launch Vehicle; Aerodynamic Heating; Hypersonic Speed; Turbulent Flow; Scale Models; Wind Tunnel Tests; Computational Fluid Dynamics*

## 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*.

**20030057759** National Inst. of Standards and Technology, Gaithersburg, MD, USA

### **Meta-Analysis of Face Recognition Algorithms**

Phillips, P. J.; Newton, E. M.; Mar. 07, 2001; 24 pp.; In English

Report No.(s): PB2001-102891; NISTIR-6719; No Copyright; Avail: CASI; [A03](#), Hardcopy

To obtain a quantitative assessment of the state of automatic face recognition, the authors performed a meta-analysis of performance results of face recognition algorithms in the literature. The analysis was conducted on 24 papers that report identification performance on frontal facial images and used either the FERET or ORL database in their experiments. The 24 papers contained 68 performance scores that included 40 performance scores on novel algorithms, and matching baseline performance scores for 33 of the 40 scores. There are three main conclusions from the analysis. The first conclusion is that the majority of experiments do not adequately model challenging problems and their results have saturated performance levels. The second conclusion is that authors do not adequately document their experiments. Only twelve out of the 24 papers in this study provided complete documentation. The third conclusion is that performance results for novel or experimental algorithms need to be accompanied by baseline algorithm performance scores.

NTIS

*Pattern Recognition; Identifying; Face (Anatomy)*

**20030057864** Pacific Northwest National Lab., Richland, WA, USA, Oak Ridge National Lab., TN, CH2M/Hill, Inc., Richland, WA, USA

### **Qualification of the Lasentec M600P Particle Size Analyzer and the Red Valve Model 1151 Pressure Sensor**

Bontha, J. R.; Colton, N. G.; Daymo, E. A.; Hylton, T. D.; Bayne, C. K.; Jan. 2000; 62 pp.; In English

Report No.(s): DE2003-15002697; PNNL-13064; No Copyright; Avail: Department of Energy Information Bridge

The Lasentec M600 in-line particle size analyzer was installed at Oak Ridge National Laboratory (ORNL) in August 1998 to support retrieval of the Gunitite and Associated Tanks (GAAT). Before installation at OWL, the sensor underwent validation testing at the Pacific Northwest National Laboratory (PNNL) Instrument Validation facility. Mechanically, the instrument worked well during validation testing and met all expectations. Operationally, much was learned about optimum ways to display and interpret the data. Slurry samples taken during the in-line tests at PNNL were shipped to the vendor for analysis with a benchtop Lasentec sensor. These experiments were performed to determine if off-line analyses yield particle size distributions similar to those generated by the in-line sensor. It was determined that the Lasentec sensor measures repeatable chord lengths as long as particles are 'present' to the sensor window the same way. After the initial non-radioactive simulation testing at PNNL, the instrument was shipped for radioactive validation and acceptance testing in the Slurry Monitoring Test System (SMTS) connected to the Tank W-9 of the G&4Ts at ORNL. For all acceptance tests conducted at ORNL, the variation in the chord length distribution and the total particle count corresponded very well with the slurry density data as determined using an in-line Promass 63M Coriolis meter. Based on the performance results obtained, the Lasentec M600P FBRM is expected to meet the requirements for measuring the particle size distribution during the slurry transfer operations at Hanford and the Oak Ridge GAAT remediation project.

NTIS

*Pressure Sensors; Particle Size Distribution; Analyzers; Performance Tests*

**20030058100** Air Force Research Lab., Eglin AFB, FL

### **Polarization Signature Research**

Goldstein, Dennis H.; Feb. 2003; 87 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-2068

Report No.(s): AD-A411012; AFRL-MN-EG-TR-2003-7013; No Copyright; Avail: CASI; [A05](#), Hardcopy

Documentation of work in Mueller matrix spectropolarimetry, Mueller matrix laser polarimetry, and near infrared imaging polarimetry is presented. Spectropolarimetric reflectometer instrumentation is described, and measurements made with this instrumentation on Spectralon and Federal Standard paint samples are given. Laser polarimeter measurements on sapphire and

quartz plates with small birefringence are discussed. Results from an imaging near infrared rotating retarder Stokes polarimeter are presented.

DTIC

*Polarimeters; Polarimetry; Reflectometers; Infrared Signatures*

**20030058738** Carnegie-Mellon Univ., Pittsburgh, PA

**Precision Measurement for Microsurgical Instrument Evaluation**

Hotraphinyo, Lee F.; Riviere, Cameron N.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411169; No Copyright; Avail: CASI; [A01](#), Hardcopy

An accurate three-dimensional optical sensing system to track the tip of a microsurgical instrument has been developed for laboratory use. The system is useful for evaluation of microsurgical instrument designs and devices for accuracy enhancement (both robotic devices and active hand-held instrument), as well as for assessment and training of micro-surgeons. It can also be used as a high-precision input interface to micro-surgical simulators. Tracking is done by illuminating the workspace at an infrared wavelength and using optical sensors to find the position of a small reflective ball at the instrument tip.

DTIC

*Measurement; Precision; Surgical Instruments; Optical Measuring Instruments*

**20030058770** Observatoire de la Cote d'Azur, Caussols, France

**The OCA CCD Camera Controller**

Maury, Alain; Jan. 1996; 149 pp.; In English

Contract(s)/Grant(s): F61708-93-W-0076

Report No.(s): AD-A410929; SPC-93-4007; No Copyright; Avail: CASI; [A07](#), Hardcopy

This document describes a new CCD camera controller adapted to Schmidt telescopes. If several large CCD detectors can be adapted in the focal plane of a large Schmidt telescope, deeper digital images can be obtained, the operating cost of a CCD camera is several orders of magnitudes smaller than that of glass photographic plates. This also opens new ways of using Schmidt telescopes; i.e., real time detection of celestial sources. This report contains the following sections: Requirements analysis Description of the Loral CCD442A CCD Description of the camera controller Physical implementation of a mono CCD camera Physical implementation of a multi CCD camera Appendix 1: Controller schematics Appendix 2: Data sheets of the major components Appendix 3: Information about the microcontroller and its software.

DTIC

*Ccd Cameras; Controllers; Schmidt Telescopes; Photography*

**20030058785** University Coll. of Wales, Aberystwyth, UK

**Computer Assisted Assessment of Wound Appearance Using Digital Imaging**

Hoppe, A.; Wertheim, D.; Melhuish, J.; Morris, H.; Harding, K. G.; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411562; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper describes a digital image processing system for the analysis of colour in wound images under clinical conditions. The system uses a 3CCD array digital video camera together with a colour scale for reference. The accuracy of colour assessment was compared with clinicians assessment of the amount of slough (necrotic tissue) in digital images. The system was found to be within the range of 10% in describing red hue values in red colour patches between different clinical sessions. There was agreement in 75% of the cases between clinicians assessment of the amount of slough and a computer assessment using digital imaging. However, colour may not be sufficient to describe wound appearance accurately.

DTIC

*Diagnosis; Computer Techniques; Systems Analysis; Imaging Techniques; Wound Healing; Computer Aided Design; Injuries*

**20030058834** Naval Research Lab., Washington, DC

**Field and Laboratory Boresighting Methods for Hyperspectral Imaging Sensor Systems**

Olchowski, Frederick M.; Stelman, Christopher M.; Bucholtz, Frank; Mar. 6, 2003; 25 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412185; NRL/MR/5620--03-8671; No Copyright; Avail: CASI; [A03](#), Hardcopy

Multi-sensor platforms for airborne reconnaissance and surveillance often require the alignment of two or more imaging

systems along a common optical axis. This is true especially when data fusion is performed where the signal processing involves the analysis of data taken from different sensors at the same time and of the same location. For example, the NRL War Horse platform combines imagery from a VIS/NIR slit-dispersive hyperspectral sensor with imagery from a slit-aperture linear CCD array camera with pointing and geolocation information from a digital GPS/INS instrument (C-MIGITS). This sensor suite has flown successfully aboard the Unmanned Air Vehicle (UAV) predator. Several crude boresighting procedures have been adopted for use in the field which take advantage of long baselines between the camera systems and objects at a distance. However, accurate alignment procedures are difficult to perform in the field owing to variable and unpredictable hangar, aircraft, and weather conditions. Typically, the various imaging and geolocation instruments are mounted on mechanical frame prior to installation on the aircraft. Hence, it is desirable to have an accurate method for boresighting a suite of sensors to a common optical axis in the laboratory using a relatively short baseline.

DTIC

*Radar Detection; Imaging Techniques; Boresights*

**20030058884** NASA Ames Research Center, Moffett Field, CA, USA

**The AstroBiology Explorer (ABE) MIDEX Mission: Using Infrared Spectroscopy to Identify Organic Molecules in Space**

Sandford, S. A.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 153-155; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The AstroBiology Explorer (ABE) mission is one of four selected for Phase A Concept Study in NASA's current call for MIDEX class missions. ABE is a cooled space telescope equipped with spectrographs covering the 2.5-20 micron spectral range. The ABE mission is devoted to the detection and identification of organic and related molecular species in space. ABE is currently under study at NASA's Ames Research Center in collaboration with Ball Aerospace.

Author

*Infrared Spectroscopy; Organic Materials; Spaceborne Telescopes*

**20030058908** Imperial Coll. of Science and Technology, London, UK

**Laboratory Astrophysics and High Resolution Atomic Spectroscopy with the Imperial College Fourier Transform Spectrometer**

Pickering, Juliet C.; Thorne, Anne P.; Blackwell-Whitehead, Richard; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 77-79; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

We report work, both recently completed and still in progress, on significant improvements to wavelengths, energy levels and oscillator strengths of neutral and singly ionized atoms of astrophysical importance, mainly in the iron group, carried out by means of high resolution Fourier transform spectroscopy from the near infrared to the vacuum ultraviolet regions. In some cases hyperfine structure has also been analyzed. We also report highly accurate measurements of absolute wavelengths of certain transitions relevant to studies of possible variations of the fine structure constant.

Author

*Fourier Transformation; Atomic Spectra; Spectrometers; High Resolution; Infrared Spectroscopy; Ultraviolet Spectroscopy*

**20030058947** PAMAM-Human Factors Engineering (1989) Ltd., Hod Hasharon, Israel

**Multisensor Image Interpretation**

Brickner, Michael; Oettinger, Ayelet; Kuperman, Gilbert; Apr. 2002; 52 pp.; In English  
Contract(s)/Grant(s): F33615-98-D-6000; Proj-7184

Report No.(s): AD-A411135; AFRL-HE-WP-TR-2002-0254; No Copyright; Avail: CASI; [A04](#), Hardcopy

A target acquisition experiment was conducted using simulated synthetic aperture radar (SAR) and forward looking infrared (FLIR) imagery. Ground order of battle provided the target set. Confuser vehicles and decoys were also included in the stimuli. The current study explored the operational utility of using synchronized, multi-sensor images for the acquisition of pre-brief ground order of battle targets and specifically for distinguishing real targets from decoys. The rates of target Hits and False Alarms with a synthetic aperture radar (SAR) sensor alone were compared to the corresponding rates when both SAR and forward looking infrared (FLIR) sensors were employed sequentially.

DTIC

*Multisensor Applications; Target Acquisition; Synthetic Aperture Radar; Image Processing*

**20030058974** Intelligent Inference Systems, Sunnyvale, CA, USA

**Perception-based Co-evolutionary Reinforcement Learning for UAV Sensor Allocation**

Berenji, Hamid R.; Feb. 2003; 15 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-02-M-0265

Report No.(s): AD-A411839; IIS-03-01; No Copyright; Avail: CASI; [A03](#), Hardcopy

In this project, we have formulated the problem of sensor allocation in a team of UAVs within a mathematical programming framework. A Perception-based reasoning approach based on co-evolutionary reinforcement learning was developed for jointly addressing sensor allocation on each individual UAV and allocation of a team of UAVs in the geographical search space. An elaborate problem setup was simulated and experimented with, for testing and analysis of this framework using the Player-Stage multi-agent simulator. This simulator was developed jointly at the USC Robotics Research Lab and HRL Labs. The experimental results demonstrated a very strong performance of our methodology for UAV sensor allocation problem domains. Our results indicate that not only it is feasible to use perception-based reinforcement learning for this problem but it is an adequate solution for many typical UAV teams.

DTIC

*Pilotless Aircraft; Sensors; Mathematical Programming; Perception*

**20030059021** Smithsonian Astrophysical Observatory, Cambridge, MA, USA

**Test of the Equivalence Principle in an Einstein Elevator**

Shapiro, Irwin I.; Lorenzini, E. C.; Glashow, S.; Cosmo, M. L.; Cheimets, P.; Finkelstein, N.; Schneps, M.; Iafolla, V.; Nozzoli, S.; June 2003; 127 pp.; In English

Contract(s)/Grant(s): NAG8-1780; No Copyright; Avail: CASI; [A07](#), Hardcopy

The laboratory activity consisted in the construction of a laboratory prototype of a differential accelerometer. The laboratory prototype has been used to conduct key tests on the differential instrument. We demonstrated the ability to damp quickly transient oscillations by utilizing a resistive load in the feedback loops and then removing that load to reestablish a high quality factor of the detector. A rotating divide with tilt control was also built. This device was utilized to impart (through the Earth's gravity) common-mode perturbations to the differential accelerometer. These calibration disturbances have been used to trim the acceleration outputs of the individual proof masses in order to obtain a common-mode rejection factor better than  $10(\exp -4)$  in a sufficiently large frequency band centered at the spin frequency.

Derived from text

*Equivalence; Einstein Equations; Numerical Analysis; Dynamic Models; Prototypes; Accelerometers*

## 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*.

**20030057963** Naval Postgraduate School, Monterey, CA

**Megawatt Class Free Electron Lasers for Naval Application - Short Rayleigh Length and Stability Analysis**

Ossenfort, William J., Jr; Dec. 2002; 125 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411145; No Copyright; Avail: CASI; [A06](#), Hardcopy

The free electron laser (FEL) is theoretically capable of scaling up to a MW class laser for naval point defense. At such high power levels, the FEL's optics could be damaged. An FEL operating with a short Rayleigh length reduces intensity at the mirrors; however, the performance of short Rayleigh length FELs is unknown. This thesis presents simulations of Thomas Jefferson Laboratories' proposed 100 kW FEL operating with a short Rayleigh length, and of a proposed 1 MW FEL undergoing shipboard induced mirror vibrations. In the 100 kW FEL, Rayleigh lengths of 0.1L to 0.5L (where L is the undulator length) were simulated. Weak field gain increases as Rayleigh length decreases, indicating that short Rayleigh length FELs will start from spontaneous emissions. Final FEL efficiency also increases as Rayleigh length decreases, with the exception of a spike at the typical Rayleigh length design value of 0.3L. For the 1 MW FEL system, the high operating current acts to stabilize the optical mode against vibrations that result in mirror tilts of 0 to 400 microradians, where final output power

was reduced 80%. When used in conjunction with an active mirror alignment system, output power of the 1 MW FEL is unaffected.

DTIC

*Free Electron Lasers; Mirrors*

**20030058052** Naval Postgraduate School, Monterey, CA

**Free Electron and Solid State Lasers Development for Naval Directed Energy**

Kalfoutzos, Aristeidis; Dec. 2002; 128 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411326; No Copyright; Avail: CASI; [A07](#), Hardcopy

A MW level FEL is being designed with a short a Rayleigh length resonator to increase the spot size at the mirrors and to avoid mirror damage. In this thesis, it is found that it is desirable to focus the electron beam to improve the FEL extraction efficiency. Three-dimensional simulations show that the focused electron beam increases the extraction efficiency far beyond the desired value of 0.7%. It is also found in this thesis that shifting the electron beam off-axis less than 0.3 mm, the efficiency remains above the required value. The proposed FEL design uses high power, short optical pulses whose spectrum may cover many absorption lines. The absorbed laser energy can heat up the air resulting in defocusing the laser beam (thermal blooming). This thesis shows that thermal blooming is not an issue for a moderate clear atmosphere when the stagnation zone size remains less than 10 m. A transitional step for the development of a MW level FEL weapon is the proposed 100 kW upgrade of the Thomas Jefferson National Accelerator Facility's FEL. It has also been shown in this thesis that the use of a step-taper undulator slightly improves the performance of the FEL. Finally, the potential of various high average power solid-state laser designs are reviewed.

DTIC

*Solid State Lasers; Free Electrons*

**20030058078** Naval Postgraduate School, Monterey, CA

**High Energy Lasers for Ship-Defense and Maritime Propagation**

Bouras, Vasileios; Dec. 2002; 109 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411177; No Copyright; Avail: CASI; [A06](#), Hardcopy

High Energy Lasers (HELs) are a new class of weapons that may be of great value to the Navy in the near future. A high-power Free Electron Laser (FEL) is being designed using short Rayleigh-length resonators to increase the spot size at the mirrors and hence avoid mirror damage. Three-dimensional simulations are used to study the effects of an electron beam misalignment (electron beam tilt). This thesis shows that the proposed design is tolerant of typical electron beam misalignments. The performance of a step-tapered undulator is also studied for the 100 kW proposed upgrade of the Jefferson Laboratory FEL. The results of this research show that the gain is above the required threshold for the 100 kW design while the energy spread does not change significantly over any undulator design. The spectrum of the proposed FEL shows that most of the power is concentrated around the fundamental frequency. It is shown in this thesis that smooth FEL pulses can significantly reduce the negative effects of absorption and scattering. Recent HEL science and technology developments are discussed for both Free Electron and Solid State Lasers.

DTIC

*High Power Lasers; Ships*

**20030058739** Naval Postgraduate School, Monterey, CA

**Simulations of a Short Rayleigh Length 100 kW FEL and Mirror Stability Analysis**

Campbell, Thomas E.; Dec. 2002; 101 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411216; No Copyright; Avail: CASI; [A06](#), Hardcopy

A MW class free electron laser capable of delivering energy at the speed of light can improve ASCM defensive capability for Navy ships. Many design challenges must be overcome to make such a weapon possible. One such challenge is to maintain the power density on laser cavity mirrors at acceptable levels. The use of a short Rayleigh length to increase beam spot size at the mirror is studied as a possible solution to this problem. In this thesis, it is shown that by using a short Rayleigh length FEL, power densities at the mirrors are significantly reduced without causing a noticeable reduction in performance. For a short Rayleigh length FEL, the resonator cavity is sensitive to misalignment and vibration. The effect of mirror tilt due to vibrations is explored and the results show that as mirror tilt increases, FEL efficiency does decrease. However, a mirror tilt several orders of magnitude greater than currently achievable active alignment tolerances is required before the FEL efficiency

is noticeably affected. In this thesis, it is shown that mirror tilt within achievable tolerance limits will not adversely affect the performance of a FEL.

DTIC

*Free Electron Lasers; Rayleigh Waves*

**20030058969** Air Force Research Lab., Edwards AFB, CA, USA

**Measurement and Control of the Properties of Gases Produced by Ablation of Delrin (Polyformaldehyde) with a CO<sub>2</sub> Laser**

Mead, Franklin; Larsen, Bill; Feb. 19, 2003; 5 pp.; In English

Report No.(s): AD-A412560; AFRL-PR-ED-TP-2003-040; No Copyright; Avail: CASI; [A01](#), Hardcopy

The primary objective of this research is to enable control of the properties of gases that are produced by ablation of solid Delrin with a pulsed CO<sub>2</sub> laser. Target gas properties are: (1) a specific energy content greater than 100 MJ/Kg, (2) a specific impulse range from 200 to 800 seconds, and (3) an overall conversion efficiency of laser energy to jet kinetic energy of at least 50%.

DTIC

*Ablation; Thermodynamics; Energy Conversion; Delrin (Trademark)*

### 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*.

**20030059016** NASA Langley Research Center, Hampton, VA, USA

**Advanced Durability and Damage Tolerance Design and Analysis Methods for Composite Structures: Lessons Learned from NASA Technology Development Programs**

Harris, Charles E.; Starnes, James H., Jr.; Shuart, Mark J.; June 2003; 36 pp.; In English

Contract(s)/Grant(s): 706-85-12-01

Report No.(s): NASA/TM-2003-212420; L-18297; NAS 1.15:212420; No Copyright; Avail: CASI; [A03](#), Hardcopy

Aerospace vehicles are designed to be durable and damage tolerant. Durability is largely an economic life-cycle design consideration whereas damage tolerance directly addresses the structural airworthiness (safety) of the vehicle. However, both durability and damage tolerance design methodologies must address the deleterious effects of changes in material properties and the initiation and growth of microstructural damage that may occur during the service lifetime of the vehicle. Durability and damage tolerance design and certification requirements are addressed for commercial transport aircraft and NASA manned spacecraft systems. The state-of-the-art in advanced design and analysis methods is illustrated by discussing the results of several recently completed NASA technology development programs. These programs include the NASA Advanced Subsonic Technology Program demonstrating technologies for large transport aircraft and the X-33 hypersonic test vehicle demonstrating technologies for a single-stage-to-orbit space launch vehicle.

Author

*Aircraft Reliability; Damage; Design Analysis; Microstructure; Life (Durability)*

**20030059019** ABB Power Generation, Inc., Midlothian, VA, USA

**Advanced Turbine System Conceptual Design and Product Development**

Mayer, A. H.; Aug. 26, 1998; 10 pp.; In English

Report No.(s): DE2003-778089; No Copyright; Avail: Department of Energy Information Bridge

The Project Plan for the subject program was submitted (mailed) to the Department of Energy (DOE) on May 18, 1995. This task is complete. The information required for the NEPA Report was submitted (mailed) to the DOE on June 22, 1995. This task is complete. The technical work on this task has been completed and presented to the DOE. Final report is in preparation for this task and was also be presented to the DOE. Surveys of potential Task 4 CFATS cycles were completed by ABB Power Plant Laboratories (PPL). A brief overview of the results of this work to date were also presented at the September 27, 1995, briefing with the DOE. No further efforts will be expended on this task as indicated in the 5th quarterly report. The following tasks are included in the revised contract: turbine aerodynamics & aero-thermal integration, advanced



steam cooled vanes, advanced air cooled blading, and thermal barrier coating and steam oxidation.  
NTIS  
*Gas Turbine Engines; Product Development; Engine Design*

### 38

#### QUALITY ASSURANCE AND RELIABILITY

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

**20030057794** Lawrence Livermore National Lab., Livermore, CA

##### **Meso-Scale Metrology Tools: A Survey of Relevant Tools and a Discussion of Their Strengths and Weaknesses**

Hibbard, R. L.; Bono, M. J.; Dec. 01, 2002; In English

Report No.(s): DE2003-15003278; UCRL-JC-151048; No Copyright; Avail: National Technical Information Service (NTIS)

Lawrence Livermore National Laboratory, LLNL, manufactures laser experiment targets made of cylindrical and spherical components and assemblies that are generally 2 mm in size or smaller, which are machined with micron level accuracy. The targets exhibit many features that are common to typical inertial confinement fusion, ICF, and high energy density laser targets. Targets are currently being manufactured for laser experiments conducted on the Omega Laser at the University of Rochester, and they are beginning to be fabricated for the National Ignition Facility NIF. The targets need to be fully characterized with an uncertainty of + or -1 micrometer, but in approximately five years, the required accuracy is expected to become +/- 0.25 micrometers. It is difficult to find metrology tools than can adequately measure these laser targets. The current paper is intended to serve as a basis for formulating a plan for developing needed meso-scale metrology tools for target fabrication and other meso-scale applications. There is an apparent shortcoming in meso-scale metrology tools and a national need for developing them, and discussions should be initiated with interested parties and experts in the field to pursue this area of metrology.

NTIS

*Fabrication; Laser Targets; Inertial Confinement Fusion*

### 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*.

**20030057752** NASA Langley Research Center, Hampton, VA, USA, Army Research Lab., Hampton, VA, USA

##### **Modeling the Interactions Between Multiple Crack Closure Mechanisms at Threshold**

Newman, John A.; Riddell, William T.; Piascik, Robert S.; May 2003; 22 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): 706-62-31-51

Report No.(s): NASA/TM-2003-212402; L-18279; NAS 1.15:212402; ARL-TR-2959; No Copyright; Avail: CASI; [A03](#), Hardcopy

A fatigue crack closure model is developed that includes interactions between the three closure mechanisms most likely to occur at threshold; plasticity, roughness, and oxide. This model, herein referred to as the CROP model (for Closure, Roughness, Oxide, and Plasticity), also includes the effects of out-of-plane cracking and multi-axial loading. These features make the CROP closure model uniquely suited for, but not limited to, threshold applications. Rough cracks are idealized here as two-dimensional sawtooths, whose geometry induces mixed-mode crack-tip stresses. Continuum mechanics and crack-tip dislocation concepts are combined to relate crack face displacements to crack-tip loads. Geometric criteria are used to determine closure loads from crack-face displacements. Finite element results, used to verify model predictions, provide critical information about the locations where crack closure occurs.

Author

*Fatigue (Materials); Crack Closure; Crack Tips; Surface Roughness; Plastic Properties*

**20030057797** Lawrence Livermore National Lab., Livermore, CA

**Dynamic Experiments: An Overview**

Nellis, W. J.; Jul. 06, 2001; 30 pp.; In English

Report No.(s): DE2003-15003022; UCRL-JC-144593; No Copyright; Avail: Department of Energy Information Bridge

This article is concerned with high pressures achieved dynamically by shock compression. In fact, the terms dynamic and shock are used interchangeably to describe pressure pulses above 1 GPa (10 kbar) or so. Because dynamic compression is so fast, the process is adiabatic and temperature increases. Shock compression is achieved by high velocity impact obtained with light-gas guns (two-stage, single-stage, and powder guns), pulsed lasers, high pulsed electrical currents, and explosives. In this article we are concerned with strong shock compressions; that is, those which occur in a time of the order of a ps and for which the pressure exceeds 1 GPa. Typical durations of the pressure pulse are a few 100 ns, a few ns, a few 10 ns, and a few 1000 ns for guns, lasers, pulsed currents, and explosives, respectively.

NTIS

*Shock Waves; Pulses; Compression Waves*

**20030057835** National Inst. of Standards and Technology, Gaithersburg, MD, USA

**Energy Dissipation Devices for Bridges with Steel Superstructures**

Riley, M. A.; Apr. 2003; 56 pp.; In English

Report No.(s): PB2003-104604; NISTIR-6937; No Copyright; Avail: CASI; [A04](#), Hardcopy

Recent earthquakes have clearly demonstrated the seismic vulnerability of bridges constructed with steel superstructures. The relative flexibility of these bridges, especially in the transverse direction, may result in overstressing or even failure of components, including trusses, end diaphragms, beams, bearings, piers, and columns. For the case of slab-on-girder steel bridges, flexible end diaphragms may experience large deformations, leading to buckling or brittle fracture during seismic excitations. However, if the end diaphragms are too stiff, the forces transmitted through the diaphragms to the bearings and substructure may lead to damage or failure in the supporting system. Structural dampers and other energy dissipation techniques are viable options to enhance the ductility and energy dissipation capacity of the diaphragms, thereby increasing the safety and reliability of the bridges. Prior research has clearly shown that ductile end diaphragms can greatly improve the response of steel slab-on-girder bridges; however, only a limited number of the many available energy dissipation devices have been investigated.

NTIS

*Earthquakes; Bridges (Structures); Steel Structures; Structural Engineering; Energy Dissipation*

**20030057931** Technische Univ., Delft

**Probabilistic Analysis of the Buckling of Thin-Walled Shells using an Imperfection Database and a Two-Mode Analysis**

Doup, M. R.; Aug. 1997; 198 pp.; In English

Report No.(s): PB2003-104799; M-808; No Copyright; Avail: CASI; [A09](#), Hardcopy

This memorandum is about the probabilistic analysis and design of thin-walled cylinders. Use has been made of an imperfection database and of a two-mode imperfection analysis. The database has been filled with all the available tests on thin-walled isotropic cylinders loaded under axial compression. All numerical values of the test data are given in standard international units. The selection interface, for output and analysis of the buckling data, has been improved in order to include selection of variables such as the ratio of the shell radius divided by the shell thickness, or the ratio of the experimental buckling load divided by the classical buckling load. It has also been made possible to impose constraints on the experimental buckling load divided by the classical buckling load and the ratio of the experimental buckling stress divided by the yield stress. Several small programs were created in order to calculate and plot histograms and reliability functions of selected data. Also statistical properties of selected data, such as the expectation and variance, can be calculated and printed. These programs are connected to the selection interface.

NTIS

*Buckling; Cylinders; Probability Theory; Statistical Analysis*

**20030057938** Army Engineer Research and Development Center, Vicksburg, MS, USA

**Investigative Study for Underwater Construction of Lock Floors and Culverts**

Fehl, Barry D.; Gaddie, Thurman D.; Abraham, Kevin; Jan. 2003; 97 pp.; In English

Report No.(s): AD-A410810; ERDC/ITL-TR-03-1; No Copyright; Avail: CASI; [A05](#), Hardcopy

This report presents the results of a detailed investigation into the construction and design of lock floor slabs and culverts

in an underwater condition (versus in the dry). An extensive review process and discussions with Corps of Engineers Division and District representatives led to the selection of seven plans for inclusion in the intensive investigation. The plans selected were those that offered reasonable expectations for advantageous construction and represented the potential for application to a wide variety of construction technologies for in-the-wet construction. These plans were used to help define the design parameters that might need adjustment due to construction being performed underwater. The innovative plans were evaluated against a set of criteria to identify the advantages and limitations of each plan and to determine its applicability to underwater construction. These criteria included issues related to maintenance, longevity, projected ease or difficulty of implementation (i.e. constructibility), risks to the operation of the lock, cost, environmental concerns, hydraulic efficiency, and construction time. The conclusions presented will permit designers to evaluate various options for constructing floor slabs and culverts with a better understanding of the benefits and the restrictions associated with a given approach. Further investigation is recommended for several design parameters: flotation factors of safety, capacity of piles driven in water, design parameters for high-performance concrete, sheet-pile cutoff walls, and seepage control.

DTIC

*Construction; Cost Effectiveness; Design Analysis; Floors; Underwater Structures*

**20030058732** Aerospace Corp., El Segundo, CA

**Thermomechanical Properties of Selected Space-Related Materials**

Childs, W. H.; Sep. 30, 2002; 165 pp.; In English

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

Report No.(s): AD-A411587; ATR-2002(8565)-7; SMC-TR-03-09; No Copyright; Avail: CASI; A08, Hardcopy

Room-temperature values for nine thermomechanical material properties of 130 space-related materials have been tabulated in this report. These data are essential for analyses to determine material response to pulsed radiation that relate to survivability assessments of space systems based on above- and below-ground nuclear weapons effects experiments. The nine properties tabulated for each of the 130 materials include density, specific heat (constant pressure), specific heat (constant volume), Poisson's ratio, Gruneisen constant, adiabatic sound velocity, Young's modulus, isothermal bulk modulus, and volumetric coefficient of thermal expansion. Various appropriate elements, oxides, carbides, halides, metallic alloys, semiconductors, optical materials, glasses, plastic and graphites are included in the tabulation. The majority of the materials are high density, low porosity, isotropic and polycrystalline in form.

DTIC

*Mechanical Properties; Radiation Effects; Thermodynamics; Aerospace Systems; Pulsed Radiation*

**42**

**GEOSCIENCES (GENERAL)**

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

**20030057740** Lawrence Livermore National Lab., Livermore, CA

**Monitoring Carbon Dioxide Sequestration Using Electrical Resistance Tomography (ERT): A Minimally Invasive Method**

Newmark, R. L.; Ramirez, A. L.; Daily, W. D.; Aug. 05, 2002; 12 pp.; In English

Report No.(s): DE2002-15002007; No Copyright; Avail: Department of Energy Information Bridge

Successful geologic sequestration of carbon dioxide (CO<sub>2</sub>), will require monitoring the CO<sub>2</sub> injection to confirm the performance of the caprock/reservoir system, assess leaks and flow paths, and understand the geophysical and geochemical interactions between the CO<sub>2</sub> and the geologic minerals and fluids. Electrical methods are especially well suited for monitoring processes involving fluids, as electrical properties are sensitive to the presence and nature of the formation fluids. High resolution tomographs of electrical properties are now used for site characterization and to monitor subsurface migration of fluids (i.e., leaking underground tanks, infiltration events, steam floods, contaminant movement, and to assess the integrity of engineered barriers). When electrical resistance tomography (ERT) imaging can be performed using existing well casings as long electrodes, the method is nearly transparent to reservoir operators, and reduces the need for additional drilling. Using numerical simulations and laboratory experiments, we have conducted sensitivity studies to determine the potential of ERT methods to detect and monitor the migration of CO<sub>2</sub> in the subsurface. These studies have in turn been applied to the design

and implementation of the first field casing surveys conducted in an oil field undergoing a CO<sub>2</sub> flood.  
NTIS

*Carbon Dioxide; Electrical Resistance; Geophysics; Tomography; Imaging Techniques; Geochemistry*

**20030057760** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**TH PULSE: Program for Calculating Infiltration of Episodic Liquid Fingers in Superheated Rock Fractures. Theory, Use's Manual, and Sample Applications**

Birkholzer, J. T.; Jun. 2002; In English

Report No.(s): DE2003-804011; LBNL/PUB-3277; No Copyright; Avail: National Technical Information Service (NTIS)

This report describes the code TH (underline symbol) PULSE developed at the Ernest Orlando Lawrence Berkeley National Laboratory (Berkeley Lab). The code handles gravity-driven flow of episodic infiltration events entering above-boiling rock-temperature regions. Such temperature conditions are expected, for example, after emplacement of heat-generating nuclear waste in underground repositories. Complex fluid-flow and heat-transfer phenomena occur, as the infiltrating water is subject to vigorous boiling from the hot rock. A new efficient semi-analytical method is presented herein that simulates such phenomena. It is assumed that flow forms in localized preferential flow paths (referred to as 'fingers'). The first section of this report gives the conceptual and mathematical background for the solution scheme. The second section is a user's manual for TH (underline symbol) PULSE, providing all information required to run the code, including a detailed description of the input and output files. In the third section, the new solution scheme is applied to several test cases. Sample simulations are performed for conditions representative of the potential nuclear waste repository at Yucca Mountain, Nevada. A brief summary is given in Section 4.

NTIS

*Boiling; Fluid Flow; Fractures (Materials); Heat Transfer; Rocks*

**20030057781** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Measurement System for Systematic Hydrological Characterization of Unsaturated Fractured Welded Tuff in a Mined Underground Tunnel**

Cook, P. J.; Salve, R.; Freifeld, B. M.; Tsang, Y. W.; 2002; 32 pp.; In English

Report No.(s): DE2003-805440; No Copyright; Avail: Department of Energy Information Bridge

The possibility that certain locations in unsaturated, fractured geological environments may serve as possible disposal sites for high-level radioactive waste has in recent years spurred much research towards understanding of flow and transport phenomena in these settings. Water flow in unsaturated fractured rock is complex because it is affected by both the matrix and fracture properties, and the coupling between them, which in turn, is dependent on the degree of saturation. The intrinsic complexity of the flow processes, and the difficulty in interpreting and correlating measurements to flow and transport parameters, call for experiments executed under well-controlled conditions that are more easily attainable in the laboratory. On the other hand, because of the significant role of spatial scaling in flow phenomena, in-situ measurements are also indispensable. In this paper, we describe an experimental system for field investigations of flow and transport in partially saturated, fractured welded volcanic tuff. The in-situ measurements were designed to specifically address the issue of spatial variability.

NTIS

*Flow Measurement; Fracturing; Rocks; Petrology; Igneous Rocks*

**20030057901** Environmental Protection Agency, Washington, DC, USA

**QTRACER2 Program for Tracer-Breakthrough Curve Analysis for Tracer Tests in Karstic Aquifers and Other Hydrologic Systems**

May 2002; In English

Report No.(s): PB2003-500056; EPA/600/R-02/001-CD; No Copyright; Avail: National Technical Information Service (NTIS)

The purpose of the QTRACER2 is to serve as a technical guide to various groups who must address potential and/or existing contamination problems in hydrological systems. Tracing are always appropriate and probably necessary, but analyses can be difficult and tedious. This document and associated computer programs alleviate some of these problems. The Qtracer2 take basic input data obtained at the start and finish of a hydrologic tracer test and performs the basic calculations for extracting critical hydraulic and geometric information about the flow system under investigation. Tracer testing is generally regarded

as the most reliable and efficient method of gathering surface and subsurface hydraulic information.

NTIS

*Models; Computer Programs; Aquifers; Karst; Hydrology; Tracers*

## 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*.

**20030058055** Colorado Univ., Boulder, CO, USA

#### **Radiation Climatology of the Greenland Ice Sheet Derived from Greenland Climate Network Data**

Steffen, Konrad; Box, Jason; March 2003; 19 pp.; In English

Contract(s)/Grant(s): NAG5-11612; No Copyright; Avail: CASI; [A03](#), Hardcopy

The magnitude of shortwave and longwave radiative fluxes are critical to surface energy balance variations over the Greenland ice sheet, affecting many aspects of its climate, including melt rates, the nature of low-level temperature inversions, the katabatic wind regime and buoyant stability of the atmosphere. Nevertheless, reliable measurements of the radiative fluxes over the ice sheet are few in number, and have been of limited duration and areal distribution (e.g. Ambach, 1960; 1963, Konzelmann et al., 1994, Harding et al., 1995, Van den Broeke, 1996). Hourly GC-Net radiation flux measurements spanning 1995-2001 period have been used to produce a monthly dataset of surface radiation balance components. The measurements are distributed widely across Greenland and incorporate multiple sensors

Author

*Atmospheric Radiation; Greenland; Ice; Radiation Distribution; Short Wave Radiation; Long Wave Radiation; Flux Density; Annual Variations*

**20030058074** California Univ., Santa Barbara, CA, USA

#### **'Land-Cover Conversion in Amazonia, The Role of ENV' Ironment and Substrate composition in Modifying SOI**

Roberts, Dar A.; Chadwick, Oliver A.; Batista, Getulio T.; [2003]; 21 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): NCC5-282; No Copyright; Avail: CASI; [A03](#), Hardcopy

LBA research from the first phase of LBA focused on three broad categories: 1) mapping land cover and quantifying rates of change, persistence of pasture, and area of recovering forest; 2) evaluating the role of environmental factors and land-use history on soil biogeochemistry; and 3) quantifying the natural and human controls on stream nutrient concentrations. The focus of the research was regional, concentrating primarily in the state of Rondônia, but also included land-cover mapping in the vicinity of Marabá, Pará, and Manaus, Amazonas. Remote sensing analysis utilized Landsat Thematic Mapper (TM) and Multispectral Scanner (MSS) data to map historical patterns of land-cover change. Specific questions addressed by the remote sensing component of the research included: 1) what is the areal extent of dominant land-cover classes? 2) what are the rates of change of dominant land cover through processes of deforestation, disturbance and regeneration? and 3) what are the dynamic properties of each class that characterize temporal variability, duration, and frequency of repeat disturbance? Biogeochemical analysis focused on natural variability and impacts of land-use/land-cover changes on soil and stream biogeochemical properties at the regional scale. An emphasis was given to specific soil properties considered to be primary limiting factors regionally, including phosphorus, nitrogen, base cations and cation-exchange properties. Stream sampling emphasized the relative effects of the rates and timing of land-cover change on stream nutrients, demonstrating that vegetation conversion alone does not impact nutrients as much as subsequent land use and urbanization.

Derived from text

*Mapping; Biogeochemistry; Dynamic Characteristics; Forests; Soils; Remote Sensing; Environment Management*

**20030058750** Lockheed Electronics Co., Las Vegas, NV, USA

#### **MTI and Ground Truth Collection: Ivanpah Dry Lake Bed, California. May, July, and August 2002**

Hawley, D. L.; 2002; In English

Report No.(s): DE2002-806536; No Copyright; Avail: National Technical Information Service (NTIS)

A multi-agency collaboration successfully completed a series of ground truth measurements at the Ivanpah Dry Lake bed during FY 2002. Four collection attempts were made: two in May, one in July, and one in August. The objective was to collect

ground-based measurements and airborne data during Multispectral Thermal Imager satellite overpasses. The measurements were to aid in the calibration of the satellite data and in algorithm validation. The Remote Sensing Laboratory, Las Vegas, Nevada; the National Aeronautics and Space Administration; Los Alamos National Laboratory; and the University of Arizona participated in the effort. Despite less-than-ideal weather conditions, the data for the Multispectral Thermal Imager calibration were obtained. A unique set of circumstances also allowed data collection during overpasses of the LANDSAT7 and ASTER satellites.

NTIS

*Remote Sensing; Ground Truth; Radiometers; Data Acquisition*

## 44

### ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power*; *20 Spacecraft Propulsion and Power*; and *28 Propellants and Fuels*.

**20030057749** Fluor Daniel Hanford, Inc., Richland, WA, USA

#### **Diesel Generator Control Panel: Wiring, Connectors, Receptacles, Plugs and Terminals**

Van Katwijk, C.; June 2000; 22 pp.; In English

Report No.(s): DE2003-803965; SNF-6263-REV-2; No Copyright; Avail: Department of Energy Information Bridge

No abstract available

NTIS

*Wiring; Diesel Engines; Electric Generators; Control Boards; Electric Connectors; Energy Technology*

**20030057751** Department of Energy, Richland, WA, USA

#### **Environmental Management Performance Report April 2000**

Apr. 2000; 194 pp.; In English

Report No.(s): DE2003-802973; No Copyright; Avail: Department of Energy Information Bridge

The purpose of the Environmental Management Performance Report (EMPR) is to provide the Department of Energy Richland Operations Office's (DOE-RL's) report of Hanford's Environmental Management (EM) performance by: Project Hanford Management Contract (PHMC) through Fluor Hanford, Inc. (FHI) and its subcontractors; Environmental Restoration Contract through Bechtel Hanford, Inc. (BHI), and its subcontractors; Pacific Northwest National Laboratories (PNNL) for EM and EM Science and Technology (S and T) Mission; and Office of Safety Regulation of the TWRS Privatization Contractor. This report is a monthly publication that summarizes EM Site performance under RL Operations Office. It is organized by the four sections listed above, with each section containing an Executive Summary and Area Performance Summaries.

NTIS

*Environment Management; Research And Development; Project Management*

**20030057753** Argonne National Lab., Washington, DC, USA

#### **Environmental Regulatory Drivers for Coal Bed Methane Research and Development**

Elcock, D.; Gasper, J.; Dec. 1999; 16 pp.; In English

Report No.(s): DE2003-803905; No Copyright; Avail: Department of Energy Information Bridge

In 1999, the National Petroleum Council (NPC) stated that the resource base for meeting growing natural gas demands in the USA is adequate. A significant and increasing portion of natural gas production (8% by 2015) is expected to come from coal bed methane (CBM). The NPC cautions that for this to occur, certain factors, including compliance with environmental requirements, must be addressed. Numerous federal, state, and local programs address a variety of environmental issues, including water quality and quantity, air quality, wildlife, noise, and visibility. This paper examines existing and potential environmental regulatory requirements that could affect the timely development and production of CBM resources in the USA.

NTIS

*Air Quality; Natural Gas; Requirements*

**20030057757** Fluor Daniel Hanford, Inc., Richland, WA, USA

**Project Hanford Management Contractor Environmental Management Performance Report to DOE Richland Operations Office**

Jun. 2000; 18 pp.; In English

Report No.(s): DE2003-803922; No Copyright; Avail: Department of Energy Information Bridge

The purpose of this report is to provide the Department of Energy Richland Operations Office (DOE-RL) a monthly summary of the Project Hanford Management Contractor's (PHMC) Environmental Management (EM) performance by Fluor Hanford (FH) and its subcontractors. In addition to project-specific information, it includes some PHMC-level data not detailed elsewhere in the report. Section A, Executive Summary, provides an executive level summary of the cost, schedule, and technical performance described in this report. It summarizes performance for the period covered, highlights areas worthy of management attention, and provides a forward look to some of the upcoming key performance activities as extracted from the PHMC baseline. The remaining sections provide detailed performance data relative to each individual Project (e.g., Waste Management, Spent Nuclear Fuels, etc.), in support of Section A of the report. Unless otherwise noted, the Safety, Conduct of Operations, and Cost/Schedule data contained herein is as of April 30,2000. All other information is updated as of May 19, unless otherwise noted.

NTIS

*Costs; Project Management; Safety; Schedules; Waste Management*

**20030057783** National Renewable Energy Lab., Golden, CO

**Battery Voltage Stability Effects on Small Wind Turbine Energy Capture**

Corbus, D.; Newcomb, C.; Baring-Gould, E. I.; Friedly, S.; May 2002; In English

Report No.(s): DE2003-15002865; NREL/CP-500-32511; No Copyright; Avail: National Technical Information Service (NTIS)

Previous papers on small wind turbines have shown that the ratio of battery capacity to wind capacity (known as battery-wind capacity ratio) for small wind systems with battery storage has an important effect on wind turbine energy output. Data analysis from pilot project performance monitoring has revealed shortcomings in wind turbine energy output up to 75% of expected due to the effect of a weak battery grid. This paper presents an analysis of empirical test results of small wind battery systems, showing the relationships among wind turbine charging rate, battery capacity, battery internal resistance, and the change in battery voltage. By understanding these relationships, small wind systems can be designed so as to minimize dumped or unused energy from small wind turbines.

NTIS

*Wind Turbines; Electric Batteries*

**20030057882** Fuel Cell Engineering Corp., Danbury, CT, USA

**Molten Carbonate Fuel Cell Product Design Improvement. Report No. 7**

2000; In English

Report No.(s): DE2003-804910; No Copyright; Avail: National Technical Information Service (NTIS)

Under the cooperative agreement DE-FC21-95MC31184 with DOE/NETL, FuelCell Energy, Inc. formerly Energy Research Corporation, has been developing its direct Carbonate FuelCell (DFC) technology for stationary power plants. The objective of the program is to develop and demonstrate a cost-effective, market-responsive DFC power plant design(s) and make it ready for commercial entry. Significant progress has been achieved during the reporting period.

NTIS

*Fuel Cell Power Plants; Molten Carbonate Fuel Cells*

**20030057902** National Renewable Energy Lab., Golden, CO, Tennessee Univ., Knoxville, TN, USA, Oak Ridge National Lab., TN, USA

**Some Electrical Properties of Ion-Implanted Urania, Part 2**

von Roedern, B. G.; Meek, T. T.; Haire, M. J.; Feb. 2003; In English

Report No.(s): DE2003-15003239; NREL/CP-520-33441; No Copyright; Avail: National Technical Information Service (NTIS)

As part of the U.S. Department of Energy's effort to evaluate the use of UO<sub>2</sub> as a material for photovoltaic (e.g., solar cell) applications, single-crystal UO<sub>2</sub> samples were characterized as to their electrical and electro-optical properties. Samples of UO<sub>2</sub> were ion implanted with boron and sulfur dopants as well as with boron and sulfur co-dopants at the Ion Beam

Materials Laboratory facility at the Los Alamos National Laboratory. Activation energies for electrical conduction were measured to be from 0.13 to 0.26 eV, when temperatures varied from 180 to 450 K. Dark current was measured followed by light current under 1-sun illumination. In general, the dark and light currents were about an order of magnitude greater than those reported earlier for polycrystalline UO<sub>2</sub>. Optical and infrared absorption and transmission data were also obtained and are reported. Transmission data on the single-crystal samples revealed a complex structure that made it difficult to resolve a single optical bandgap.

NTIS

*Electrical Properties; Uranium Oxides; Solar Cells*

**20030057967** Army Research Office, Research Triangle Park, NC

**Experimental Ammonia-Based Power Systems**

Schmit, Steve; May 17, 2002; 76 pp.; In English

Contract(s)/Grant(s): DAAD19-01-C-0076

Report No.(s): AD-A411154; ARO-42692.1.CH-11; No Copyright; Avail: CASI; [A05](#), Hardcopy

Gradient Technology has investigated a small-scale experimental ammonia-based power system. The system is composed of two primary components. The first component, a hydrogen-generating catalytic reactor, operates through the autothermal decomposition of ammonia at large space velocities. Since reactor volume is inversely proportional to space velocity, small amounts of catalyst can process large amounts of ammonia.

DTIC

*Adsorption; Ammonia; Fuel Cells*

**20030058034** Air Force Research Lab., Wright-Patterson AFB, OH

**Cryogenic Power Research. High-Temperature Superconducting (HTS) conductors**

Barnes, Paul N.; Sep. 2001; 21 pp.; In English

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

Report No.(s): AD-A411087; AFRL-PR-WP-TM-2003-2005; No Copyright; Avail: CASI; [A03](#), Hardcopy

The program addresses the scientific and engineering issues related to the development of an HTS conductor and incorporation of that conductor into magnet and generator coil windings.

DTIC

*High Temperature Superconductors; Electric Generators; Cryogenics*

**20030058812** Hi-Z Technology, Inc., San Diego, CA, USA

**NSWC Sensor Generator**

Bass, John C.; Elsner, Norbert B.; Ghamaty, Saaid; Morris, Charles C.; Sep. 2000; 68 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N65540-00-M-0534; Proj-2098

Report No.(s): AD-A410946; HI-Z 2000F; No Copyright; Avail: CASI; [A04](#), Hardcopy

This report presents the results of a preliminary program to develop a low power generator to power remotely located sensors. The generator is to use small changes (about 5 deg C) in the ambient conditions to provide up to 1000 microwatts of power at 3.5 Volts. As an example, the generator would be attached to a structure, such as the hull of a ship, and utilized the difference in temperature between the ambient temperature within the compartment and the hull structure. Older structures or machines that produce heat within a ship's compartment can also be considered as heat sources, rather than a heat sink.

DTIC

*Electric Generators; Thermoelectric Power Generation; Sensors; Energy Conversion*

**20030059045** Fuel Cell Engineering Corp., Danbury, CT, USA

**Molten Carbonate Fuel Cell Product Design Improvement. Report No. 6**

2000; In English

Report No.(s): DE2003-804909; No Copyright; Avail: National Technical Information Service (NTIS)

Under the cooperative agreement DE-FC21-95MC31184 with DOE/NETL, FuelCell Energy, Inc. formerly Energy Research Corporation, has been developing its direct Carbonate FuelCell (DFC) technology for stationary power plants. The objective of the program is to develop and demonstrate a cost-effective, market-responsive DFC power plant design(s) and



make it ready for commercial entry. Significant progress has been achieved during the reporting period.  
NTIS

*Fuel Cell Power Plants; Molten Carbonate Fuel Cells; Product Development; Plant Design*

## 45

### ENVIRONMENT POLLUTION

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

**20030057855** National Inst. for Occupational Safety and Health, Cincinnati, OH, USA

**In-Depth Study Report: Control Technology for Crystalline Silica Exposures in Construction: The Effect of Exhaust Flow Rate Upon the Respirable Dust Emissions for Tuck Pointing Operations and a Preliminary Evaluation of a Ventilated Tool for Brick**

Heitbrink, W. A.; Watkins, D. S.; Feb. 2001; 44 pp.; In English

Report No.(s): PB2003-104179; EPHB-247-18; No Copyright; Avail: CASI; [A03](#), Hardcopy

As brick buildings age, mortar deteriorates and needs to be replaced. Before replacing the mortar, the existing mortar is removed to a depth of 0.5 and .75 inches. Typically, a 4-inch diameter grinder, operated at 10,000-12,000 rpm, is used to remove mortar. Mortar removal causes exposures to respirable crystalline silica concentrations as high as 10 gm/cu(m). A tool resembling a router can also be used to remove mortar. For four different shrouds, the effect of exhaust flow rate upon respirable dust emissions was experimentally evaluated. To conduct this testing, a small brick wall was built and enclosed in a hall-shaped, ventilated test chamber. The grinder was mounted on a mechanical trolley which moved the grinder horizontally down the wall at a constant velocity of approximately 1 m/min and the mortar was removed at a fixed cut depth of 0.5 or 0.75 inches. A vacuum cleaner equipped with high efficiency filters (99.9% at 0.3 cubic(m)) exhausted air from the shrouds to a location outside the enclosure. The vacuum cleaner's exhaust air flow was varied by controlling the voltage applied to the vacuum cleaner. An air flow rate of 2794 cubic feet per minute was drawn through the test chamber and past mixing baffles and into an exhaust duct. A time-of-flight aerosol spectrometer was used to measure the respirable dust concentration in the duct.

NTIS

*Silicon Dioxide; Air Pollution; Environment Effects; Biological Effects; Exposure; Dust*

**20030057860** Pacific Northwest National Lab., Richland, WA, USA

**Estimating Field-Scale Hydraulic Parameters of Heterogeneous Soils Using a Combination of Parameter Scaling and Inverse Methods**

Zhang, Z. F.; Ward, A. L.; Gee, G. W.; Dec. 2002; In English

Report No.(s): DE2003-15002667; PNNL-14109; No Copyright; Avail: National Technical Information Service (NTIS)

As the Hanford Site transitions into remediation of contaminated soil waste sites and tank farm closure, more information is needed about the transport of contaminants as they move through the vadose zone to the underlying water table. The hydraulic properties must be characterized for accurate simulation of flow and transport. This characterization includes the determination of soil texture types, their three-dimensional distribution, and the parameterization of each soil texture. This document describes a method to estimate the soil hydraulic parameter using the parameter scaling concept (Zhang et al. 2002) and inverse techniques. To this end, the Groundwater Protection Program Science and Technology Project funded vadose zone transport field studies, including an analysis of the results to estimate field-scale hydraulic parameters for modeling. Parameter scaling is a new method to scale hydraulic parameters. The method relates the hydraulic parameter values measured at different spatial scales for different soil textures. Parameter scaling factors relevant to a reference texture are determined using these local-scale parameter values, e.g., those measured in the lab using small soil cores. After parameter scaling is applied, the total number of unknown variables in hydraulic parameters is reduced by a factor equal to the number of soil textures. The field-scale values of the unknown variables can then be estimated using inverse techniques and a well-designed field experiment. Finally, parameters for individual textures are obtained through inverse scaling of the reference values using an a priori relationship between reference parameter values and the specific values for each texture.

NTIS

*Soils; Hydraulics; Radioactive Wastes*

**20030057867** General Accounting Office, Washington, DC

**Environmental Protection: Federal Planning Requirements for Transportation and Air Quality Protection Could Potentially Be More Efficient and Better Linked**

Apr. 2003; 68 pp.

Report No.(s): PB2003-104709; GAO-03-581; No Copyright; Avail: CASI; [A04](#), Hardcopy

To protect the public from harmful emissions, transportation planners in areas with poor air must show that their plans will not make it worse. Every time they update their transportation improvement program (TIP) and their 20-year plan--every 2 and 3 years respectively--federal laws and regulations require that they ensure the emissions from their plans will not exceed the mobile source emissions budget. This is known as demonstrating conformity. Areas that fail to do so generally cannot spend federal funds on new projects until they resolve the problem. The Committee asked GAO to determine (1) how many areas have failed, why, and what corrective actions they took, and (2) what issues transportation planners had with the conformity process and what solutions are possible.

NTIS

*Environment Protection; Air Pollution; Management Planning; Transportation; Pollution Control*

**20030057873** Health Effects Inst., MA, USA

**Particle Characteristics Responsible for Effects on Human Lung Epithelial Cells**

Aust, A. E.; Ball, J. C.; Hu, A. A.; Lighty, J. S.; Smith, K. R.; Dec. 2002; 86 pp.; In English

Report No.(s): PB2003-104264; HEI-RR-110; No Copyright; Avail: CASI; [A05](#), Hardcopy

Some recent epidemiologic investigations have shown an association between increased incidence of respiratory symptoms and exposure to low levels of particulate matter (PM\*) less than 10 mm or less than 2.5 mm in aerodynamic diameter (PM10 and PM2.5, respectively). If particulates are causally involved with respiratory symptoms, it is important to understand which components may be responsible. However, increasing evidence suggests that transition metals present in particles, especially iron, generate reactive oxygen species (ROS) that may be involved in producing some of the observed respiratory symptoms. The hypothesis for this study is twofold: bioavailable transition metals from inhaled airborne particulates catalyze redox reactions in human lung epithelial cells, leading to oxidative stress and increased production of mediators of pulmonary inflammation; and the size, transition metal content, and mineral speciation of particulates affect their ability to cause these effects.

NTIS

*Epidemiology; Epithelium; Particulates; Signs And Symptoms; Transition Metals; Cells (Biology)*

**20030057906** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Atmospheric Dispersion of CO(2) Seepage from Geologic Carbon Sequestration Sites**

Oldenburg, C. M.; Unger, A. J. A.; Hepple, R. P.; Nov. 2002; In English

Report No.(s): DE2003-806139; LBNL-51734; No Copyright; Avail: National Technical Information Service (NTIS)

The transport of carbon dioxide (CO2) by wind and density-driven flow above the ground surface delivers CO2 to receptors such as plants, humans, and other animals. However, during this above-ground transport process, significant dispersion is likely thus diluting CO2 concentrations to safe levels. While intuition suggests that mixing and dilution in the atmosphere will be fast processes, experience from natural CO2 releases and industrial dense gas accidents demonstrates that dense gases resist mixing under certain circumstances. The purpose of this report is to summarize our work aimed at quantifying atmospheric dispersion of seeping CO2 due to leakage from geologic carbon sequestration sites.

NTIS

*Carbon Dioxide; Seepage; Risk*

**20030057937** Lawrence Livermore National Lab., Livermore, CA

**Removal of NO(X) From Diesel Generator Exhaust by Pulsed Electron Beams**

Penetrante, B. M.; Jul. 03, 1997; 14 pp.; In English

Report No.(s): DE2003-16412; UCRL-JC-128068; No Copyright; Avail: Department of Energy Information Bridge

The objective of this paper is to determine the effects of electron beam pulse parameters on the utilization of the reactive free radicals for removal of NOx from diesel generator exhaust. A dose per pulse less than 1 kGy has been determined to be optimum for effective radical utilization. During each post-pulse period, the radicals are utilized in the removal of NOx in a timescale of around 100 microseconds; thus, with pulse frequencies of around 10 kHz or less, the radical concentrations remain sufficiently low to prevent any significant competition between radical-pollutant and radical-radical reactions. It is

shown that a pulsed electron beam reactor, operating with a dose per pulse of less than 1 kGy/pulse and pulse repetition rate of less than 10 kHz, will have the same plasma chemistry efficiency (parts per million of removed NO<sub>x</sub> per kGy of electron beam dose) as an electron beam reactor operating with a low dose rate of 50 kGy/s in continuous mode. Ozone accumulation is a limiting factor under high pulse frequency conditions. The total dose requirement determines the optimum combination of dose per pulse and pulse frequency for both radical utilization and prevention of ozone buildup.

NTIS

*Electron Beams; Exhaust Gases; Diesel Engines; Nitrogen Oxides*

**20030057941** Brookhaven National Lab., Upton, NY, USA

**Measurement Technique for Hydroxyacetone**

Klotz, P. J.; Ewok, E. S. C.; Zhou, X.; Lee, J. H.; Lee, Y. N.; Oct. 1999; In English

Report No.(s): DE2003-750769; BNL-66932; No Copyright; Avail: National Technical Information Service (NTIS)

Hydroxyacetone (HA) is mainly produced in the atmosphere from oxidation of hydrocarbons of the type, CH<sub>3</sub>(R)C=CH<sub>2</sub>. Tuazon and Atkinson (1990) reported HA yield of 41% from the OH-initiated oxidation of methacrolein in the presence of NO<sub>x</sub>. Since methacrolein is a major product of isoprene oxidation (Carter and Atkinson, 1996), isoprene, a key biogenic hydrocarbon, is therefore expected to be an important source for HA. Consequently, knowledge of ambient concentration of HA would provide information needed to examine the applicability of isoprene reaction mechanisms developed in laboratory and to assess the contribution of isoprene to photooxidant production. The commonly used GC-FID technique involving cryo-focusing is unsuitable for HA owing to HA's thermal instability. When subjected to a temperature of 100 C for only a few seconds, HA was found to disappear completely. Since HA is highly soluble in water (its Henry's law constant being approx  $2 \times 10^4$  M atm<sup>-1</sup>) at 20 C, Zhou and Lee, unpublished data, we developed a wet chemical technique similar in principle to the one we reported earlier (Lee and Zhou, 1993), namely, based on derivatization following liquid scrubbing. To increase the sensitivity, we adopted a fluorescence detection scheme based on o-phthalaldehyde (OPA) chemistry. The technique was deployed in the field during two measurement periods at a NARSTO site located on Long Island (LI), New York. We report the principle and the operation of this technique and the results obtained from these field studies.

NTIS

*Hydroxyl Compounds; Acetone*

## 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*.

**20030057877** California Univ., Los Angeles, CA, USA

**2D MHD Simulation of the Emergence and Merging of Coherent Structures**

Wu, Cheng-Chin; Chang, Tom, Americ; Geophysical Research Letters; March 15, 2002; ISSN 0094-8276; Volume 27, No. 6, pp. 863-866; In English

Contract(s)/Grant(s): NAG5-9111

Report No.(s): Paper-1999GL003704; Copyright; Avail: Other Sources

A model of sporadic localized merging of coherent structures has recently been proposed by Chang to describe the dynamics of the Earth's magnetotail. Here we report the results of MHD simulations regarding the development and merging of 2D coherent structures. With a magnetic shear, such coherent structures are generated in alignment with the imposed current sheet. The calculated fluctuation spectra suggest long-ranged correlations with power-law characteristics.

Author

*Current Sheets; Geomagnetic Tail; Magnetic Islands; Plasma Waves; Plasma Dynamics; Planetary Magnetic Fields; Magnetohydrodynamic Turbulence; Magnetic Storms*

**20030058025** Army Research Lab., Adelphi, MD, USA

**Performance of Classifier Architectures with the RNADS Feature Space**

Wellman, Mark; Sep. 1999; 11 pp.; In English

Report No.(s): AD-A410996; No Copyright; Avail: CASI; A03, Hardcopy

To evaluate the efficiency of the remote netted acoustic/seismic sensor array (RNADS) 1-6 for classification, we must

investigate the performance of various classification algorithms. Currently, the U.S. Army Research Laboratory (ARL) is developing an acoustic/seismic target classifier using a back propagation neural network (BPNN) algorithm. Various techniques for extracting features have been evaluated to improve the confidence level and probability of correct identification (ID) 1,3,6. For any given feature space, the BPNN creates complex boundaries in the hyperspace occupied by the feature vectors and only one hidden layer is required to create hyperplanes as decision boundaries 7,8; this, however, may not be the ideal classifier. Alternately, nonparametric and parametric classifier architectures are being investigated, since it is the mutual relationship between features and classifiers that allows the maximum recognition performance. Intuitively, we expect the BPNN to perform well, based on results from k-means analysis techniques. Using a hierarchical k-means analysis tool, we determined that only a few feature data clusters exist for each class. These 'feature pockets' may comprise about 40 percent of the training data in some instances and, in fact, have been suggested to be useful in a minimum distance classifier or beneficial in learning vector quantization. The nonparametric classifier architectures make no assumption about the statistics of the feature space distribution 7 and instead, rely on the data to estimate classification parameters. They have advantages when the features are created using nonlinear processes with highly non-Gaussian statistics and allow flexibility in the tradeoff of computation, memory, training, and testing.

DTIC

*Acoustics; Signal Detectors; Classifications; Targets*

**20030058026** Rockwell International Corp., Thousand Oaks, CA

**Seismic Attenuation Characterization Using Tracked Vehicles**

Scholl, James F.; Clare, Loren P.; Agre, Jonathan R.; Aug. 1999; 11 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAL01-96-2-0001

Report No.(s): AD-A410999; No Copyright; Avail: CASI; [A03](#), Hardcopy

Target classification is one of the most important issues in battlefield situational awareness. As seismic signals are an effective means of obtaining such information any knowledge of the subsurface environment in which the target signal propagates is very important in either developing or finetuning classification algorithms. Seismic signal attenuation is an essential subsurface environmental characteristic and is known to be frequency dependent. We first describe a simple method for computing seismic attenuation using a single seismic measuring device and a large tracked vehicle with known tread spacing characteristics. Following this we extend the method to an array of randomly placed sensor nodes. We first illustrate this method for a single node by means of tracking the size of certain spectral features in measured seismic data. For example the seismic signature of an M60 tank has a distinct peak at a specific frequency depending on its speed. Given the distance to CPA and the vehicle speed a portion of the signal corresponding to a given distance from vehicle to sensor can be examined and the power spectral density of that peak measured corresponding to that distance. From this type of data attenuation profiles can be measured as a function of distance for various frequencies. Seismic attenuation parameters can be computed from the profiles using suitable regression techniques. Data collected for sensor arrays will be analyzed and compared with the single sensor results to assess local ground effects. Also we will compare the ability of an array of sensors to characterize the ground using an impulsive source with the moving vehicle source. This then characterizes the seismic medium and can assist in classification of general targets.

DTIC

*Attenuation; Tracked Vehicles; Targets; Classifications; Seismic Energy*

**20030058740** Naval Research Lab., Washington, DC

**VENTFLUX2: Single Channel Seismics, Piston Coring, and CTD Casts Associated with Gas Hydrates Offshore Vancouver Island. Report of Cruise PG01-003 C.C.G. Vessel John P. Tully, 23 July-12 August 2001. Volume 1: Operations**

Spence, George; Hoehne, Johanna; Coffin, Richard B.; Hyndman, Roy; MacDonald, Robert; Feb. 8, 2003; 125 pp.; In English Report No.(s): AD-A411571; NRL/MR/6110--03-8648; X5-X5; No Copyright; Avail: CASI; [A06](#), Hardcopy

Cruise PGC00-003 was a collaborative experiment between the University of Victoria, the Geological Survey of Canada, and the Naval Research Laboratory. The program focused on seafloor vents that may be sites of significant fluid and methane flux. There were six sites with different indicators of fluid flow selected for this cruise: (1) Bullseye vent: hydrate had been recovered in this region in four piston cores collected during the 2000 VentFlux cruise. (2) Cucumber Ridge: numerous tube worms and clams had been observed and collected during ROPOS dives in May 2001. (3) FishBoat site: in November 2000, a commercial trawler dragged up one to two tons of hydrate at this site in Barclay Canyon in water depth of 800 m; (4) ShallowPlume sites: apparent methane plumes were observed on the continental shelf edge in water depths of -200 m. The plumes were identified on 28 MHz sounder records. (5) Nootka Fault Zone: swath bathymetry collected in July 2001 found

two mud volcanoes in the open ocean basin in water depths of 2600 m. (6) Northern Fault Zone: Located -5 km northwest of ODP Site 8889, this was detected as a northeast-southwest linear zone of seismic blazing on 1999 3D COAMS data. Sites 1 to 5 were targets for piston coring and water column sampling during daytime operations. Sites 2 to 6 were high resolution single channel seismic grids during nighttime operations.

DTIC

*Ocean Bottom; Core Sampling; Hydrates; Geological Surveys; Seismology*

**20030058856** Colorado Univ., Boulder, CO

**State-to-State Thermal/Hyperthermal Collision Dynamics of Atmospheric Species**

Nesbitt, David J.; Jan. 30, 2003; 15 pp.; In English

Contract(s)/Grant(s): F49620-00-1-0146

Report No.(s): AD-A411039; CU-1532078; AFRL-SR-AR-TR-03-0023; No Copyright; Avail: CASI; [A03](#), Hardcopy

Direct absorption IR laser methods developed under AFOSR support have been used to study state-to-state reactive scattering dynamics under single collision conditions. Efforts over this past year have led to significant progress in several areas: i) H atom abstraction dynamics in prototypic atom+diatom (e.g. X+HD->HX(v,J)+D), atom+triatom (e.g. X+H<sub>2</sub>O->HX(v,J)+OH(v,N) and atom+polyatom (e.g. X+CH<sub>3</sub>-CH<sub>3</sub>) reaction systems; ii) application of novel slit discharge concentration modulation methods for ultrasensitive IR laser based detection of cold ions in supersonic jets; iii) stereodynamics of aligned collisions in rovibrationally state-selected molecules in crossed jets; iv) first efforts in extending high sensitivity IR absorption methods to reaction scattering at the gas+hydrocarbon liquid interface, which indicate surprisingly 'hot', highly non-statistical product state distributions as well as direct evidence for both 'direct' and 'trapping/desorption' reaction channels.

DTIC

*Infrared Absorption; Atmospheric Composition; Particle Collisions; Thermodynamic Properties; Atmospheric Chemistry*

## 47

### METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

**20030057975** Air Force Inst. of Tech., Wright-Patterson AFB, OH

**Comparing TRMM Rainfall Retrieval With NOAA Buoy Rain Gauge Data**

Phillips, Amy B.; Dec. 2002; 60 pp.; In English

Report No.(s): AD-A410736; CI02-847; No Copyright; Avail: CASI; [A04](#), Hardcopy

This study compares rain rate measurements from the Tropical Rainfall Measuring Mission (TRMM) satellite to rain rate measurements from rain gauges on open-ocean buoys. The rain gauges are part of the instrument package on the Next Generation Autonomous Temperature Line Acquisition System (ATLAS) buoys in the Tropical Atmosphere-Ocean/Triangle Trans-Ocean Buoy Network (TAO/TRITON) array in the tropical Pacific. The rain rate data from TRMM and 25 buoys are collected from January of 1998 to December of 2001. TRMM's 3G68 product provides instantaneous rain rate data averaged over 0.50 x 0.50 latitude-longitude grid boxes for the TRMM Microwave Imager (TMI), Precipitation Radar (PR), and a combined algorithm (COMB). The buoy's rain rate data are averaged over and reported in 10-minute intervals. Buoy data are compared to 1.00 x 1.00 TRMM area-averaged values centered on each of the 25 buoy locations. The 1.00 x 1.00 boxes are composed of four 0.50 x 0.50 3G68 grid boxes.

DTIC

*Rain Gages; Meteorological Radar; Precipitation (Meteorology); Microwave Imagery; Satellite Observation*

**20030058059** Woods Hole Oceanographic Inst., MA

**A Comparison of Buoy Meteorological Systems**

Payne, Richard E.; Huang, Kelan; Weller, Robert A.; Freitag, H. P.; Cronin, M. F.; Dec. 2002; 69 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411553; WHOI-2002-10; No Copyright; Avail: CASI; [A04](#), Hardcopy

During May and June 2000, an intercomparison was made of buoy meteorological systems from the Woods Hole Oceanographic Institution (WHOI), the National Oceanographic and Atmospheric Administration (NOAA), Pacific Marine Environmental Laboratory (PMEL), and the Japanese Marine Science and Technology Center (JAMSTEC). Two WHOI systems mounted on a 3 m discus buoy, two PMEL systems mounted on separate buoy tower tops and one JAMSTEC system

mounted on a wooden platform were lined parallel to, and 25 m from Nantucket Sound in Massachusetts. All systems used R. M. Young propeller anemometers, Rotronic relative humidity and air temperature sensors and Eppley short-wave radiation sensors. The PMEL and WHOI systems used R. M. Young self-siphoning rain gauges, while the JAMSTEC system used a Scientific Technology ORG-115 optical rain gauge. The PMEL and WHOI systems included an Eppley PIR long-wave sensor, while the JAMSTEC had no long-wave sensor. The WHOI system used an AIR DB-1A barometric pressure sensor. PMEL and JAMSTEC systems used Paroscientific Digiquartz sensors. The Geophysical Instruments and Measurements Group (GIM) from Brookhaven National Laboratory (BNL) installed two Portable Radiation Package (PRP) systems that include Eppley short-wave and long-wave sensors on a platform near the site. It was apparent from the data that for most of the sensors, the correlation between data sets was better than the absolute agreement between them. The conclusions made were that the sensors and associated electronics from the three different laboratories performed comparably.

DTIC

*Buoys; Ocean Data Acquisitions Systems*

**20030058065** Hughes Technical Center, Atlantic City International Airport, NJ, USA

**Report on Current Convective Weather Processes and Product Requirements at the Air Traffic Control System Command Center (ATCSCC) and Kansas City Air Route Traffic Control Center (ARTCC)**

Sims, Danny; Fidalgo, Cynthia; Weinrich, Jeff; Mar. 2002; 24 pp.; In English; Original contains color illustrations

Report No.(s): AD-A410973; DOT/FAA/CT-TN02/13; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report summarizes current processes and information sources used when convective weather impacts Air Traffic Control (ATC) operations at the Air Traffic Control System Command Center (ATCSCC) and Kansas City Air Route Traffic Control Center (ARTCC). In addition, user needs for convective weather forecast products are presented. ACT-320 collected information from both facilities through site visits and interviews during the early summer of 2000. Based upon collected information, it is recommended that the integration of a convective weather forecast capability, for example, the National Convective Weather Forecast (NCWF), into the Traffic Situation Display (TSD) be investigated. In addition, further research should be conducted to extend the forecast period of current automated forecast products.

DTIC

*Weather Forecasting; Information Systems; Air Traffic Control*

**20030058085** Naval Postgraduate School, Monterey, CA

**Demonstration of Linked UAV Observations and Atmospheric Model Predictions in Chem/Bio Attack Response**

Davidson, Kenneth L.; Kaminer, Isaac; Miller, Douglas; Dobrokhodov, Vladimir; Jan. 21, 2003; 26 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412243; NPS-MR-03-001; No Copyright; Avail: CASI; [A03](#), Hardcopy

Both the faculty and staff from the Departments of Meteorology and Aeronautics evaluated the integration of components for a near-real time decision aid designed to enable small units to respond in a focused way to a ChemBio attack. This effort included the field-testing of an atmospheric dispersion prediction model, an instrumented UAV for collecting meteorological data, and the means for linking the UAV data to real-time dispersion prediction. The primary modeling effort focused on an adaptation of the 'Wind On Constant Streamline Surfaces' (WOCSS) model developed to run on a small computer with input from an external mesoscale model (MM5). The combined models were run for approximately one month for the region surrounding Camp Roberts, CA. In situ meteorological data were collected at the Camp Roberts airfield from 2 October to 5 November 2002 to validate the model predictions. The model results showed promise in capturing the diurnal evolution of near-surface temperatures that drive the local circulations in the warm season. Linking WOCSS with the atmospheric mesoscale model forecasts showed no significant improvement in wind forecasts when compared to the mesoscale model wind forecasts alone. Linking WOCSS to the trajectory visualization code revealed that vertical wind component estimates needed to be improved. The linked model/UAV demonstration of 7-9 October 2002 tested the synthesis of UAV measurements and dispersion model predictions. Although a UAV mishap occurred soon after the demonstration began, the instrumented UAV performance during this early period and in preliminary flight tests indicate that the hardware/software architecture for UAV data collection and its linkage with real-time dispersion prediction will be successful. Overall, the demonstration proved the feasibility of linking a coarse grid mesoscale model to a fine-scale diagnostic wind model for producing fine resolution forward and backward trajectories.

DTIC

*Dispersing; Predictions; Chemical Warfare; Decision Support Systems; Atmospheric Models*

**20030058098** Federal Aviation Administration, Atlantic City, NJ

**The Integrated Turbulence Forecasting Algorithm (ITFA) Meteorological Evaluation**

Sims, Danny; Weinrich, Jeff; Passetti, Victor; Mar. 2002; 44 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A411057; DOT/FAA/CT-TN02/12; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report summarizes the Integrated Turbulence Forecasting Algorithm (ITFA) Meteorological Evaluation conducted by ACT-320 from January to August 2000. The ITFA, developed at the National Center for Atmospheric Research (NCAR), combines several turbulence forecasting techniques into a single algorithm that produces a forecast of the potential for high-level, clear-air turbulence. The purpose of the evaluation was to provide a subjective assessment of the performance, characteristics, and trends of the ITFA before and during periods of widespread, significant turbulence. Evaluation results indicate that ITFA has the potential to be a useful tool for the detection and prediction of jet-stream/wind shear induced upper-level turbulence. In addition, several recommendations were made for further development.

DTIC

*Algorithms; Clear Air Turbulence; Weather Forecasting; Forecasting*

**20030058973** Woods Hole Oceanographic Inst., MA

**Mixed Layer Response to Monsoonal Surface Forcing in the Arabian Sea**

Weller, Robert A.; Mar. 13, 2003; 6 pp.; In English

Contract(s)/Grant(s): N00014-94-1-0161

Report No.(s): AD-A411756; No Copyright; Avail: CASI; [A02](#), Hardcopy

A surface mooring was deployed in the Arabian Sea for one year. Subsequent analyses provided quantitative descriptions of the upper ocean response to the surface forcing, including heat budgets and identification of the relative roles of various physical processes. One- and three-dimensional models were used to further examine the dynamics of the response at the site of the moored array and to extend the study to the entire Arabian Sea. The fieldwork produced the first long time series of high quality surface meteorology and air-sea fluxes from the Arabian Sea. Observations of the strong cooling heat flux associated with offshore transport gave new insight into the dynamic mechanisms connecting coastal upwelling and upper ocean cooling. New understanding of the physics of the upper ocean in the Arabian Sea was developed, including the impact of the diurnal cycle and of high-frequency wind forcing on the vertical mixing and on larger-scale circulation changes. Comparison of mixed layer model performance suggests some simple improvements in the parameterizations could be made in lieu of resolution of the diurnal cycle.

DTIC

*Monsoons; Arabian Sea; Air Water Interactions; Surface Layers; Wind (Meteorology)*

**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*.

**20030058996** Louisiana State Univ., Baton Rouge, LA

**Lagrangian Study of Circulation, Transport, and Vertical Exchange in the Gulf of Mexico**

Welsh, S. E.; Inoue, M.; Nov. 2002; In English

Report No.(s): PB2003-103645; No Copyright; Avail: National Technical Information Service (NTIS)

The recent increased activity associated with offshore oil and gas exploration and production in the outer continental shelf and slope regions of the northern Gulf of Mexico (GOM) calls for a better understanding of the ocean circulation in these regions and the potential environmental effects of those activities. Safe operation of offshore facilities during exploration and production is required for the protection of human life and the marine environment. Moving into deep water places the oil and gas operations closer to strong surface-intensified currents associated with the Loop Current (LC) and LC rings. Sub-surface current measurements over the northern continental slope provide evidence of vigorous currents and Topographic Rossby Waves. ventilation of deep water; and (3) the residence time of water in the deep GOM. The first goal of this project was to realistically reproduce the observed upper-layer circulation features of the GOM using a primitive-equation, numerical ocean model. The model features high vertical resolution and seasonally-varying inflow through the Yucatan Channel. Special attention was given to simulating the 3-dimensional structure of the LC and LC rings, which dominate the circulation in the eastern GOM. Lagrangian methods were used to analyze the trajectories of tens of thousands of inert tracer particles in an

effort to characterize the three dimensional circulation and transport pathways in the GOM.  
NTIS  
*Gulf Of Mexico; Ocean Models; Ocean Currents*

## 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*.

**20030058724** University of the Algarves, Faro, Portugal

#### **Neural Network Classification of Cerebral Embolic Signals**

Matos, S.; Ruano, M. G.; Ruano, A. E.; Evans, D. H.; Oct. 25, 2001; 4 pp.; In English

Report No.(s): AD-A411669; No Copyright; Avail: CASI; [A01](#), Hardcopy

The presence of circulating cerebral emboli represents an increased risk of stroke. The detection of such emboli is possible with the use of a transcranial Doppler ultrasound (TCD) system. When a gaseous or particulate embolus passes through the TCD sample volume, it produces high intensity transient signals that are normally relatively easily detected. However, because most current TCD systems rely on human experts for the detection and classification of candidate events, this technique is not widely used. The appearance of a reliable automatic system, able to detect these signals and to classify them as originating from either a gaseous or solid source, would encourage the widespread utilization of this technique. This paper reports the application of new signal processing techniques to the analysis and classification of embolic signals. We applied a Wavelet Neural Network algorithm to approximate the embolic signals, with the parameters of the wavelet nodes being used to train a Neural Network to classify these signals as resulting from normal flow, or from gaseous or solid emboli.

DTIC

*Detection; Cerebrum; Embolisms*

**20030058816** Kobe Univ., Japan

#### **Analysis of MEG Relating to Subjective Preference of Visual Motion Stimuli**

Okamoto, Yosuke; Soeta, Yoshiharu; Nakagaw, Seji; Tonoike, Mistsuo; Ando, Yoichi; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412088; No Copyright; Avail: CASI; [A01](#), Hardcopy

The aim of this study is to identify the relationship between subjective preference and the human brain responses to visual motion under changing its period. First, preference judgments using the paired-comparison method for sinusoidal movements of a single circular target in horizontal direction were performed. Then, MEG data were recorded during presentations of the most preferred and the least preferred moving stimuli. From the initial delay range of ACF of the alpha wave, the effective duration tau (sub e)) was analyzed. Results show that the stimulus with most preferred periods has a greater value of tau sub e than that with least preferred periods at the occipital area, especially in the left hemisphere.

DTIC

*Brain; Visual Perception; Auditory Signals; Magneto-Optics; Optical Switching*

**20030058989** Linköping Univ., Sweden

#### **Characterisation of the Cartilage/Bone Interface Utilising Reflectance Spectroscopy**

Oeberg, P. A.; Sundqvist, T.; Johansson, A.; Sundberg, M.; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412109; No Copyright; Avail: CASI; [A01](#), Hardcopy

Optical reflection spectra of the cartilage/bone interface from hip joints of cows were studied. When comparing to ultrasonic measurement, it was found that cartilage thickness could be extracted using optical reflectance spectroscopy. For thicker cartilage layers, a high reflection for the wavelengths 400-600 was seen, and for thinner cartilage layers, the characteristic spectra of blood and bone dominated. The optical reflectance spectra may be used to characterize cartilage, and specifically cartilage thickness, in connection with in situ diagnosis or autologous chondrocyte implantation (ACI).

DTIC

*Implantation; Spectroscopy; Reflectance; Ultrasonics; Bones; Cartilage; Cattle*



**20030059032** Defence Science and Technology Organisation, Edinburgh, Australia

**Biometrics Technology Review 2002**

Blackburn, T.; Butavicius, M.; Graves, I.; Hemming, D.; Ivancevic, V.; Johnson, R.; Kaine, A.; McLindin, B.; Meaney, K.; Smith, B., et al.; March 2003; 55 pp.; In English

Report No.(s): DSTO-GD-0359; DODA-AR-012-602; Copyright; Avail: CASI; [A04](#), Hardcopy

The September 11 2001 terrorist attacks in the USA have motivated renewed global efforts to secure national borders and accordingly Australian authorities have demonstrated an interest in mechanisms that support these endeavours. This report examines the current state of biometric technologies, characterises the main categories and focuses on face recognition, which is the least intrusive but most effective means of applying filters at access points to the country. It also reviews some of the ramifications of large scale surveillance measures when applied to populations.

Author

*Biometrics; Technological Forecasting; Surveillance; Security*

**52**

**AEROSPACE MEDICINE**

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments, see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

**20030057989** Istituto Superiore di Sanita, Rome, Italy

**Baroreceptor-Sensitive Fluctuations of Heart Rate and Pupil Diameter**

Calcagnini, G.; Giovannelli, P.; Censi, F.; Bartolini, P.; Barbaro, V.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411212; No Copyright; Avail: CASI; [A01](#), Hardcopy

It is generally known that the pupil is under the control of the autonomic nervous system. Recently, those rhythms characterizing the autonomic fluctuations of heart period and arterial blood pressure have been detected in spontaneous Pupil Diameter (PD) fluctuations. The physiological mechanisms underlying such variability have not been widely investigated. Aim of this study was to investigate the origin of the pupil fluctuations in humans, using a non-invasive modulation of carotid baroreceptors by Neck Suction (NS). To this purpose, we simultaneously recorded ECG, respiration activity, NS pressure and PD fluctuations from 10 normal subjects. The equipment for the PD measurement and the NS stimulation was developed in our laboratory. The response of the pupil to the NS was studied at stimulation frequencies of 0.10 and 0.20 Hz% by using parametric spectral and cross-spectral estimation. In all subjects, the NS rhythms were clearly detectable in heart rate variability series in both stimulation frequencies and also in the PD spectra with significant coherences (>0.5). These findings suggest that blood pressure fluctuations propagate to the pupil via carotid baroreceptors afferent pathways. However a central contribution can not be excluded. Keywoals - pupil diameter fluctuations, heart rate variability%, baroreceptors, spectral analysis

DTIC

*Respiratory System; Heart Rate; Blood Pressure; Stimulation*

**20030058044** Army Research Inst. of Environmental Medicine, Natick, MA

**USRIEM Heat Strain Model: New Algorithms Incorporating Effect of High Terrestrial Altitude**

Matthew, William T.; Berlund, Larry G.; Santee, William R.; Gonzalez, Richard R.; Mar. 2003; 16 pp.; In English

Report No.(s): AD-A412274; USARIEM-TR-T03-9; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report describes modifications made to the USARIEM model to extend its applicability to high terrestrial altitude environments. Current deployments of U.S. forces to high altitude regions in and around Afghanistan provided the immediate impetus for this effort. Primary focus has been placed on elevations ranging from 0 (sea level) and 4000 meters (13,123 ft). The approach draws exclusively on previously published work, and is necessarily based on a combination of rational and empirically derived relationships compatible with the USARIEM model's computational structure. The modifying algorithms use atmospheric pressure and are applied to the convective and evaporative heat transfer components of the USARIEM model, specifically the thermal resistance  $L(\text{SUB } T)$  and maximum evaporative power of the environment  $E(\text{sub max})$  algorithm

derivations. These two modifications are minimally invasive to the USARIEM model computational engine and should be applicable to hyperbaric as well as more drastic hypobaric environments.

DTIC

*Computerized Simulation; Physiological Effects; Body Temperature; Heat Tolerance*

**20030058721** Army Research Inst. of Environmental Medicine, Natick, MA

**Cold Exposure Human Immune Responses and Intracellular Cytokine Expression**

Castellani, John W.; Brenner, Ingrid K.; Rhind, Shawn G.; Jul. 2002; 9 pp.; In English

Report No.(s): AD-A411099; No Copyright; Avail: CASI; [A02](#), Hardcopy

It is commonly believed that exposure to cold environmental temperatures depresses immune function and increases the risk for infection. This review paper will 1) present an overview of human physiological responses to cold exposure, 2) present the human studies examining the effects of cold exposure on immune responses, and 3) summarize recent experiments from our laboratories examining the effects of exercise and fatigue on immune responses during subsequent cold exposure. Based on the review of the literature, there is no support for the concept that cold exposure depresses immune function.

DTIC

*Exposure; Ambient Temperature; Physiological Responses; Cold Tolerance; Immune Systems; Cells (Biology)*

**20030058728** Army Research Inst. of Environmental Medicine, Natick, MA

**Symposium: Immune Function in Environmental Extremes - An Introduction**

Castellani, John W.; Jan. 2002; 3 pp.; In English

Report No.(s): AD-A411101; No Copyright; Avail: CASI; [A01](#), Hardcopy

The purpose of these series of papers presented at the 2001 Annual Meeting of the American College of Sports Medicine, is to review the current knowledge about the effects of cold, hypoxia and space travel on the immune system.

DTIC

*Cold Tolerance; Physiological Effects*

**20030058777** Johns Hopkins Univ., Baltimore, MD

**Cross-Correlation Analysis of Epileptiform Propagation Using Wavelets**

Bahcivan, Hasan; Zhang, Ning; Mirski, Marek A.; Sherman, David; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A411706; No Copyright; Avail: CASI; [A01](#), Hardcopy

We have analyzed cortical and subcortical field recordings from spatially distinct neural circuits in order to support the hypothesis that spatially distinct brain locations display correlated ictal activity during epileptic seizures. Field recordings have been obtained from cortex (CTX), anterior thalamic nuclei (AN), posterior thalamus (PT) and hippocampus (HPC) during pentylentetrazol (PTZ) seizures in anesthetized animals. We use Wavelet Transform Cross-Correlation (WTCC) method in order to quantify the common activity between two recordings at particular bands of interest. In contrary to Fourier Transform Coherence (FTC), we show that WTCC provides a more reliable estimate of band-specific common activity or cross-coherence between two epileptic sources. Although most of the signal power is located at higher frequencies (15-30Hz), results from WTCC reveal significant mean cross-correlation estimates (0.7-0.8) at primarily the lower regions of the spectrum (0-10Hz). The behavior observed in the brain recordings analyzed in this paper lets us differentiate between local and global behavior, where the global behavior is assumed to be due to a pacemaker function which is a quasi-periodic train of impulse functions that differentially excites various areas of the brain.

DTIC

*Cross Correlation; Wavelet Analysis; Electroencephalography; Signal Processing; Epilepsy*

**20030058827** Army Research Inst. of Environmental Medicine, Natick, MA

**Simulation of Human Thermoregulatory Responses to Micro-Cooling in Hot Environments**

Berglund, Larry G.; Jan. 2002; 6 pp.; In English

Report No.(s): AD-A412272; USARIEM-M02-29; No Copyright; Avail: CASI; [A02](#), Hardcopy

Situations occur where individual cooling is desirable to reduce heat injury and improve productivity. Simulation of human responses while wearing possible micro-cooling systems can assist planning and soften their development. A thermo-physiological model modified for micro-cooling was developed to predict body temperatures, other physiological parameters, and discomfort in hot environments. The micro-cooling simulated was: (1) uniform whole body cooling under clothing, (2) cooling of upper torso with a water cooled vest under clothing, and (3) cooling of upper torso with an air cooled

vest under clothing. The modeling suggests upper torso cooling above 200 watts can cause vasoconstriction reducing the effectiveness of greater cooling.

DTIC

*Simulation; Physiological Effects; Temperature Control; Body Temperature; Exposure*

**20030058836** Scripps Research Inst., La Jolla, CA

**Chronic Stress and Neuronal Pathology: Neurochemical, Molecular and Genetic Factors**

Koob, George F; Sanna, Pietro P.; Roberts, Amanda; Jan. 2003; 77 pp.; In English

Contract(s)/Grant(s): DAMD17-99-1-9501

Report No.(s): AD-A412114; No Copyright; Avail: CASI; [A05](#), Hardcopy

The purpose of this project was to determine whether chronic activation of brain - corticotropin releasing factor (CRF) stress systems led to oxidative damage of brain dopamine systems and to investigate individual susceptibility to this pathological cascade. In Specific Aim 1, the goal was to explore the effects of chronic psychological and physical stress on neuropharmacological, neurochemical and oxidative stress measures of mesocortical and nigrostriatal dopaminergic system integrity. Chronic psychological - stress was found to produce activation and temporary dysfunction of the mesocortical and nigrostriatal dopaminergic systems, changes that were accompanied by evidence of increased lipid peroxidation, a marker of oxidative stress. In Specific Aim 2, the goal was to selectively breed rats for high and low response to stressors on the basis of their HPA-axis response to footshock.

DTIC

*Genetics; Neurophysiology; Stress (Psychology); Pathology; Molecular Biology*

**20030059003** Department of Defence, Canberra

**Third International Conference on Health and Usage Monitoring - HUMS2003**

Forsyth, Graham F; Feb. 2003; 145 pp.; In English

Report No.(s): AD-A412058; DSTO-GD-0348; DODA-AR-012-516; No Copyright; Avail: CASI; [A07](#), Hardcopy

This document includes formal papers for the Third International Conference on Health and Usage Monitoring, HUMS2003, which will be held in Melbourne in February 2003. The scope of papers covers a wide range of monitoring issues with focus on the application to helicopters, military aircraft and gas turbine engines This document includes only the formal papers made available for publication during December 2002. Other papers will be available from the conference CD-ROM which includes this document, other formal papers, presentations not available as formal papers and related software.

DTIC

*Military Helicopters; Aircraft Engines; Flight Stress (Biology); Biological Effects; Physiological Effects*

## 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*.

**20030057820** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Environmental Control and Life Support System Evolution**

Wieland, Paul; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 579-609; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Space Station Freedom Environmental Control and Life Support System (ECLSS) will have to accommodate the changes to Freedom as it evolves over the design life of 30 years or more. Requirements will change as pressurized modules are added, crew numbers increase, and as the tasks to be performed change. This evolution will result in different demands on the ECLSS and the ECLSS will have to adapt. Technologies other than the baselined ones may be better able to perform the various tasks and technological advances will result in improved life support hardware having better performance, increased reliability, reduced power consumption, weight, and volume, greater autonomy, and fewer resupply requirements. A preliminary study was performed to look at alternative technologies for life support and evaluate them for their integration requirements, focusing on the fluid line interface requirements. (A follow-on study will expand greatly on the scope of this preliminary study.) The integration requirements of the alternative technologies may be different from those of the baselined technologies. If this is the case, then by designing the initial space station to have the necessary fluid lines, etc. required by

the selected alternative technologies then the task of replacing the baselined ones will be greatly simplified, thereby reducing the cost in on-orbit time as well as dollars.

Author

*Environmental Control; Life Support Systems; Space Station Freedom; Technology Utilization*

**20030057893** Tennessee Univ., Knoxville, TN

**Meltblowns for Chemical Protective Liners**

Wadsworth, Larry C.; Lee, Youn E.; Schreuder-Gibson, Heidi L.; Gibson, Phillip W.; Mar. 28, 2002; 26 pp.; In English  
Contract(s)/Grant(s): DAAD19-01-1-0732

Report No.(s): AD-A410948; ARO-42880.1-CH-11; No Copyright; Avail: CASI; [A03](#), Hardcopy

The purpose of chemical protective clothing is to shield or isolate individuals from the chemical, physical, and biological hazards that may be encountered in potentially hazardous environments, including biological hazards. When dealing with hazardous materials or working in toxic environment, chemical protective clothing is critical to guard against the effects of toxic products, which could enter the body through inhalation or skin absorption, or cause tissue damage upon contact with the skin. So, there is increased interest in the development of protective wear that provides protection against chemical and biological threats while also being lightweight, comfortable, stretchable and affordable. For this purpose, the melt blown (MB) processing of thermoplastic polyurethanes (Noveon Estane(R) 58237, 58245 and 58280) was studied using the 6-inch and 20-inch MB lines at TANDEC, University of Tennessee, Knoxville. This study was performed in three phases.

DTIC

*Hazardous Materials; Thermoplasticity; Respiration; Protective Clothing*

**20030057925** McGill Univ., Montreal, Quebec, Canada

**Unifying Vestibulo-Ocular Reflexes**

Wagner, R.; Galiana, H. L.; October 25, 2001; 5 pp.; In English; 23rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 25-28 Oct. 2001, Istanbul, Turkey

Report No.(s): AD-A410877; No Copyright; Avail: CASI; [A01](#), Hardcopy

The authors present an eye/head gaze controller based on recent findings in biological gaze control. Despite the absence of an explicit vestibulo-ocular (VOR) mechanism the model is able to produce classical VOR responses, and reject head perturbations during the saccadic portion of a gaze shift executed to a remembered target -- what is usually attributed to a separate vestibular mechanism. The authors argue that distinguishing between both types of responses is not justified, as each is a manifestation of one reflex system having different goals during the stages of gaze redirection.

DTIC

*Eye (Anatomy); Reflexes; Vestibules; Models*

**20030058095** Mississippi State Univ., Mississippi State, MS, USA

**Integrating Digital Eye Tracking With Personnel Optimization Research**

Doane, Stephanie; Bradshaw, Gary; Feb. 7, 2003; 6 pp.; In English

Contract(s)/Grant(s): N00014-02-1-0619

Report No.(s): AD-A411009; No Copyright; Avail: CASI; [A02](#), Hardcopy

This award funded the purchase of a Digital Eye Tracking Research System (DETRS). The DETRS is a state-of-the-art system that allows cognitive scientists at Mississippi State University to integrate eye movement capture into their personnel optimization research. The DETRS enables integration of video and eye tracking data by capturing video data in a digital format, and allows access to several aspects of the same performance, such as pupil measures and point of gaze, and the ability to cross reference data from multiple subjects simultaneously. It includes high precision eye tracking instruments and components that enable the analysis and interpretation of the massive data sets. The non-linear digital data allows the selection of particular frames or crucial moments and this enables focused analysis and display of the data of interest. The DETRS is configured to maintain portability for field experiments and still provide the data storage and processing capacity necessary for archiving, editing and analyzing data. All equipment has been purchased, is in use, and is augmenting the research of multiple DoD and NSF grants.

DTIC

*Human Factors Engineering; Pupils; Information Processing (Biology); Eye Movements*

**20030058720** Chalmers Univ. of Technology, Goeteborg

**Vocalization of Heart Rate Variability**

Saliu, Sokol; Birand, Ahmet; Kudaiberdieva, Gulmira; Oct. 25, 2001; 4 pp.; In English

Report No.(s): AD-A411918; No Copyright; Avail: CASI; [A01](#), Hardcopy

In this paper we have proposed vocalization of heart rate variability (HRV) as a perceptual analysis tool. We adapted a phonation-production model to encode external signals and generate audible representations of them. HRV changes caused by induced perturbations to the autonomous nervous system, could be perceived on vocalized HRV.

DTIC

*Heart Rate; Variability; Human-Computer Interface; Voice; Auditory Signals*

**20030058985** Aristotle Univ. of Thessaloniki, Greece

**Validation of Portable Muscle Tone Measurement Device Based on a Motor-Driven System**

Chen, Jia-Jin J.; Lee, Hsin-Min; Huang, Ying-Zu; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412106; No Copyright; Avail: CASI; [A01](#), Hardcopy

As a component of upper motor neuron syndrome, assessment of abnormality, in muscle tone, including spasticity and rigidity, is a routine clinical examination. The aim of this study is to extend a sophisticated motor-driven measurement system, developed in our previous research, as a validation platform for developing a portable muscle tone measurement system. The main features of hand-held muscle tone measurement device are small angular-rate sensor for recording stretch velocity, and light air-bag cuff for measuring the pressure difference at two sides of the wrist. To test the validity, the measurements recorded from the portable device shows good correlation with that recorded from the motor driven system after removing the gravitational effect. To differentiate the normal from abnormal muscle tone, the slope of stretch resistance versus position was used to differentiate the normal muscle tone from that of a parkinsonism. However, there several factors, including the application of air-bag, the air-filled pressure, and the stretch velocity, could affect the accuracy in using the hand-held device for muscle tone assessment.

DTIC

*Portable Equipment; Robots; Muscles; Medicine; Neurons; Medical Equipment*

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*.

**20030057765** Lawrence Livermore National Lab., Livermore, CA

**Hierarchical Representation of Time-Varying Volume Data with 4 over Root(2) Subdivision and Quadrilinear B-Spline Wavelets**

Linsen, L.; Pascucci, V.; Duchaineau, M. A.; Hamann, B.; Joy, K. I.; Nov. 19, 2002; In English

Report No.(s): DE2003-15002518; UCRL-JC-151063; No Copyright; Avail: National Technical Information Service (NTIS)

No abstract available

NTIS

*Wavelet Analysis; Time Functions; Mathematical Models*

**20030057777** Lawrence Livermore National Lab., Livermore, CA

**Self-Calibrating Multi-Band Region Growing Approach to Segmentation of Single and Multi-Band Images**

Paglieroni, D. W.; Dec. 20, 2002; In English

Report No.(s): DE2003-15003255; UCRL-JC-150988; No Copyright; Avail: National Technical Information Service (NTIS)

Remotely sensed images (e.g., multi-spectral and hyperspectral images) often contain many spectral bands (i.e., multiple layers of 2D images). Multi-band images are important because they contain more information than single -band images. Objects or natural variations that are readily apparent in certain spectral bands may be invisible in 2D broadband images. In this paper, the classical region growing approach to image segmentation is generalized from single to multi-band images. While it is widely recognized that the quality of image segmentation is affected by which segmentation algorithm is used, this paper shows that algorithm parameter values can have an even more profound effect. A novel self-calibration framework is developed for automatically selecting parameter values that produce segmentations that most closely resemble a calibration edge map (derived separately using a simple edge detector). Although the framework is generic in the sense that it can imbed

any core segmentation algorithm, this paper only demonstrates self-calibration with multi-band region growing. The framework is applied to a variety of AVIRIS image blocks at different spectral resolutions, in an effort to assess the impact of spectral resolution on segmentation quality. The image segmentations are assessed quantitatively, and it is shown that segmentation quality does not generally appear to be highly correlated with spectral resolution.

NTIS

*Image Processing; Image Resolution*

**20030057805** Rutherford Appleton Lab., Oxford, UK

**Multidimensional Filter Algorithm for Nonlinear Equations and Nonlinear Least Squares**

Gould, N. I. M.; Leyffer, S.; Toint, P. L.; Feb. 12, 2003; In English

Report No.(s): PB2003-104156; RAL-TR-2003-004; No Copyright; Avail: National Technical Information Service (NTIS)

We introduce a new algorithm for the solution of systems of nonlinear equations and non-linear least-squares problems that attempts to combine the efficiency of filter techniques and the robustness of trust-region methods. The algorithm is shown, under reasonable assumptions, to globally converge to zeros of the system, or to first-order stationary points of the Euclidean norm of its residual. Preliminary numerical experience is presented that shows substantial gains in efficiency over the traditional monotone trust-region approach.

NTIS

*Algorithms; Nonlinear Equations*

**20030057857** National Inst. of Standards and Technology, Gaithersburg, MD

**Face Recognition Vendor Test 2002 Performance Metrics**

Grother, P.; Michaels, R.; Phillips, J.; 2002; 18 pp.; In English

Report No.(s): PB2003-104208; NISTIR-6982; No Copyright; Avail: CASI; [A03](#), Hardcopy

The authors present the methodology and recognition performance characteristics used in the Face Recognition Vendor Test 2002. The authors refine the notion of a biometric imposter, and show that the traditional measures of identification and verification performance, are limiting cases of the open-universe watch list task. The watch list problem generalizes the tradeoff of detection and identification of persons of interest against a false alarm rate. In addition, the authors use performance scores on disjoint populations to establish a means of computing and displaying distribution-free estimates of the variation of verification vs. false alarm performance. Finally the authors formalize gallery normalization, which is an extension of previous evaluation methodologies; the authors define a pair of gallery dependent mappings that can be applied as a post recognition step to vectors of distance or similarity scores. All the methods are biometric non-specific, and applicable to large populations.

NTIS

*Image Processing; Face (Anatomy)*

**20030057910** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Pennsylvania State Univ., University Park, PA, USA

**Adaptive Dimension Reduction for Clustering High Dimensional Data**

Ding, C.; He, X.; Zha, H.; Simon, H. D.; 2002; 12 pp.; In English

Report No.(s): DE2003-807420; No Copyright; Avail: Department of Energy Information Bridge

It is well-known that for high dimensional data clustering, standard algorithms such as EM and the K-means are often trapped in local minimum. Many initialization methods were proposed to tackle this problem, but with only limited success. In this paper we propose a new approach to resolve this problem by repeated dimension reductions such that K-means or EM are performed only in very low dimensions. Cluster membership is utilized as a bridge between the reduced dimensional subspace and the original space, providing flexibility and ease of implementation. Clustering analysis performed on highly overlapped Gaussians, DNA gene expression profiles and internet newsgroups demonstrate the effectiveness of the proposed algorithm.

NTIS

*Algorithms; Dimensions; Cluster Analysis*

**20030057934** Technische Univ., Delft, Netherlands

**Imaging Algorithms for Real Time Applications**

denHeijer, D. M.; Feb. 2002; 94 pp.; In English

Report No.(s): PB2003-104805; ET/EM-1990-06; Copyright; Avail: National Technical Information Service (NTIS)

In several applications real time imaging methods are needed, e.g. for the location of land mined with Ground Penetrating Radar. In this report, the authors described a number of algorithms for obtaining an image of a scattering object. The first one operates in the time domain through proper interpolation. The second algorithm however operates in the frequency domain where an Inverse Fourier Transform is used to obtain the image data. The third algorithm is an extension of the first one in that it interpolates over the pre-envelope of the data instead of the original data. In the last algorithm, the complex pre-envelope is subjected to the Inverse Fourier Transform as an extension of the second algorithm. All these algorithms are implemented in Matlab computer code resulting directly in a visual image. By considering different electromagnetic field components in the imaging algorithms, the electromagnetic vectorial character of the scattering problem is illustrated.

NTIS

*Scattering; Algorithms; Imaging Techniques; Real Time Operation*

**20030057946** Rutherford Appleton Lab., Oxford, UK

**Global Convergence of a Non-Monotone Trust-Region Filter Algorithm for Nonlinear Programming**

Gould, N. I. M.; Toint, P. L.; Feb. 12, 2003; 40 pp.; In English

Report No.(s): PB2003-104157; RAL-TR-2003-003; No Copyright; Avail: CASI; [A03](#), Hardcopy

A non-monotone variant of the trust-region SQP-filter algorithm analyzed in Fletcher, Gould, Leyffer, Toint and Wachter (2002a) that directly uses the dominated area of the filter as an acceptability criterion for trial points is defined. It is proved that, under reasonable assumptions and for all possible choices of the starting point, the algorithm generates at least a subsequence converging to a first-order critical point.

NTIS

*Algorithms; Nonlinear Programming; Computer Programming*

**20030058004** Swedish Defence Research Establishment, Linköping, Sweden

**Security in Active Networks**

Persson, M.; Dec. 2001; 34 pp.; In Swedish

Report No.(s): PB2003-103204; FOI-R-0309-SE; No Copyright; Avail: CASI; [A03](#), Hardcopy

The report describes active networks and how they can be used. Current research results are briefly described and the report also contains an analysis and evaluation of the security in some implementations of active networks. The functionality of an active network can be changed by sending program code (mobile code) between the nodes in the network. This makes it possible to treat the network as a programmable shared computer. Even today, you can see noticeable trends that the networks become more active. Examples are firewalls and webproxies, which can be configured and controlled by fast loading of new program code. The disadvantage is increased security risks when using this form of mobile program code.

NTIS

*Computer Networks; Computer Information Security*

**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*.

**20030057993** CACI Technologies, Inc., Chantilly, VA, USA

**Programming High Performance Reconfigurable Computers (HPRC)**

Peterson, Gregory D.; Jan. 2003; 74 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F30602-00-D-0221; Proj-459T

Report No.(s): AD-A411220; AFRL-IF-RS-TR-2003-2; No Copyright; Avail: CASI; [A04](#), Hardcopy

The integration of High Performance Computing with Reconfigurable Computing offers great potential for increased performance and flexibility for a wide range of computing problems. High Performance Computing architectures and Reconfigurable Computing systems have independently demonstrated performance advantages for applications such as digital signal processing and pattern recognition. By exploiting the near hardware specific speed of Reconfigurable Computing systems incorporated into a computer cluster, there is potential for significant performance advantages over software-only or uniprocessor solutions. However, application development barriers exist that will slow the widespread adoption of this technology. This report presents the results of research seeking to overcome one of these barriers, the development of a

programming framework for High Performance Reconfigurable Computing systems.

DTIC

*Signal Processing; Architecture (Computers)*

## 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.

**20030057769** Fermi National Accelerator Lab., Batavia, IL, USA, Nicolaus Copernicus Univ., Torun, Poland

#### **3D Visualization for the MARS CODE**

Rzepecki, J. P.; Kostin, M. A.; Mokhov, N. V.; Jan. 2003; In English

Report No.(s): DE2003-807167; FERMILAB-TM-2197; No Copyright; Avail: National Technical Information Service (NTIS)

A new three-dimensional visualization engine has been developed for the MARS14 code system. It is based on the OPENINVENTOR graphics library and integrated with the MARS built-in two-dimensional Graphical-User Interface, MARS-GUI-SLICE. The integrated package allows thorough checking of complex geometry systems and their fragments, materials, magnetic fields, particle tracks along with a visualization of calculated 2-D histograms. The algorithms and their optimization are described for two geometry classes along with examples in accelerator and detector applications.

NTIS

*Three Dimensional Models; Graphical User Interface; Display Devices*

**20030057833** Lawrence Livermore National Lab., Livermore, CA

#### **HADES User's Manual**

Aufderheide, M. B.; Slone, D. M.; SchachvonWittenau, A. E.; Dec. 26, 2002; 72 pp.; In English

Report No.(s): DE2003-15003149; UCRL-MA-151338; No Copyright; Avail: Department of Energy Information Bridge

HADES is a computer code that simulates transmission radiography through a mesh and/or solid bodies. This code is a successor to an old code called XRAY. HADES is designed to be backward compatible with XRAY (i.e. it will accept and correctly parse XRAY input decks), but HADES has many more features that greatly enhance its versatility and its simulation of experimental effects. HADES can simulate X-Ray radiography, neutron radiography or GeV proton radiography using ray-tracing techniques. A short article has been published which discusses HADES' capabilities. HADES also has some capability for simulating pinhole imaging and backlight imaging. The best way to obtain HADES is to ask one of the authors for a copy. This manual covers all features in version 2.5.0 of HADES.

NTIS

*Image Processing; Radiography; Computer Programs*

**20030057856** Pacific Northwest National Lab., Richland, WA, USA

#### **Visual Sample Plan Version 2.0 User's Guide**

Hassig, N. L.; Wilson, J. E.; Gilbert, R. O.; Carlson, D. K.; O'Brien, R. F.; Sep. 2002; In English

Report No.(s): DE2003-15002648; PNNL-14002; No Copyright; Avail: National Technical Information Service (NTIS)

This user's guide describes Visual Sample Plan (VSP) Version 2.0 and provides instructions for using the software. VSP selects the appropriate number and location of environmental samples to ensure that the results of statistical tests performed to provide input to environmental decisions have the required confidence and performance. VSP Version 2.0 provides sample-size equations or algorithms needed by specific statistical tests appropriate for specific environmental sampling objectives. The easy-to-use program is highly visual and graphic. VSP runs on personal computers with Microsoft Windows operating systems (95, 98, NT, 2000, Millennium Edition, and XP). Designed primarily for project managers and users without expertise in statistics, VSP is applicable to any two-dimensional geographical population to be sampled (e.g., surface soil, a defined layer of subsurface soil, building surfaces, water bodies, and other similar applications) for studies of environmental quality.

NTIS

*Sampling; Statistics; Environment Pollution*



**20030057868** Technical Research Centre of Finland, Espoo, Finland

**Software Architecture for Configuration and Usage of Process Simulation Models. Software Component Technology and XML-Based Approach**

Karhela, T.; 2002; 158 pp.

Report No.(s): PB2003-105026; VTT-PUB-479; No Copyright; Avail: CASI; [A08](#), Hardcopy

Increased use of process simulation in different phases of the process and automation life cycle makes the information management related to model configuration and usage more important. Information management increases the requirements for more efficient model customization and reuse, improved configurational co-use between different simulators, more generic extensibility of the simulation tools and more flexible run-time connectivity between the simulators and other applications. In this thesis, the emphasis is on large-scale dynamic process simulation of continuous processes in the power, pulp and paper industries. The main research problem is how to apply current information technologies, such as software component technology and XML, to facilitate the use of process simulation and to enhance the benefits gained from using it. As a development task this means developing a new software architecture that takes into account the requirements of improved information management in process simulation. As a research objective it means analyzing whether it is possible to meet the new requirements in one software architecture using open specifications developed in information and automation technologies. Process simulation is analyzed from the points of view of standardization, current process simulation systems and simulation research. A new architectural solution is designed and implemented. The degree of meeting the new requirements is experimentally verified by testing the alleged features using examples and industrial cases. The main result of this thesis is the design, description and implementation of a new integration architecture for the configuration and usage of process simulation models. The original features of the proposed architecture are its openness, general distribution concept and distributed extensibility features.

NTIS

*Architecture (Computers); Software Engineering; Computer Systems Simulation*

**20030057874** Army Research Lab., Aberdeen Proving Ground, MD

**Computer Study of the Ionic Mechanisms of Organophosphorous-Caused Long-QT Syndrome (LQTS)**

Zoltani, Csaba K.; Baskin, Steven I.; Feb. 2003; 28 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): Proj-2U5/NC

Report No.(s): AD-A410799; ARL-TR-2902; No Copyright; Avail: CASI; [A03](#), Hardcopy

An important clinical marker of organophosphorous (OP)-caused cardiac toxicity is long-QT syndrome, the prolongation of the repolarization period in the ventricles, as measured in an electrocardiogram. The primary membrane currents responsible for this condition are two potassium currents, IKr and IKs. This computer simulation investigated the effect of the modulation of the membrane currents most likely affected by the OP on the action potential in a two-dimensional slab of cardiac tissue. We have shown that modulation and reduction of the potassium currents, changes in the background current, and calcium overload of the cells mimic the experimentally observed change in slope of the depolarization in the presence of OPs as well as the prolongation and change in the shape of the plot of repolarization voltage vs. time. These changes are precursors to the onset of Torsade de Pointes and ventricular fibrillation and suggest the required pharmacology of antidotes for force protection. Based on these results, an estimated dose-response curve is presented.

DTIC

*Computerized Simulation; Ion Distribution; Fibrillation; Heart; Prolongation*

**20030057881** Chicago Univ., Chicago, IL

**A Method for Simulating Mammograms**

Nishikawa, Robert M.; Aug. 2002; 9 pp.; In English

Contract(s)/Grant(s): DAMD17-99-1-9122

Report No.(s): AD-A410853; No Copyright; Avail: CASI; [A02](#), Hardcopy

This project is to facilitate research in digital mammography and related technologies, in particular computer aided diagnosis and image processing. A major limitation to the rapid development and subsequent clinical implementation of these technologies is the lack of a standardized set of mammograms to be used in development and evaluation. We are developing a method to produce simulated mammograms. The method relies on a model of image formation that takes into account the absorption of x-rays in the phosphor, subsequent conversion to light and the scattering of the light before escaping the phosphor. The model also takes into account the finite thickness of the phosphor, the divergence of the x-ray beam, scattered radiation, and noise due to film granularity and from the film digitizer. Almost all the components of the model are completed and computer code is being written. We are now testing the model using x-ray phantoms. We are comparing simulated images

created based on a high quality film radiograph to an image acquired using a mammographic screen-film system. The resolution properties of the simulated image closely match that of a real image, but the noise properties differ. We are in the process of determining why there is a difference.

DTIC

*Computer Techniques; Diagnosis; Image Processing; X Rays; Clinical Medicine*

**20030057891** Virginia Univ., Charlottesville, VA

**Identification of Novel Drug Targets for Breast Cancer by Designing a Computer Simulation Program to Analyze the Kinetic Process for PIP2 Hydrolysis by PLCgamma**

Jones, Gwenith; Jun. 2002; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-91-1-0663

Report No.(s): AD-A410787; No Copyright; Avail: CASI; [A03](#), Hardcopy

PLC gamma 1 hydrolyzes the lipid substrate PIP2 to the two second messengers, IP3 and DAG, in response to certain growth factors, such as EGF. PLC gamma 1 is often overexpressed and activated in breast tumors. Overexpression and activation of PLC gamma 1 in breast tumors have been correlated with increased cell motility, therefore, PLC gamma 1 may play a role in tumor metastasis. As a consequence, PLC gamma 1 is an attractive target for novel anti-cancer therapies. My laboratory proposes to investigate if a computer simulation program can be generated based on existing experimental data, that can predict the kinetic behavior of PLC gamma 1. Creation of a kinetic simulation program for PLC gamma 1 will allow us to predict which steps are rate-limiting and then design experiments to test these predictions. The new experimental data will then be used to refine the simulation program. This approach, if successful, will allow a more rapid identification of potential drug targets. Additional benefit of the program is that it may be able to describe the kinetic behavior of any phospholipase or enzyme, which has been implicated in the progression of breast cancer, that requires binding to the membrane in order to be active.

DTIC

*Computerized Simulation; Drugs; Cancer; Tumors*

**20030057895** Technical Research Centre of Finland, Espoo, Finland

**Virtual Prototyping VTT Research Program 1998-2000**

Lehtonen, M.; Feb. 01, 2001; In English

Report No.(s): PB2003-103154; VTT-SYM-210; No Copyright; Avail: National Technical Information Service (NTIS)

Contents include the following: Preface; Concurrent engineering - organisational and software requirements; Product data portal; Real time simulation in product development; Simulation and analysis of human machine system; Virtual manufacturing on the Internet; Virtual production system development in product process and Advantages and problems of CAVE-visualisation for design purposes.

NTIS

*Prototypes; Computerized Simulation; Virtual Reality*

**20030058043** Instituto Nacional de Pesquisas Espaciais, Sao Jose dos Campos, Brazil

**Strategies and Patterns for Softboard-Based Systems Human-Computer Interface Modelling**

GomesdeSiqueira, Eunice; 2003; 163 pp.; In Portuguese

Report No.(s): INPE-9621-TDI/844; Copyright; Avail: CASI; [A08](#), Hardcopy

The use of the computers by society is growing. However, for this use to be efficient and effective, it is necessary to consider the computer system's human-computer interface. The interface influences the user's satisfaction and productivity, the training, then technical support and the operation costs, and in some cases, even people's safety. Aiming at better software systems' quality, more especially for human-computer interface, this research is presented as a set of strategies and patterns for SOFTBOARD-based systems' human-computer interface modelling. In order for developers to achieve better productivity, this research also defines a metadata model which is necessary to the Human-Computer Interface Component of SOFTBOARD. This allows it to be configured for use in different applications.

Author

*Human-Computer Interface; Computer Design; Computer Programs; Computer Systems Design; Software Engineering*

**20030058097** Naval Postgraduate School, Monterey, CA

**Face Recognition Using Infrared Imaging**

Pereira, Diogo C.; Dec. 2002; 114 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411044; No Copyright; Avail: CASI; [A06](#), Hardcopy

This study investigated a (IR) face recognition system using an uncooled IR camera. A computer-based image collection set-up was designed and used to create a small database of 420 facial images, from 14 volunteers. Manual and automated facial image cropping routines were implemented. Two linear approaches (PCA and LDA) for the dataset dimension reduction and classification were implemented and their resulting classification performances compared. Results show that the best PCA-based average classification performance is equal to 92,22\% while the LDA-based classification performance is equal to 99,40\%. These results successfully show that an uncooled IR camera may be used to disseminate between individual subjects obtained from a small database collected under a very controlled environment.

DTIC

*Infrared Imagery; Recognition; Face (Anatomy); Computer Vision*

**20030058719** Carnegie-Mellon Univ., Pittsburgh, PA

**A Federation Object Model (FOM) Flexible Federate Framework**

Dumond, Regis; Little, Reed; Mar. 2003; 32 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A412315; CMU/SEI-2003-TN-007; No Copyright; Avail: CASI; [A03](#), Hardcopy

The concept of a framework as a reusable software component has become a state-of-the-practice technique in software companies. A number of frameworks based on High Level Architecture (HLA) are available commercially, and many companies have developed their own frameworks for internal applications. Using a framework reduces development time and allows software architects and programmers to focus on the unique aspects of the simulation. However, the challenge of developing a reusable component to support dynamic reconfigurability remains. Indeed, existing frameworks use a static object-model representation that requires full knowledge of object model components when a federate is built (at compile-time). This report describes an approach to designing a domain framework that encapsulates expertise in developing an HLA federate by hiding runtime infrastructure (RTI) internal operations from the developer. This approach uses a Java virtual machine and a parser to map object representations of federation object model (FOM) elements dynamically.

DTIC

*Software Engineering; High Level Languages; Architecture (Computers)*

**20030058735** California Univ., Davis, CA

**URC Fuzzy Modeling and Simulation of Gene Regulation**

Sokhansanj, B. A.; Fitch, J. P.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411144; No Copyright; Avail: CASI; [A01](#), Hardcopy

Recent technological advances in high-throughput data collection give biologists the ability to study increasingly complex systems. A new methodology is needed to develop and test biological models based on experimental observations and predict the effect of perturbations of the network (e.g. genetic engineering, pharmaceuticals, gene therapy). Diverse modeling approaches have been proposed, in two general categories: modeling a biological pathway as (a) a logical circuit or (b) a chemical reaction network. Boolean logic models can not represent necessary biological details. Chemical kinetics simulations require large numbers of parameters that are very difficult to accurately measure. Based on the way biologists have traditionally thought about systems, we propose that fuzzy logic is a natural language for modeling biology. The Union Rule Configuration (URC) avoids combinatorial explosion in the fuzzy rule base, allowing complex system models. We demonstrate the fuzzy modeling method on the commonly studied lac operon of E. coli. Our goal is to develop a modeling and simulation approach that can be understood and applied by biologists without the need for experts in other fields or 'black-box' software.

DTIC

*Genetic Engineering; Computer Programs*

**20030058751** Massachusetts Inst. of Tech., Cambridge, MA

**An IIOP Architecture for Web-Enabled Physiological Models**

Zhang, Shixin; Dewey, C. F., Jr; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411453; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper develops a specific information architecture to serve complex physiological information models and a means of delivering these models in a manner that allows interactive and distributed use. By redesign of existing models for distributed use, the IIOP (Internet Inter-ORB Protocol) architecture provides general access across the Internet; the methods are replicable with many different types of physiological models that produce a variety of results. This paper defines and

explains the complete architecture for the user interface, the model encapsulation, and the communication layer between the client and server by developing a general example. Using the equivalent of interactive browsers to access remote models and display the results, the IIOP architecture is built up using platform-independent technology such as CORBA, Java and XML. The existing physiological models are first encapsulated by a suitable software language respect to the legacy models. Then CORBA IDL-XML interfaces are built accordingly as a broker interface connecting user interfaces to encapsulating interfaces. Therefore, the standard user interfaces on the browsers are easily built to access these models through the CORBA ORB and the encapsulating interfaces. This interface software is capable of interpreting and displaying very high-level descriptors and model output such that the amount of data required to be transmitted over the Internet is reduced.

DTIC

*Computer Programming; Information Retrieval*

**20030058787** Naval Postgraduate School, Monterey, CA

**Performance Evaluation of Voice Over Internet Protocol**

Dechjaroen, Chaiporn; Dec. 2002; 115 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411578; No Copyright; Avail: CASI; [A06](#), Hardcopy

Voice over Internet Protocol (VoIP) was developed to emulate toll services with lower communication cost. In VoIP applications, voices are digitized and packetized into small blocks. These voice blocks are encapsulated in a sequence of voice packets using the Real-time Transport Protocol (RTP) and delivered by the User Datagram Protocol (UDP). To help VoIP applications deal with unpredictable network performance, the Real-time Transport Control Protocol (RTCP) is developed to monitor the performance of RTP packets and provide feedback to the VoIP applications. The feedback on packet delay, jitter, and loss rate enables the applications to adapt to network conditions to maintain a certain level of voice quality. With this architecture, the quality of service of VoIP relies on the effectiveness of the RTCP network performance report mechanism. This research collects RTCP performance reports from live traffic over real networks and compares their values with the statistics derived from direct measurements of RTP packets to evaluate the effectiveness of RTCP. The live experiments were conducted on networks resembling respectively, Local Area Network (LAN), Wide Area Network (WAN), campus network, and encrypted wireless LAN. Results from these experiments show that RTCP is effective for low delay networks but RTCP performance reports can be inaccurate for networks with large, volatile delays.

DTIC

*Evaluation; Wide Area Networks; Radio Signals; Voice Communication*

**20030058789** Thiokol Propulsion, Brigham City, UT, USA

**Focus Control System for Solar Thermal Propulsion**

Wassom, Steven R.; Mar. 2, 2000; 3 pp.; In English

Contract(s)/Grant(s): Proj-1011

Report No.(s): AD-A411570; AFRL-PR-ED-AB-2000-041; No Copyright; Avail: CASI; [A01](#), Hardcopy

Solar thermal propulsion (STP) uses a parabolic concentrator like a large magnifying glass to focus the sun's energy and heat a working fluid such as hydrogen to very high temperatures (3,000 K). The hydrogen is then expelled through a nozzle to produce thrust. This innovative concept has twice the efficiency of currently used chemical upper-stage propulsion systems. Inflatable solar concentrators can be packaged more efficiently than rigid concentrators of equal power. The Air Force Research Laboratory at Edwards Air Force Base, CA, is sponsoring Thiokol Propulsion and SRS Technologies to design, build, and demonstrate an inflatable STP system. This paper will address the use of ADAMS and MATRIXx to develop the structure's focus control system, which uses an articulated mechanism to track the sun and focus the solar energy. Animations of the closed-loop, 3-D models have been developed to show the feasibility of the concept. (3 figures)

DTIC

*Solar Energy; Active Control; Rocket Engines; Propulsion System Performance; Temperature Effects*

**20030058796** Maryland Univ., College Park, MD

**Jazz: An Extensible Zoomable User Interface Graphics Toolkit in Java**

Bederson, Benjamin B.; Meyer, Jon; Good, Lance; Jan. 2000; 12 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F33615-97-1-1018; Proj-ARPA

Report No.(s): AD-A412202; AFRL-SN-WP-TP-2003-109; No Copyright; Avail: CASI; [A03](#), Hardcopy

In this paper the authors investigate the use of scene graphs as a general approach for implementing two-dimensional (2D) graphical applications, and in particular Zoomable User Interfaces (ZUIs). Scene graphs are typically found in three-

dimensional (3D) graphics packages such as Sun's Java3D and SGI's OpenInventor. They have not been widely adopted by 2D graphical user interface toolkits. To explore the effectiveness of scene graph techniques, the authors have developed Jazz, a general-purpose 2D scene graph toolkit. Jazz is implemented in Java using Java2D, and runs on all platforms that support Java 2. This paper describes Jazz and the lessons we learned using Jazz for ZUIs. It also discusses how 2D scene graphs can be applied to other application areas. (5 figures, 27 refs.)

DTIC

*Graphical User Interface; Software Development Tools; Java (Programming Language)*

**20030058833** Amsterdam Univ., Netherlands

**Model Clamp: A Computer Tool to Probe Action Potential Transfer Between Cardiac Cells**

Wilders, Ronald; Verkerk, Arie O.; Verheijck, E. E.; van Ginneken, Antoni C.; Kumar, Rajiv; Oct. 25, 2001; 5 pp.; In English Report No.(s): AD-A412111; No Copyright; Avail: CASI; [A01](#), Hardcopy

In the early nineties, Joyner and coworkers introduced the 'coupling clamp' technique in which an isolated cardiac cell can be electrically coupled to either another isolated cardiac cell or to an analog model cell (RC circuit). In brief, an amplifier system does a continuous analog computation of the current that would be flowing between the two cells if there had been an intercellular coupling conductance  $G(c)$ , and then provides current inputs to the cells accordingly. Building on this concept, we developed the computer-controlled 'model clamp' technique, in which an isolated cardiac cell is dynamically coupled in real time to a comprehensive mathematical cell model (e.g., the phase-2 Luo-Rudy model). With this system we have the ability to vary coupling conductance, effective size of both model cell and real cell, and intrinsic cellular properties of the model cell. In courses on cardiac electrophysiology, the model clamp system provides a useful computer tool to probe action potential transfer between cardiac cells. It can be used to assess alterations in the critical value of coupling conductance required for action potential transfer from a real ventricular cell to the Luo-Rudy model ventricular cell upon exposure of the real cell to, e.g., noradrenaline.

DTIC

*Heart; Electrophysiology; Mathematical Models; Applications Programs (Computers); Cells (Biology); Cardiovascular System*

**20030058837** Army Engineer Research and Development Center, Vicksburg, MS, USA

**Conceptual Methods for Generation of Urban Terrain Data for Military Operations in Urban Terrain (MOUT)**

Hahn, Charles D.; Bunch, Laura S.; Ballard, Jerrell R., Jr; Dec. 2002; 40 pp.; In English; Original contains color illustrations Report No.(s): AD-A410988; ERDC/EL-TR-02-40; No Copyright; Avail: CASI; [A03](#), Hardcopy

Computer modeling and simulation (M&S) for military purposes has become more and more important with dwindling military budgets but more complex military equipment. M&S allows military weapons designers to test weapons systems under a variety of environmental conditions and under many varying terrains at a far lower cost than testing under real conditions. M&S also provides troops with intensive training on complex military systems without fuel costs, wear and tear on equipment, and risk of injury or death from training accidents. The OneSAF, JSAF, and ModSAF systems have all been developed to meet the needs of the M&S community. However, there has been one deficiency in all of the previous M&S work: all of the efforts have focused on rural environments. The Army M&S Office (AMSO) established the Military Operations in Urban Terrain (MOUT) Focus Area Collaborative Team (FACT) as part of an effort to expand M&S into the urban landscape. The Army realizes that as military operations become more frequent in the urban environment, it becomes even more important to train and test in that environment. This project was undertaken in an effort to develop a process to generate realistic urban terrain databases that may be used in M&S systems in a cost-effective and efficient manner. This report discusses the procedure developed to generate an urban landscape database and the application of that procedure to a real urban landscape.

DTIC

*Computer Programs; Computerized Simulation; Computer Aided Design; Targets; Terrain; Cities; Military Operations*

**20030058849** Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA

**Web-Based Collaborative Learning: An Assessment of a Question-Generation Approach**

Belanich, James; Wisher, Robert A.; Orvis, Kara L.; Jan. 2003; 35 pp.; In English

Report No.(s): AD-A410956; ARI-TR-1133; No Copyright; Avail: CASI; [A03](#), Hardcopy

Students linked into a learning environment over the Internet may learn topics better by collaborating to create questions and answers. In research reported here, students used a learning aid for collaborative question generation called Army

TEAMThink, a commercial program modified for Army use under a TRADOC Delivery Order contract Research was done at three US Army schools to assess the quality or doctrinal correctness of questions and answers generated by students and to measure any learning benefit. Students first completed a tutorial on how to write effective multiple-choice questions. Next, students wrote questions and reviewed questions written by other students. Based on the feedback from the reviews, authors were allowed to modify their own questions. Finally, students took a test of the questions that had been developed by students using the learning aid. Army subject matter experts judged that most of the questions developed were considered acceptable and could be repurposed for use in course exams. A majority of the question feedback was constructive, indicating that the collaborative process was helpful. Students who went through the process scored higher on a test of novel questions than those who did not use Army TEAMThink. They also scored higher than students who went through the process on a different topic from the test topic, demonstrating a moderate learning effect. The general finding of this research about a collaborative question-generation approach is that instructors can accumulate quality multiple-choice questions and monitor student comprehension, and students have an additional opportunity for better learning.

DTIC

*World Wide Web; Internets; Education; Computer Programming*

**20030058863** Purdue Univ., West Lafayette, IN

**Perpetual Testing**

Young, Michal; Feb. 2003; 34 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F30602-97-2-0034; AF Proj. E099

Report No.(s): AD-A412542; AFRL-IF-RS-TR-2003-32; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Perpetual Testing project was part of the High Assurance Cluster of projects in the DARPA Evolutionary Design of Complex Software Program. The Perpetual Testing project as a whole was a collaboration of Purdue University (continued at the University of Oregon), University of Massachusetts, and the University of California at Irvine, under three separate Air Force contracts. This report describes the portion of work conducted at Purdue University and the University of Oregon under cooperative agreement F30602-97-2-0034 with the Air Force Research Laboratory, Rome NY. The Perpetual Testing project goal was to develop technologies to support seamless, perpetual analysis and testing of software through deployment and evolution. The current development paradigm treats testing as a phase that succeeds development and precedes delivery. The Perpetual Testing project's focus was to build a foundation for treating analysis and testing as on-going activities to improve quality assurance through generations of a project.

DTIC

*Software Engineering; Evaluation; Computer Programs*

**20030058995** Swedish Defence Research Establishment, Tumba

**KRYP, a Finite Element Tool for Crystal Plasticity Analyses**

Olovsson, L.; Mar. 2002; 36 pp.; In English

Report No.(s): PB2003-103208; FOI-R-0374-SE; No Copyright; Avail: CASI; [A03](#), Hardcopy

KRYP is a finite element program for meso-mechanical crystal plasticity simulations. The theory is based on a continuum mechanical approach where dislocations are treated as field variables. The objective of the ongoing development project is to reach a state where KRYP becomes a useful tool for predictions of grain interaction characteristics and texture formation properties in the process of developing new materials. The code development project was initiated in August 2001. Today, six months later, KRYP is a fully functioning finite element program, including an FCC crystal plasticity model that is ready to be scrutinized in detail.

NTIS

*Crystals; Plastic Properties; Finite Element Method; Computer Programs*

**20030058998** Swedish Defence Research Establishment, Stockholm, Sweden

**Trade Name) (Guidance of Collaborating Missiles - A Study of Modelling and Simulation in FLAMES (Trade Name)**

EKloef, M.; Pelo, J.; Ulriksson, J.; Wallstroem, D.; December 2001; 36 pp.; In Swedish

Report No.(s): PB2003-103231; FOI-R-0322-SE; No Copyright; Avail: CASI; [A03](#), Hardcopy

This document describes the task of modeling and simulation a military situation in the framework FLAMES (trademark). The study is performed under the project 'Collaborating Missiles' and its prime objective has been to study the advantage and the possibilities of a collaborating missile system in contrast to a conventional missile system but also investigate the possibility to illustrate those advantages through computer simulations. The study has been launched to investigate two major

issues. The first has been to investigate how to build a specific scenario in FLAMES (trademark) with models that are needed to build a scenario flexibly enough to illuminate the specific problems in this specific case. A suitable scenario has been chosen and is briefly described. This scenario has been modeled in FLAMES (trademark) with today's existing modules and the result is discussed. Thereafter is a description of how different functions are modeled. And finally presents a list of functions and modules that is needed to build more advance models and to make modeling easier.

NTIS

*Missiles; Computerized Simulation; Missile Control; Military Technology; Guidance (Motion)*

**20030059000** Sandia National Labs., Albuquerque, NM

**SIERRA Framework Version 3: Core Services Theroy and Design**

Edwards, H. C.; Nov. 2002; In English

Report No.(s): DE2002-805863; No Copyright; Avail: National Technical Information Service (NTIS)

The SIERRA Framework core services provide essential services for managing the mesh data structure, computational fields, and physics models of an application. An application using these services will supply a set of physics models, define the computational fields that are required by those models, and define the mesh upon which its physics models operate. The SIERRA Framework then manages all of the data for a massively parallel multiphysics application.

NTIS

*Software Engineering; Data Management; Applications Programs (Computers)*

**20030059030** NASA Langley Research Center, Hampton, VA, USA

**X-33 Computational Aeroheating/Aerodynamic Predictions and Comparisons With Experimental Data**

Hollis, Brian R.; Thompson, Richard A.; Berry, Scott A.; Horvath, Thomas J.; Murphy, Kelly J.; Nowak, Robert J.; Alter, Stephen J.; January 05, 2003; 88 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): WU 762-30-51-30

Report No.(s): NASA/TP-2003-212160; L-18254; NAS 1.60:212160; No Copyright; Avail: CASI; [A05](#), Hardcopy

This report details a computational fluid dynamics study conducted in support of the phase II development of the X-33 vehicle. Aerodynamic and aeroheating predictions were generated for the X-33 vehicle at both flight and wind-tunnel test conditions using two finite-volume, Navier-Stokes solvers. Aerodynamic computations were performed at Mach 6 and Mach 10 wind-tunnel conditions for angles of attack from 10 to 50 with body-flap deflections of 0 to 20. Additional aerodynamic computations were performed over a parametric range of free-stream conditions at Mach numbers of 4 to 10 and angles of attack from 10 to 50. Laminar and turbulent wind-tunnel aeroheating computations were performed at Mach 6 for angles of attack of 20 to 40 with body-flap deflections of 0 to 20. Aeroheating computations were performed at four flight conditions with Mach numbers of 6.6 to 8.9 and angles of attack of 10 to 40. Surface heating and pressure distributions, surface streamlines, flow field information, and aerodynamic coefficients from these computations are presented, and comparisons are made with wind-tunnel data.

Author

*Aerodynamic Heating; Computational Fluid Dynamics; Flow Distribution; Navier-Stokes Equation; Pressure Distribution*

**20030059036** UNIVERSIDAD DE LA CORUNA (SPAIN)

**Design and Implementation of A DICOM PACS With Secure Access Via Internet**

Pereira, J.; Lamelo, A.; Vazquez-Naya, J. M.; Fernandez, M.; Lopez-Gestal, J. M.; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A411081; No Copyright; Avail: CASI; [A01](#), Hardcopy

Among the last new developments in the field of teleradiology, a new system of teleradiologic which allows the remote transmission of digital images via Internet is prevailing. These communications have to be made through mechanisms that guarantee the confidentiality and the integrity of the clinical data, as well as the authenticity of the transmitter. This system is, in many cases, the only way to diagnose the patient pathology in emergency rooms with no radiologist on call. Access to the medical data from any computer is possible through the implantation of a picture archiving and communication system (PACS) with direct acquisition from DiCOM equipment and Web technology. So, the radiologist with a computer connected to the WWW (from inside or outside the hospital) has access to the clinical histories and images. Free distribution software (Apache-PHP-MySQL) and PC platforms in WinNT environment has been used. All the medical imaging equipment of a medium size hospital has been connected to he system, integrating them with the medical history data. Restricted access based on privileges were design to make reports or only to consult data.

DTIC

*Radiology; Internets; Telemedicine; Software Engineering; Data Transmission; Biomedical Data*

## 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.

**20030057832** National Inst. of Standards and Technology, Gaithersburg, MD, Drexel Inst. of Tech., Philadelphia, PA, USA, Advanced Technology and Research, Inc., Burtonsville, MD, USA, Robotic Systems Technology, Westminster, MD, USA  
**4D/RCS: A Reference Model Architecture for Unmanned Vehicle Systems, Version 2.0**

Albus, J.; Huang, H. M.; Meystel, A.; Barbera, A.; Fitzgerald, M. L.; Aug. 2002; 176 pp.; In English  
 Report No.(s): PB2003-104542; NISTIR-6910; No Copyright; Avail: CASI; [A09](#), Hardcopy

The 4D/RCS architecture provides a reference model for military unmanned vehicles on how their software components should be identified and organized. It defines ways of interacting to ensure that missions, especially those involving unknown or hostile environments, can be analyzed, decomposed, distributed, planned, and executed intelligently, effectively, efficiently and in coordination. To achieve this, the 4D/RCS reference model provides well defined and highly coordinated sensory processing, world modeling, knowledge management, cost/benefit analysis, behavior generation, and messaging functions, as well as the associated interfaces. The 4D/RCS architecture is based on scientific principles and is consistent with military hierarchical command doctrine.

NTIS

*Remotely Piloted Vehicles; Architecture (Computers)*

**20030057865** Pacific Northwest National Lab., Richland, WA, USA

**Federal Emergency Management Information System (FEMIS) Bill of Materials (BOM) for FEMIS Version 1.4.6**

Mar. 05, 1999; 28 pp.; In English

Report No.(s): DE2003-15002698; PNNL-10689; No Copyright; Avail: Department of Energy Information Bridge

This document describes the hardware and software required for the Federal Emergency Management Information System version 1.4.6 (FEMIS v1.4.6)(a). FEMIS is designed for a single Chemical Stockpile Emergency Preparedness Program (CSEPP) site that has multiple Emergency Operations Centers (EOCs). Each EOC has personal computers (PCs) that emergency planners and operations personnel use to do their jobs. These PCs are connected via a local area network (LAN) to servers that provide EOC-wide services. Each EOC is interconnected to other EOCs via a Wide Area Network (WAN). A UNIX server provides a platform to support the Oracle relational database management system (RDBMS) distributed by Pacific Northwest National Laboratory (PNNL)(b), ARC/INFO geographic information system (GIS) capabilities (optional), basic file management services, the evacuation model (ESIM), the data exchange interface (DEI), and the notification service. FEMIS is a client/server system where much of the application software is located on the client PC. This client software includes the FEMIS application, government furnished dispersion and evacuation models, and Commercial-Off-The-Shelf (COTS) software applications, including the ArcView GIS and Microsoft Project (electronic planning). Several configurations are possible at a CSEPP site. In this document, a site is understood to include several installations of FEMIS, including the depot, surrounding Immediate Response Zone (IRZ) and Protective Action Zone (PAZ) counties, and one or more state EOCs. In general, the main differences between possible configurations are the numbers of PC workstations at an installation, the location of the UNIX server(s), and the WAN links between installations.

NTIS

*Information Systems; Chemical Warfare; Computer Networks; Emergencies*

**20030057969** Naval Postgraduate School, Monterey, CA

**Performance of IEEE 802.11a Wireless LAN Standard Over Frequency-Selective, Slowly Fading Nakagami Channels in a Pulsed Jamming Environment**

Kosa, Irfan; Dec. 2002; 128 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411160; No Copyright; Avail: CASI; [A07](#), Hardcopy

Wireless local area networks (WLAN) are increasingly important in meeting the needs of the next generation broadband wireless communication systems for both commercial and military applications. In 1999, the Institute of the Electrical and Electronics Engineers (IEEE) 802.11a working group approved a standard for a 5 GHz band WLAN that supports a variable bit rate from 6 to 54 Mbps, and orthogonal frequency-division multiplexing (OFDM) was chosen because of its well-known ability to avoid multipath effects while achieving high data rates by combining a high order sub-carrier modulation with a high rate convolutional code. This thesis investigates the performance of the OFDM based IEEE. 802. 11a WLAN standard in frequency-selective, slowly fading Nakagami channels in a pulsed-noise jamming environment. Contrary to expectations, the



signal-to-interference ratio (SIR) required to achieve a specific P does not monotonically decrease when the bit rate decreases. Furthermore, the results show that the performance is improved significantly by adding convolutional coding with Viterbi% decoding, and thus highlights the importance of forward error correction (FEC) coding to the performance of wireless communications systems.

DTIC

*Local Area Networks; Jamming; Telecommunication*

**20030058066** University of Southern California, Marina del Rey, CA

**Next Generation Internet (NGI) Multicast Applications and Architecture (NMAA)**

Perkins, Colin; Griggs, Aaron; Flidr, Jaroslav; Riley, Ron; Perez, Maryann; Jan. 31, 2003; 24 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): MDA972-99-C-0022; ARPA ORDER-H645

Report No.(s): AD-A411010; No Copyright; Avail: CASI; [A03](#), Hardcopy

The NGI Multicast Applications and Architecture project has developed innovative technologies and standards that greatly increase the quality and scalability of IP-based multicast teleconferencing and real-time motion imagery distribution systems. These scalability enhancements fall into two categories: 1) improved support for large-scale distributed meetings; 2) improved support for distribution of high-definition video. In particular, we have demonstrated a prototype Digital Amphitheater supporting virtual meetings with hundreds of simultaneous teleconferenced participants, and a prototype system for delivery of gigabit-rate High Definition video over commodity IP networks. These capabilities are significantly beyond those available commercially, and leverage the advanced network infrastructure developed as part of the DARPA Next Generation Internet research program.

DTIC

*Internets; Telemetry; Video Conferencing; Communication Networks*

**20030058092** Naval Postgraduate School, Monterey, CA

**Alternate High Speed Network Access for the Last Mile**

Lee, Peng J.; Dec. 2002; 147 pp.; In English; Original contains color illustrations

Report No.(s): AD-A410990; No Copyright; Avail: CASI; [A07](#), Hardcopy

Existing copper wire infrastructure no longer provides the required bandwidth for today's bandwidth-intense internet applications. Homes and businesses in the last mile require the same access speeds offered by fiber optic cables. It is however, economically infeasible to bring fiber optic cable to each and every house and business in the last mile. Free Space Optics and IEEE 802.11 are two technologies that offer high -speed capability and are potential last mile network access option. Free Space Optics uses lasers and IEEE 802.11 uses radio waves to send large amounts of data from one place to another. Both are wireless and uses license-free frequency band for transmission. Both are quickly deployable, easily scalable and cheaper to install and upgrade compared to wired infrastructures. These characteristics support applications that require high bandwidth and high degree of mobility, which are common in the military and civil networks. This thesis addresses the last mile problem and the current available access technologies which are unable to provide a high speed solution. Free Space Optics and IEEE 802.11 wireless technologies are explored and applied to a fictitious city for an economic analysis as possible high-speed network access method.

DTIC

*Communication Networks; Wireless Communication; Free-Space Optical Communication; Radio Waves; Computer Networks*

**20030058698** Massachusetts Inst. of Tech., Lexington, MA

**Declarative Routing Protocol Documentation**

Boettcher, P.; Coffin, D.; Czerwinski, R.; Kurian, K.; Nischan, M.; Feb. 28, 2003; 48 pp.; In English

Contract(s)/Grant(s): F19628-00-C-0002

Report No.(s): AD-A412846; ESC-TR-2001-086; ECCS-1; No Copyright; Avail: CASI; [A03](#), Hardcopy

This report documents the motivation, present capability, and theoretical promise of the Declarative Routing Protocol (DRP) developed at MIT Lincoln Laboratory as part of the DARPA Sensor Information Technology (SensIT) program. DRP was developed as a means of enabling distributed wireless sensors to configure themselves into a scalable ad hoc network and respond in an energy-efficient way to asynchronous requests for sensor information. Conventional networking approaches are generally not adequate for such applications because of energy constraints, reliability and scalability requirements and the greater variability in topology present compared with traditional fully wired or last-hop wireless (remote to base station)

networks. DRP operates within these constraints by exploiting energy-supplied data descriptions to control network routing and resource allocation.

DTIC

*Computer Networks; Acoustics; Detectors; Information Systems*

**20030058769** NORTH CAROLINA STATE UNIV AT RALEIGH DEPT. OF COMPUTER SCIENCE, Raleigh, NC, USA

**A Competitive-Market Approach to Distributed Resource Allocation**

Reeves, Douglas S.; Dec. 2002; 13 pp.; In English

Contract(s)/Grant(s): F49620-99-1-0264

Report No.(s): AD-A410933; AFRL-SR-AR-TR-03-0028; No Copyright; Avail: CASI; [A03](#), Hardcopy

Resource allocation is an issue in any system for which resources are in short supply. In computer networks, the resources in question are bandwidth, buffer space, and processing time, and they are allocated at multiple scales of time and quantity (e.g. from a single user's packets over a 30 second interval to a network providers backbone capacity for a 1 year interval). For military networks and computers, these resources may be scarce or limited during attack, at remote sites, etc. Decisions about resource allocation should be made in accordance with some overall policy. In many instances, this policy is referred to as the 'fairness' in making resource allocation decisions. A policy that is reasonable in one situation (e.g., 'normally, everyone shares equally the available bandwidth') may be unsuitable in another situation (e.g., 'in times of emergency, high priority tasks get their bandwidth requests satisfied before low priority tasks are considered'). In this report, we summarize the progress we have made in applying resource pricing principles to network and computer resource allocation. In each section we explain what we did, and why it is useful, followed by a list of the 'outputs' of that effort. We conclude by summarizing the major findings, and describing some future directions and open problems.

DTIC

*Computer Networks; Resource Allocation; Market Research; Packets (Communication)*

**20030058791** National Univ. of Ireland, Dublin

**Online Database for the Assessment and Comparative Evaluation of Rehabilitation Outcomes**

Ward, T. E.; Caulfield, B.; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411600; No Copyright; Avail: CASI; [A01](#), Hardcopy

The changing face of rehabilitation structures and practices has meant that measurement of outcomes of rehabilitation has become an absolute necessity. Unfortunately the level of agreement over which measures to use is poor as a result of lack of access to measures and lack of knowledge concerning methods of analysis and interpretation of results. In this paper we report on efforts by the authors to address these issues through the establishment of an online database available over a variety of web devices for the comparative evaluation of rehabilitation outcomes. We discuss the background to the problem the development and use of an initial system and the future directions of the project.

DTIC

*Data Bases; Procedures; Information Transfer*

**20030058829** Stanford Univ., Stanford, CA

**Being Bayesian About Network Structure: A Bayesian Approach to Structure Discovery in Bayesian Networks**

Friedman, Nir; Koller, Daphne; Jan. 2002; 31 pp.; In English

Contract(s)/Grant(s): DAAH04-96-1-0341

Report No.(s): AD-A412332; ARO-35873-MA-MUR.178; No Copyright; Avail: CASI; [A03](#), Hardcopy

In many domains, we are interested in analyzing the structure of the underlying distribution e.g. whether one variable is a direct parent of the other. Bayesian model-selection attempts to find the MAP model and is its structure to answer these questions. However, when the amount of available data is modest, there might be many models that have non-negligible posterior. Thus, we want to compute the Bayesian posterior of a feature, i.e. the total posterior probability of all models that contain it. In this paper, we propose a new approach for this task. We first show how to efficiently compute a sum over the exponential number of networks that are consistent with a fixed ordering over network variables. This allows us to compute, for a given ordering, both the marginal probability of the data and the posterior of a feature. We then use this result as a basis for an algorithm that approximates the Bayesian posterior of a feature. our approach uses an Markov Chain Monte Carlo (MCMC) method, but over orderings rather than over network structures. The space of orderings is much smaller and more regular than the space of structures, and has a smoother posterior 'landscape'. We present empirical results on synthetic and

real-life datasets that compare our approach to full model averaging ( when possible), to MCMC over network structures, and to a non-Bayesian bootstrap approach,

DTIC

*Neural Nets; Bayes Theorem*

**20030058962** Booz-Allen and Hamilton, Inc., McLean, VA

**Investigating Network Intrusion**

Pilny, Julia; Jan. 2003; 17 pp.; In English

Contract(s)/Grant(s): F30602-98-C-0253; AF Proj. 7820

Report No.(s): AD-A412544; AFRL-IF-RS-TR-2002-316; No Copyright; Avail: CASI; [A03](#), Hardcopy

In today's information-hungry world, vast amounts of data pass through AF networks on a daily basis. Information Assurance, and the Air Force Enterprise Defense (AFED) product in particular, concerns itself with the protection of these networks and associated data. It is not unusual for security databases on large networks to add a million new records per day. The specific size and nature of these data is dynamic, depending greatly upon the number of network security sensors and the network load. While the static administrative data does not impose abnormal loads on the database, the more dynamic network data imposes stress on the database due to its unpredictable volume size and insertion rates. When the database contains millions of records, performance can suffer. To keep the database from becoming full or fragmented, these data records must be off loaded at certain intervals. Archiving and then removing network data causes database table sizes to fluctuate, which in turn can impact performance because indexes must be recalculated. Clearly, it is an imposing task to keep the database performing at its optimum. The goal of this paper is to discuss current storage and access methods, their advantages and shortcomings, what new database technologies are available, and what direction the database development should take to best serve the IO/IA environment.

DTIC

*Data Bases; Intrusion Detection (Computers)*

**20030058975** Stanford Univ., Stanford, CA

**Optimization Problems in High-Speed Networks**

Plotkin, Serge; Jan. 2002; 18 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0170

Report No.(s): AD-A411858; ARO-37581.1-MA; No Copyright; Avail: CASI; [A03](#), Hardcopy

The main goal of this project is to develop fundamental algorithmic techniques that can be applied to problems that arise in the context of high-speed communication networks. The explosion in the size and complexity of networks, together with QoS requirements needed by some of the new services raises many new challenging problems. In this report we outline our latest accomplishments in the areas of online routing of FTP requests and snapshot scan algorithms.

DTIC

*Communication Networks; Optimization; Algorithms; Computer Systems Programs*

**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*.

**20030057814** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Advanced Robotics for In-Space Vehicle Processing**

Smith, Jeffrey H.; Estus, Jay; Heneghan, Cate; Bosley, John; Beyond the Baseline: Proceedings of the Space Station Freedom Evolution Symposium, Volume 1: Space Station Freedom, Part 2; May 1990, pp. 677-692; In English; See also 20030057810; No Copyright; Avail: CASI; [A03](#), Hardcopy

An analysis of spaceborne vehicle processing is described. Generic crew-EVA tasks are presented for a specific vehicle, the orbital maneuvering vehicle (OMV), with general implications to other on-orbit vehicles. The OMV is examined with respect to both servicing and maintenance. Crew-EVA activities are presented by task and mapped to a common set of generic crew-EVA primitives to identify high-demand areas for telerobot services. Similarly, a set of telerobot primitives is presented that can be used to model telerobot actions for alternative telerobot reference configurations. The telerobot primitives are tied to technologies and used for compositing telerobot operations for an automated refueling scenario. Telerobotics technology

issues and design accommodation guidelines (hooks and scars) for the Space Station Freedom are described.

Author

*Telerobotics; Orbital Maneuvering Vehicles; Extravehicular Activity; Task Planning (Robotics); Spacecraft Maintenance; Tasks; Orbital Assembly; Orbital Servicing*

**20030057982** Naval Postgraduate School, Monterey, CA

**Development and Control of Robotic Arms for the Naval Postgraduate School Planar Autonomous Docking Simulator (NPADS)**

Cave, Gary L.; Dec. 2002; 110 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411173; No Copyright; Avail: CASI; [A06](#), Hardcopy

This thesis encompasses the development of two robotic arms for integration onto the Naval Postgraduate School (NPS) Planar Autonomous Docking Simulator (NPADS) servicing vehicle. This research effort involved support structure design, fabrication, and construction, off-the-shelf motion control hardware integration, and control algorithm development and testing. The NPADS system is being built as a test platform for spacecraft docking and capture mechanisms designed for autonomous rendezvous and servicing missions. As with the servicing vehicle, the robotic arms utilize a floatation system on an air-bearing granite table to provide a two-dimensional, drag-free environment. DC brushless servo motors serve as shoulder, elbow, and wrist joints allowing planar motion of the two-link arms. A National Instruments (NI) PXI computer and Motion Control card provide system processing and the software to hardware interface. The NI LabVIEW software suite enabled development of manual control code and autonomous control subroutines compatible with the control software of the NPADS main body. A single, wrist-mounted CCD bullet camera provides visual target acquisition for the robotic arms control system. Testing and analysis were completed in the NPS Satellite Servicing Laboratory on a table-based test harness to facilitate initial design iteration.

DTIC

*Test Vehicles; Spacecraft Docking; Flight Simulators; Control Simulation*

**20030057995** Chicago Univ., Chicago, IL

**Demonstration Project on Mammographic Computer-Aided Diagnosis for Breast Cancer Detection**

Doi, Kunio; Oct. 2002; 58 pp.; In English

Contract(s)/Grant(s): DAMD17-96-1-6228

Report No.(s): AD-A411233; No Copyright; Avail: CASI; [A04](#), Hardcopy

The goal of this project is to demonstrate the clinical usefulness of computer-aided diagnosis (CAD) in mammographic detection of breast cancer. Our plan is to develop advanced CAD schemes for detection and characterization of clustered microcalcifications and masses by incorporating artificial neural networks and various image processing techniques. Clinical mammography workstations for automated detection of suspicious lesions in mammograms will be developed by integration of laser digitizer, high-speed computer and advanced CAD software. The prototype workstations will be used as a 'second opinion' in interpreting mammograms by reducing observational errors. The outcomes of radiologists' image readings in the detection of breast cancer will be evaluated by examining radiologists' performance when reading films only and when reading film with the computer results. We believe that the outcomes of this demonstration project will lead to large-scale clinical trials and will result in commercial projects for practical routine use in breast imaging.

DTIC

*Mammary Glands; Cancer; Diagnosis; Computer Aided Tomography*

**20030058745** Ohio Univ., Athens, OH

**Telerobotic Control Architecture Including Force-Reflection**

Murphy, Mark A.; Williams, Robert L., III; Jun. 1998; 104 pp.; In English

Contract(s)/Grant(s): F41624-95-C-6014; Proj-7184

Report No.(s): AD-A411653; AFRL-HE-WP-TR-2002-0186; No Copyright; Avail: CASI; [A06](#), Hardcopy

This report describes the implementation of a telerobotic control architecture to manipulate a standard six-degree-of-freedom robot via a unique seven-degree-of-freedom force-reflecting exoskeleton which is located in the Human Sensory Feedback Laboratory at Wright-Patterson Air Force Base. This is the first time that the robot and exoskeleton have been interfaced. The novel Naturally-Transitioning Rate-to-Force Controller is included in the implementation. Background for the control architecture and modes of operation are presented as well as the specific system description and operating procedures. Peg-insertion experiments were conducted to compare the performance of rate control, naturally-transforming rate-to-force

control, and naturally-transforming rate-to-force control with force reflection. Task completion time and manipulator work due to contract forces moment through the Cartesian displacements were the basis for comparison. The control architecture is completely implemented. Experimental results displayed no clear differences among the control modes; this indicates that a reduction in system time delays and more precise gain tuning are needed.

DTIC

*Telerobotics; Control Systems Design; Robots; Architecture (Computers)*

**20030058746** Army Research Lab., Aberdeen Proving Ground, MD

**Reducing Spread Spectrum Image Steganography (SSIS) Extraction Errors With Feedback-Driven Adjustment**

Brundick, Frederick S.; Hartwig, George W., Jr.; Marvel, Lisa M.; Dec. 2002; 42 pp.; In English

Report No.(s): AD-A409026; ARL-TR-2889; No Copyright; Avail: CASI; [A03](#), Hardcopy

Steganographic techniques are useful to hide information in various types of common multimedia data for covert communication. Spread Spectrum Image Steganography (SSIS) is a data-hiding/hidden-communication method that uses digital imagery as a cover signal. This report examines the error sources in SSIS, their impact on payload throughput, and ways of minimizing these errors. We present a method that employs a feedback-driven adjustment to anticipate extraction errors and compensate for them without adversely affecting the detectability of the stegomessage. The technique, which is performed by the transmitter, does not require any additional effort on the part of the recipient. We also describe an experiment using multiple cover images to evaluate the change in error rate as a function of varying input values along with modifications to the SSIS message embedding process. In conclusion, we propose enhancements to the feedback process, enabling it to be used not only for error reduction, but also as a means of limiting the detectability of a stegomessage.

DTIC

*Feedback; Multimedia; Spread Spectrum Transmission; Steganography; Error Detection Codes*

**20030058824** Montreal Univ., Quebec, Canada

**Assessment of Manual Segmentation of Magnetic Resonance Images of Skeletal Muscles**

Zoabli, G.; Mathieu, P. A.; Aubin, C. E.; Tinlot, A.; Beausejour, M.; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411985; No Copyright; Avail: CASI; [A01](#), Hardcopy

Technical considerations related to the manual detection of muscles boundaries from magnetic resonance images (MRI) are evaluated. Two commercial image processing software programs were used by two operators to obtain measurements on MRI from a phantom and from muscles of the upper limb and trunk. Optimization of MRI acquisition sequences, image resolution, image contrast, and sub-sampling effect were also experimented. No significant intra- and inter-operator variation was observed and results obtained from both software were similar. Generally, sub-millimetric slice thickness offers better definition but lower contrast than thicker slices. Differences in estimated length, surface and volume of upper limb and back muscles were small for slice thickness varying between 1.5 and 4 mm. Accuracy of manual segmentation of muscles with MRI was found more dependent on the contrast than on the human factors.

DTIC

*Musculoskeletal System; Image Processing; Evaluation; Magnetic Resonance*

**20030058844** Institutul Politehnic din Bucharest, Romania

**Lower Motor Control Modeled by Neuron With Fuzzy Synapses**

Bigan, C.; Strungaru, R.; Ungureanu, M.; Lazarescu, V.; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A412200; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper presents a model of information flow through the sensors to muscle system in regard to the control of output. The model takes into account both the logical and emotional action components. The emotional components depend on the current needs of the organism. Actions resulting in a positive change in the emotional analysis of the world activate the reward component that enables the action of logical analysis of the situation. The principal component of the system, which provides input to most muscle fibers of human body, is called lower motor neuron (LMN). The control of LMN is modeled via a set of fuzzy rules. The principles of processing seem applicable to artificial systems.

DTIC

*Muscles; Neurons; Synapses; Fuzzy Systems; Artificial Intelligence*

**20030058968** Valladolid Univ., Spain

**Monocameral Visual Recognition of Marcus Hand Postures for Personal Robotic Assistants**

Gonzalo-Tasis, M.; Laschi, C.; Finat, J.; Dario, P.; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A412553; No Copyright; Avail: CASI; [A01](#), Hardcopy

The postures recognition is the first step for the gestures tracking of an artificial or a natural hand. In this article, we show a visuo-motor tracking of mobile hand configurations, which is based on symbolic representations able of supporting the biomechanical and perceptual information relative to evolving postures. After recognition, we have a virtual skeleton to identify simulated artificial hands. Such postures identification is adapted to an artificial Marcus hand developed as a human prosthesis. Nevertheless, the complex mechatronic device, this symbolic representation allows the visual identification and tracking of hand points of interest, such as tactile sensors and finger joints. In this way, a feedback for the perception-action cycle is obtained to improve the man- machine interaction in Personal Robotics, with special regard to the assistance of disabled people.

DTIC

*Robotics; Visual Perception; Hand (Anatomy); Posture*

**20030059004** Karlsruhe Univ.

**Combination of AI Components for Biosignal Processing- Application to Sleep Stage Recognition**

Schwaibold, M. H.; Penzel, T.; Schoechlin, J.; Bolz, A.; Oct. 25, 2001; 4 pp.; In English

Report No.(s): AD-A412050; No Copyright; Avail: CASI; [A01](#), Hardcopy

We present a novel approach to combining artificial intelligence components for biomedical signal processing. The modular algorithm mimics the step-by-step type procedure of a human expert and includes the two assessment steps most important for sleep stage scoring, pattern recognition in electrophysiological signal channels and rule evaluation for classifying the current sequence of patterns. The application of sleep stage scoring is a complex task in medical informatics. The ARTISANA (artificial intelligence in sleep analysis) algorithm we have developed provides high rates of correspondence with the results produced by human experts. Additional features are the transparent decision-making process and information about the detailed structure of sleep. This has been achieved by utilizing neural networks for pattern recognition and neuro-fuzzy systems for rule evaluation. The AI components chosen to perform these two classification steps were particularly successful due to their individual strengths.

DTIC

*Artificial Intelligence; Signal Processing; Sleep; Biometrics; Algorithms*

**20030059047** National Cardiovascular Center Research Inst., Suita City, Japan

**A Bionic Approach to Cardiovascular Regulation: Bionic Arterial Baroreflex System**

Sugimachi, M.; Sato, T.; Kawada, T.; Inagaki, M.; Sunagawa, K.; Oct. 25, 2001; 4 pp.; In English

Report No.(s): AD-A411120; No Copyright; Avail: CASI; [A01](#), Hardcopy

A bionic system is an artificial device, integrated into natural human physiology by communicating with native regulatory system. This can functionally operate as if it were a part of the body. Bionic systems can be realized only with the knowledge of detailed characteristics of native system. We made use of white-noise approach and have succeeded in functionally identifying the native arterial baroreflex. Using thus identified characteristics, we developed a bionic baroreflex system. Animal experiments in rats revealed that the bionic baroreflex system can stabilize pressure against hypotensive stimuli such as head-up tilt even without the native baroreflex system.

DTIC

*Baroreflexes; Bionics; Cardiovascular System; Nervous System; Physiology; Arteries*

## 64

### NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

**20030057888** Technische Hogeschool Twente, Enschede

**Investigation of the Predictability of Neural Cell Survival After Exposure to Non-Uniform Electric Fields**

Heida, T.; Rutten, W. L. C.; Marani, E.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A410768; No Copyright; Avail: CASI; [A01](#), Hardcopy

Cortical rat neurons were trapped by negative dielectrophoresis (DEP) using a planar quadruple electrode structure. The

nonuniform field created by this structure was calculated using a finite element software package. By representing the neuron with a single-shell model the membrane potential induced by the electric field can be estimated. It was investigated whether the physiological state of the trapped neurons can be predicted using this estimation. Experimentally, the physiological state of cortical cells trapped at different amplitudes and frequencies of the input signal was determined using a staining method. The authors conclude that a rough estimate of the minimum frequency and maximum amplitude can be given to predict the status of viability of the cells after being dielectrophoretically trapped.

DTIC

*Dielectrics; Nerves; Electrophoresis; Cerebral Cortex; Neurons; Electric Fields*

**20030058041** Army Research Inst. of Environmental Medicine, Natick, MA

**Assessment of Cardiovascular Dynamics Using Periodicity Attributes Derived from Peripheral Blood Flow Signals**

Kanjilal, Partha P.; Gonzalez, Richard R.; Aug. 2002; 26 pp.; In English

Report No.(s): AD-A411618; USARIEM-T02/17; No Copyright; Avail: CASI; A03, Hardcopy

A periodic process can be characterized in terms of three periodicity (or p-) attributes: the periodicity (or period-length), the periodic wave-shape or pattern and the wave-magnitude or the scaling factor; all three attributes can be time varying in a real-life situation. In this report, we hypothesize that an analysis of the dynamics underlying a nearly periodic physiological process, such as appearing in a rhythmic blood wave pattern, can be quantified in terms of the dynamics of its periodicity attributes. This report analyzes data obtained from archival studies in which the photo-plethysmograph signal (PPS) is recorded from the finger. Each specific blood wave signal is decomposed into a regular component, which is nearly periodic and an irregular residual process. The dynamics of the PPS p-attributes of the regular part are analyzed individually as well as collectively to assess the general cardiovascular state. A new class of surrogate series based on the shuffling of the p-attributes is proposed to detect the nonlinear determinism in the PPS. The dynamics is further studied by mapping the variations of the p-attributes in a novel p-space, defined by the three orthogonal periodicity-attribute components; each point in the p-space represents one nearly periodic segment. Novel complexity measures based on global and temporal variations 0 dynamics in the p-space are proposed. A correlation is explored between the complexity measures derived from the p-space mapping of PPS that closely matches the cardiovascular state of a typical human subject. The mathematical algorithms derived from a simple blood flow wave pattern can be easily applied for assessing other physiologic signals in the cardiovascular system obtained during perturbations caused by dynamic exercise, thermal stress, and potentially high terrestrial physiologic effects during hypobaric stress.

DTIC

*Cardiovascular System; Periodic Variations*

**20030058086** Air Force Research Lab., Wright-Patterson AFB, OH

**A Dual Haptic Interface Investigation for Improved Human-Computer Interaction**

Repperger, D. W.; Rothrock, Ling; Oct. 2002; 22 pp.; In English

Contract(s)/Grant(s): Proj-2313

Report No.(s): AD-A412247; AFRL-HE-WP-TR-2002-0189; No Copyright; Avail: CASI; A03, Hardcopy

This study involved designing haptic interfaces with the assistance of genetic algorithms. Five subjects were initially run in a pilot study and from these preliminary data, a model was developed to predict the response of all subjects to 65,536 possible experimental conditions. A multiobjective performance function was developed and the genetic algorithm methodology was utilized to search for the optimum experimental design conditions through a MATLAB/SIMULINK simulation. In a post hoc study, seven subjects were then evaluated with the optimum condition as well as alternative conditions over the range of the possible independent variables of interest. The subjects demonstrated that both their performance and situational awareness measures were significantly improved at the optimum design condition in the post hoc study as compared to the pilot study. The overall effort emphasized the concept of experimental design parsimony. What this means is that a few experimental conditions are initially run with a few subjects and that a computer model then generalizes the pilot data to predict the results in a more general setting. The post-hoc study then validates the initial assumptions and modeling incorporated in this effort.

DTIC

*Computerized Simulation; Human-Computer Interface*

**20030058087** Engineering Research and Consulting, Inc., Edwards AFB, CA, USA

**The Fractal Geometry of Round Turbulent Cryogenic Nitrogen Jets at Supercritical Pressures**

Chehroudi, Bruce; Talley, Doug; Mar. 2002; 13 pp.; In English

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

Report No.(s): AD-A410951; AFRL-PR-ED-TP-2002-084; No Copyright; Avail: CASI; [A03](#), Hardcopy

Box-counting and EDM methods were used to measure the fractal dimension of round turbulent cryogenic nitrogen jets at pressures ranging from subcritical to supercritical pressures. Both method produced similar trends, with close quantitative agreement for a suitably small box-counting scale. At subcritical pressures, the fractal dimension was found to be consistent with the fractal dimension of a spray in the 2nd wind-induced atomization regime. The fractal dimension tended to increase as pressure increased, until at supercritical pressures the fractal dimension was found to be consistent with that of gas jets and mixing layers. The results constitute additional quantitative evidence for the hypothesis that subcritical jets exhibit mainly spray-like behavior, while supercritical jets exhibit mainly gas-like behavior. This appears to have been the first time pressure effects on the fractal dimension of turbulent jets has been measured.

DTIC

*Fractals; Geometry; Size (Dimensions)*

**20030058088** Air Force Research Lab., Edwards AFB, CA, USA

**Computational Analysis of a Single-Element, Shear-Coaxial, GH<sub>2</sub>/GO<sub>2</sub> Engine**

Archambault, Mark; Talley, Douglas; Peroomian, Oshin; Oct. 3, 2001; 12 pp.; In English

Contract(s)/Grant(s): Proj-3058

Report No.(s): AD-A410952; AFRL/PR-ED-TP-2001-198; AIAA-2002-1088; No Copyright; Avail: CASI; [A03](#), Hardcopy

As part of a program to develop a computational methodology to obtain high-fidelity rocket engine flow solutions, computations were performed on a single element, gas/gas, H<sub>2</sub>/O<sub>2</sub> combustion engine. The solutions are compared with previously reported solutions to this problem, showing that the problem can be solved on a finer grid with a second-order accurate scheme, thus providing another level of detail to the flow physics. Additional time-accurate solutions are also presented. Comparisons among a 'quasi-steady' solution, averaged time-accurate solution, and experimental data are made and shown that for inherently unsteady flows, a time-accurate solution does as well as or better than a steady solution.

DTIC

*Computation; Rocket Engines*

**20030058694** Naval Postgraduate School, Monterey, CA

**An Improved Algebraic Grid Generator for Numerical Aerodynamic Analyses of Airfoil Cross-Sections**

Verville, Justin M.; Dec. 2002; 157 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411016; No Copyright; Avail: CASI; [A08](#), Hardcopy

Although computer-processing power has increased dramatically over the past few decades, minimizing computation time is still critical when conducting numerical aerodynamic analyses. One area where this is evident is the grid generation routines used in most code for this area of research. While many more sophisticated grid generation techniques are available, algebraic grid generation is still in use today due strictly to efficiency. Computational efficiency is of particularly great concern during analyses that involve motion of the surface being analyzed, since computing a new grid at each time step is often required. Unfortunately however, few if any, algebraic grid generation routines exist that are powerful enough to produce a grid with no overlapping gridlines and minimal distortion, yet still minimize computation time. As a result, the purpose of this thesis was to design such a routine. The end result is a C-Grid generating routine with a Graphical User Interface (GUI) called Astro Grid.

DTIC

*Computational Grids; Graphical User Interface; Grid Generation (Mathematics); Numerical Analysis*

**20030058714** Maryland Univ., College Park, MD

**Active and Reactive Shells**

Baz, Amr M.; Aug. 14, 2002; 9 pp.; In English

Contract(s)/Grant(s): DAAD19-99-1-0200

Report No.(s): AD-A412268; ARO-39126.2-EG; No Copyright; Avail: CASI; [A02](#), Hardcopy

Active Shells (AS) and Reactive Shells (RS) are proposed to attenuate the undesirable wave propagation developed by various sources of external excitations. Emphasis will be placed here on excitations resulting from moving ballistic pressures



that are developed during the firing of projectiles in gun barrels. The proposed shells are envisioned to be made of tubes that have passive or active sources of mechanical impedance mismatch which are placed along their longitudinal axes. These sources can be active inserts or reactive stiffeners that are tuned for optimal performance. The geometrical parameters and location of the active inserts or the reactive stiffeners will be optimally determined to maximize the attenuation of the waves as they propagate from one end of the shells to the other. Such attenuation results from the proper interaction between the incident, reflected and transmitted waves at the zones of impedance mismatch in a way similar to what happens in reactive mufflers of passenger cars. The development and the optimization of the RS model and RS will be carried out and the performance of the optimal configurations will be tested at the University of Maryland. The performance of prototypes of the successful configurations will be evaluated at the firing range of the U. S. Army Benet Laboratory in Watervliet Arsenal.

DTIC

*Wave Propagation; Attenuation; Wave Attenuation*

**20030058715** Institut National de la Sante et de la Recherche Medicale, Paris

**Measure and Analysis of a Gaze Position Using Infrared Light Technique**

Ramdane-Cherif, Z.; Nait-Ali, A.; Motsch, J. F.; Krebs, M. O.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411535; No Copyright; Avail: CASI; [A01](#), Hardcopy

We are interested in identifying the object or area that attracts the subject's attention in images. A computer system is developed to measure and analyze the eye position. Eye movements are recorded using an infrared light device. Our interest is concentrated mainly on the calibration of the system, more precisely, on the correction of measured data according to user's characteristics. Higher polynomial transformation is used to model the mapping between eye coordinates and image coordinates. The mean quadratic error criteria is used. This paper presents how our model works to correct the non-linearities in the oculomotor for individual subject's eyes. It also proposes a method to correct head movements.

DTIC

*Infrared Tracking; Eye Movements*

**20030058733** Michigan Univ., Ann Arbor, MI

**Neural Source Localization Using Advanced Sensor Array Signal Processing Techniques**

Oweiss, K. G.; Anderson, D. J.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411595; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper aims to describe a hybrid technique that combines the feasibility of our recently developed Multiresolution Analysis of Signal Subspace Invariance Technique (MASSIT) with the Finite Element Method (FEM) analytic model developed to obtain accurate localization scheme of neural sources in an extracellular recording environment. The power of the proposed method stems from the fact that robust array signal processing approach is fused with the FEM analysis yielding the closest scenario to practical experimental situations. Results from experimental signal and noise simulated composite are summarized and the overall performance is evaluated.

DTIC

*Signal Processing; Brain; Cells (Biology)*

**20030058798** Lawrence Livermore National Lab., Livermore, CA

**Least-Squares Approaches for the Time-Dependent Maxwell Equations**

Zhiqiang Cai, C.; Jones, J.; Dec. 01, 2001; 12 pp.; In English

Report No.(s): DE2003-15002754; UCRL-CR-147713; No Copyright; Avail: Department of Energy Information Bridge

When I was at CASC in LLNL during the period between July and December of last year, I was working on two research topics: (1) least-squares approaches for elasticity and Maxwell equations and (2) high-accuracy approximations for non-smooth problems.

NTIS

*Maxwell Equation; Least Squares Method; Nonlinear Equations*

**20030058818** Calgary Univ., Alberta, Canada

**Computationally Efficient Methods for Solving the Bidomain Equations in 3D**

Vigmond, Edward J.; Aguel, Felipe; Trayanova, Natalia A.; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A412157; No Copyright; Avail: CASI; [A01](#), Hardcopy

The bidomain equations represent the most complete description of cardiac electrical activity. However, the equations prove computationally burdensome as the resulting system of equations has two entries per spatial node. This paper examines the computational performance obtained by decoupling the bidomain equations into two separate systems of equations, an elliptic equation for the extracellular potential, and a parabolic equation for the transmembrane voltage. Each set of equations was solved on different grids with different time steps. For the elliptic problem, the performances of direct and iterative solvers were compared. For the parabolic equation, the interconnected cable method (ICCM) was compared to the finite element method (FEM). Results were obtained by simulating activity in a 3D slab of cardiac tissue whose ionic currents were described by modified Beeler- Reuter equations. It was found that the elliptic equation solution dominated the calculation. Reducing the frequency of solution and/or halving the spatial resolution resulted in considerable speed up while maintaining a reasonable error. Direct solvers were faster by a factor of 2-3 and the ICCM was about twice as fast in solving the parabolic equation as compared to the FEM. Both the elliptic and parabolic equations scaled linearly with the number of nodes.

DTIC

*Computation; Finite Element Method*

**20030058855** Montreal Univ., Quebec, Canada

**The Reciprocal Approach to the Inverse Problem of Electroencephalography**

Finke, Stefan; Gulrajani, Ramesh M.; Gotman, Jean; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A411035; No Copyright; Avail: CASI; [A01](#), Hardcopy

Forward transfer matrices relating dipole source to surface potentials can be determined via conventional or reciprocal approaches. In numerical simulations with a triangulated boundary-element three-concentric-spheres head model, we compare four inverse EEC solutions: those obtained with conventional and reciprocal transfer matrices, and relating in each case dipole components to potentials at either triangle centroids or triangle vertices. Dipole localization errors are presented in all four cases for varying dipole eccentricity and two different values of skull conductivity. For tangential dipoles, the reciprocal vertex approach performed best overall when considering both skull conductivities. No such clear-cut conclusion could be drawn for radial dipoles.

DTIC

*Electroencephalography; Numerical Analysis; Head (Anatomy); Matrices (Mathematics)*

## 65

### STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; time series analysis; and stochastic processes.

**20030057894** Center for Mathematics and Computer Science, Amsterdam

**New Limit Theorems for Regular Diffusion Processes with Finite Speed Measure. Probability Networks and Algorithms (PNA)**

vanZanten, J. H.; Oct. 31, 2000; 26 pp.; In English

Report No.(s): PB2003-103149; PNA-R0013; No Copyright; Avail: CASI; [A03](#), Hardcopy

In this paper we present some new contributions to the theory of one-dimensional diffusion processes. We derive limit theorems for diffusion processes that have a finite speed measure.

NTIS

*Probability Theory; Algorithms; Diffusion Theory; Limits (Mathematics)*

**20030058028** RAND Corp., Santa Monica, CA

**Audit of Car Ownership Models**

DE Jong, Gerard; Fox, James; Pieters, Marits; Vonk, Liese; Daly, Andrew; Jan. 2002; 125 pp.; In English

Report No.(s): AD-A411810; RAND/MR-1664-AVV; No Copyright; Avail: CASI; [A06](#), Hardcopy

In this report, a review was presented of existing models for car ownership. This review contains a description and comparison of existing Dutch car ownership models and a review and comparison of recently developed models in the international literature and models used in practice. The provision of this review was one of the objectives of this project. The other objective was to recommend on directions for potential development for improving the AVV car ownership models. The car ownership model that AVV uses for most applications is the so-called FACTS model (Forecasting Air pollution through Car Traffic Simulation). FACTS also provides the future total number of cars that is used as an external total in the Dutch national Model System (LMS) for traffic and transport. The background of this audit is the desire of AVV to obtain information

on the basis of which a well-founded decision can be made on the development of an improved car ownership model, that can produce robust and sensible car ownership forecasts for all kinds of variants of variabilization of the road tax (MRB) and car purchase tax (BPM). As part of this project, a number of policy advisers was interviewed about what types of outputs are required from a car ownership model, what should be the forecasting horizon and what should be the policy variables to be simulated.

DTIC

*Forecasting; Air Pollution; Policies; Automobiles*

**20030058067** Firat Univ., Elazig, Turkey

**The Analysis of Heart Sounds Based on Linear and High Order Statistical Methods**

Ergen, Burhan; Tatar, Yetkin; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411080; No Copyright; Avail: CASI; [A01](#), Hardcopy

This paper investigates the applicability of high order statistical autoregressive (AR-HOS) modeling method in analyzing biomedical signals. The autoregressive (AR) method using linear prediction and AR-HOS method using cumulants are applied on normal and pathological heart sound signals. It is found that the AR-HOS modeling a signal produce more accurate and higher resolution spectrum than AR modeling.

DTIC

*Linear Prediction; Prediction Analysis Techniques; Signal Processing; Statistical Analysis*

**20030058729** Tokyo Univ., Japan

**Biomagnetic Inverse Solution Using Combined-Norm and Pointwise Normalization**

Terazono, Y.; Matani, A.; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A411107; No Copyright; Avail: CASI; [A01](#), Hardcopy

In this paper, we propose a method of solving the biomagnetic inverse problem consisting of two approaches, the first of which is pointwise normalization. In the conventional normalization technique, each variable is normalized individually. This variablewise normalization is appropriate for scalar fields, but not for vector fields where one vector on a grid point is represented by several variables. Hence, pointwise operation is needed for vector fields, The second is a combination of norms. Use of the 1 sub 2-norm as the cost function of an optimization problem is known to lead to spatially spread solutions, while the 1 sub 1-norm leads to sparse solutions. To control sparseness of solutions, we propose to use an internal division of the 1 sub 2-norm and pointwise normalized 1 sub 1-norm. The optimization problem constructed as above can be recast as a second-order cone program (SOCP), a nonlinear convex problem. The problem can be solved using recently developed efficient interior-point methods, Computer simulations showed that the sparseness of estimators obtained with the proposed method reflects both the ratio of internal division and the sparseness of true sources. Regularization of normalization and relaxation of constraint conditions in the presence of noise are also presented,

DTIC

*Biomagnetism; Normalizing (Statistics); Computational Grids; Probability Theory; Linear Programming*

**20030058734** RAND Corp., Santa Monica, CA

**Motivated Metamodels: Synthesis of Cause-Effect Reasoning and Statistical Metamodeling**

Davis, Paul K.; Bigelow, James H.; Jan. 2003; 78 pp.; In English

Report No.(s): AD-A411888; RAND/MR-1570; No Copyright; Avail: CASI; [A05](#), Hardcopy

Simple, low-resolution models are needed for high-level reasoning and communication, decision support, exploratory analysis, and rapidly adaptive calculations. Analytical organizations often have large and complex object models, which are regarded as reasonably valid. However, they do not have simpler models and cannot readily develop them by rigorously studying and simplifying the object model. Perhaps the object model is hopelessly opaque, the organization no longer has the expertise to delve into the model's innards, or there simply is not enough time to do so. One recourse in such instances is statistical metamodeling, which is often referred to as developing a response surface. The idea is to emulate approximately the behavior of the object model with a statistical representation based on a sampling of base-model 'data' for a variety of test cases. No deep knowledge of the problem area or the object model is required. Unfortunately, such statistical metamodels can have insidious shortcomings, even if they are reasonably accurate 'on average.' This monograph describes some of those shortcomings and proposes a way (motivated metamodeling) to do better, which amounts to drawing upon an approximate understanding of the phenomena at work (i.e., upon approximate theory) to suggest variables for and perhaps the analytical form of the metamodel. This approach is hardly radical, but it is quite different from what happens in normal statistical

metamodeling. The quality of metamodels can sometimes be greatly improved with relatively modest infusions of theory.  
DTIC

*Models; Decision Support Systems; Statistical Analysis*

**20030058764** Washington Univ., Seattle, WA

**Statistical Analysis of Sediment Cores**

Percival, Donald B.; Jackson, Darnell R.; Briggs, Kevin B.; Jan. 2, 2003; 3 pp.; In English

Contract(s)/Grant(s): N00014-01-1-0756

Report No.(s): AD-A410673; No Copyright; Avail: CASI; [A01](#), Hardcopy

The goal of this grant was to determine the relationship between various correlation lengths for porosity and density variations in sediment cores as derived from one dimensional and three dimensional models. This goal was met by formulating both direct one dimensional and indirect one and three dimensional models for sampled measurements of these variables and by determining relationships between the correlation lengths defined for each theoretical model. The end result of this effort was a methodology for transforming the correlation length for a one dimensional discrete parameter model into lengths appropriate for one and three dimensional continuous parameter models, thus allowing a more accurate determination of a parameter needed by acoustic scattering models.

DTIC

*Acoustic Measurement; Mathematical Models; Statistical Analysis; Parameter Identification*

**20030058778** Air Force Inst. of Tech., Wright-Patterson AFB, OH

**A Unified Approach to Statistical Quality Assessment in Heuristic Combinatorial Optimization**

Giddings, Angela P.; Jan. 14, 2003; 143 pp.; In English

Report No.(s): AD-A410967; AFIT-CI-02-805; No Copyright; Avail: CASI; [A07](#), Hardcopy

Since the introduction of mathematical programming it has been all too easy to identify real-world problems that could be formulated as math programs but could not be solved to a provable optimum within a reasonable amount of time. As computing power continues to increase, so too does the size of the mathematical programs to be solved. This situation has given rise to a multitude of heuristic solution techniques that seek to provide good approximate solutions within a reasonable amount of time. Designers and users of heuristic solution techniques would like to assess the quality of their heuristics, where heuristic quality is defined in terms of the characteristics of the solutions returned by the heuristic, often emphasizing the objective function values. Fixed bounds on worst case performance are available for some heuristics, but in many cases heuristic-quality assessment approaches must take a sampling perspective and apply statistical tools to derive their assessment. Although many authors have proposed statistical methods for assessing heuristic quality, there has not been a foundation for a single unified approach or a framework for comparison of the distinct approaches to heuristic-quality assessment. The primary contribution of this research is that it presents a unifying probability modeling framework that applies whenever randomized heuristic solution techniques are applied to instances of combinatorial optimization problems. With this probability model in hand, we can better understand the relative strengths and weaknesses of the existing statistical approaches to assessing heuristic quality in combinatorial optimization. Moreover, the probability model suggests new avenues for the development of heuristic quality assessment approaches, and we present empirical results from initial applications.

DTIC

*Mathematical Programming; Heuristic Methods; Statistical Analysis; Combinatorial Analysis; Optimization*

**20030058828** Utah Univ., Salt Lake City, UT

**Optimization of Breast Cancer Treatment by Dynamic Intensity Modulated Electron Radiotherapy**

Leavitt, Dennis D.; Gaffney, David K.; Oct. 2002; 22 pp.; In English

Contract(s)/Grant(s): DAMD17-01-1-0435

Report No.(s): AD-A412101; No Copyright; Avail: CASI; [A03](#), Hardcopy

Three specific work projects were pursued during the first year of this grant: 1) Static electron fields defined by the photon MLC were measured. Beam profiles and output factors at distances of 75, 85 and 100 cm SSD were measured for fields from 1 cm to 20 cm wide. Measurements were made for electron energies of 6, 9, 12, 16 and 20 MeV. Profiles were compared vs. energy, and their departure from strictly divergent fields was noted. Profiles defined by the MLC were compared with previous profiles defined by cerrobend(Trademark) apertures. 2) Monte Carlo techniques were applied to 3D electron dose calculations. The rounded shape of the MLC ends, the long air scatter column, and the reduced density air at Utah altitude were addressed in the calculations. Excellent agreement was achieved compared to measured profiles and measured relative output factors.

The Monte Carlo calculations correctly account for air scatter effects vs. field size and SSD, and correctly predict relative output factors vs. field size and SSD. 3) An iterative optimization technique to determine the required MLC leaf positions vs. arc rotation was defined. The work to date is on track for successful completion of the project within the grant period.

DTIC

*Mammary Glands; Cancer; Radiation Therapy*

**20030058830** University of Southern Illinois, Carbondale, IL, USA

**Risk Factor Fusion for Predicting Multifactorial Diseases**

Phegley, James; Perkins, Kyle; Gupta, Lalit; Dorsey, J. K.; Oct. 25, 2001; 5 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411117; No Copyright; Avail: CASI; [A01](#), Hardcopy

A generalized classification methodology which employs risk factor fusion, normalization, DKLT based transformation, feature selection, and parametric classifier design is developed to predict the presence or absence of a multifactorial disease. The validity of method is demonstrated by applying it to predict the occurrence of gout in patients.

DTIC

*Risk; Predictions; Diseases; Classifying*

**20030058848** Brown Univ., Providence, RI

**Stochastic Control Problems in Mobile Communications**

Dupuis, Paul; Kushner, Harold J.; Dec. 2002; 6 pp.; In English

Contract(s)/Grant(s): DAAD19-00-1-0549

Report No.(s): AD-A412170; No Copyright; Avail: CASI; [A02](#), Hardcopy

The program covered a great variety of problems. Consider the allocation of the base station transmitter in time varying mobile communications with many (data) users. The channel rates for the various users are estimated at the start of the small scheduling intervals. Since the rates vary randomly, there is a conflict between full use (by selecting the user with the highest current rate) and fairness. The Proportional Fair scheduler is designed to deal with such conflicts. Convergence and optimality properties were shown, and the algorithm extended to cover a much greater variety of circumstances.

DTIC

*Algorithms; Traffic; Mobile Communication Systems; Stochastic Processes*

**20030059048** Center for Mathematics and Computer Science, Amsterdam

**Rates of Convergence and Asymptotic Normality of Curve Estimators for Ergodic Diffusion Processes**

vanZanten, J. H.; Oct. 31, 2000; 20 pp.; In English

Report No.(s): PB2003-103148; PNA-R0011; No Copyright; Avail: CASI; [A03](#), Hardcopy

For ergodic diffusion processes, we study kernel-type estimators for the invariant density, its derivatives and the drift function. We determine rates of convergence and find the joint asymptotic distribution of the estimators at different points.

NTIS

*Ergodic Process; Asymptotic Properties; Convergence*

**66**

**SYSTEMS ANALYSIS AND OPERATIONS RESEARCH**

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

**20030057892** Center for Mathematics and Computer Science, Amsterdam

**Random Walk with a Heavy-Tailed Jump Distribution**

Cohen, J. W.; Sep. 30, 2000; 42 pp.; In English

Report No.(s): PB2003-103147; PNA-R0010; No Copyright; Avail: CASI; [A03](#), Hardcopy

The classical random walk of which the one-step displacement variable  $u$  has a first finite negative moment is considered. The R.W. possesses a unique stationary distribution;  $x$  is a random variable with this distribution. It is assumed that the righthand and/or the lefthand tail of the distribution of  $u$  are heavy-tailed. For the type of heavy-tailed distribution considered in this study a contraction factor ' $\delta$ ' ( $\delta$ ) exists with ' $\delta$ ' ( $\delta$ ) (down arrow) 0 for a ( $\delta$ ) ( $\delta$ ) (up arrow) 1, and a ( $\delta$ ) ( $\delta$ ) (up arrow) 1 is

equivalent with E (u) (up arrow) 0. It is shown that (delta) (a) x converges in distribution for 'a' (up arrow) 1.  
NTIS

*Random Variables; Random Walk; Asymptotes; Queueing Theory*

**20030058045** Army Research Lab., Aberdeen Proving Ground, MD

**Fault Tree Representation and Evaluation**

Saucier, Richard; Mar. 2003; 37 pp.; In English

Contract(s)/Grant(s): 622618AH80

Report No.(s): AD-A411439; ARL-TR-2923; No Copyright; Avail: CASI; A03, Hardcopy

In order to conduct a vulnerability analysis of a combat vehicle, it is first necessary to perform a criticality analysis, which consists of describing each of its combat functions along with the underlying systems, subsystems, and components required to support the function. The basic building blocks for carrying out this process are the fault trees; they depict the logical arrangement of the components required for the proper functioning of the vehicle. This report describes a method of representing fault trees in XML (extensible Markup Language) and is accomplished by first defining a Fault Tree Markup Language (FTML) that can be used to describe the essential logical structure of any fault tree. Once the fault tree is described in FTML, it can then be stored as an ordinary text file. Furthermore, software described in this report will then enable one to generate both the deactivation diagram and the C code that is used to evaluate the fault tree. Fault tree evaluation means the determination of whether the system that the fault tree represents is either functional or nonfunctional, given that one or more components are dysfunctional. The second part of this report describes two methods for evaluating fault trees-one based on Monte Carlo sampling and the other on the algebra of probability theory.

DTIC

*Military Vehicles; Fault Trees; Statistical Analysis*

**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*.

**20030057743** Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA, Georgia Univ., Athens, GA, USA, Northern Illinois Univ., De Kalb, Deutsches Elektronen-Synchrotron, Hamburg, Germany

**Jefferson Lab-Sub-picosecond X-ray Program**

Boyce, J. R.; Benson, S. V.; Bohn, C. L.; Douglas, D. R.; Dylla, H. F.; 2000; 8 pp.; In English

Report No.(s): DE2003-804054; No Copyright; Avail: Department of Energy Information Bridge

No abstract available

NTIS

*X Rays; Accelerators; Electron Beams; Picosecond Pulses*

**20030057745** Lawrence Livermore National Lab., Livermore, CA

**Test of the ITER TF Insert and Central Solenoid Model Coil**

Martovetsky, N.; Takayasu, M.; Minervini, J.; Isono, T.; Sugimoto, M.; Jul. 29, 2002; 12 pp.; In English

Report No.(s): DE2003-15002771; UCRL-JC-149389; No Copyright; Avail: Department of Energy Information Bridge

The Central Solenoid Model Coil (CSMC) was designed and built by ITER collaboration between the European Union, Japan, Russian Federation and the USA in 1993-2001. Three heavily instrumented insert coils have been also built for testing in the background field of the CSMC to cover a wide operational space. The TF Insert was designed and built by the Russian Federation to simulate the conductor performance under the ITER TF coil conditions. The TF Insert Coil was tested in the CSMC Test Facility at the Japan Atomic Energy Research Institute, Naka, Japan in September-October 2001. Some measurements were performed also on the CSMC to study effects of electromagnetic and cooldown cycles. The TF Insert coil was charged successfully, without training, in the background field of the CSMC to the design current of 46 kA at 13 T peak field. The TF Insert met or exceeded all design objectives, however some interesting results require thorough analyses. This paper presents the overview of main results of the testing - magnet critical parameters, ac losses, joint performance, effect of

cycles on performance, quench and thermo-hydraulic characteristics and some results of the post-test analysis.  
NTIS

*Energy Technology; Solenoids; Magnetic Coils; Superconductors (Materials); Test Facilities*

**20030057747** Argonne National Lab., IL, USA

**Evaluation of Enhanced Cooling Techniques for High-Heat-Load Absorbers**

Sharma, S.; Doose, C.; Rotela, E.; Barcikowski, A.; 2002; In English

Report No.(s): DE2003-803888; No Copyright; Avail: National Technical Information Service (NTIS)

Many components of the storage ring and front ends in the third generation of light sources are subjected to high heat loads from intense x-rays. Temperature rises and thermal stresses in these components must be kept within acceptable limits of critical heat flux and low-cycle fatigue failure. One of the design solutions is to improve heat transfer to the cooling water either by increasing water velocity in the cooling channels or by using inserts, such as porous media, twisted tapes and wire springs. In this paper we present experimental and analytical results to compare various enhanced cooling techniques for conditions specific to heating from an x-ray fan.

NTIS

*Cooling; Heat Flux; Storage Rings (Particle Accelerators); Loads (Forces); Absorbers (Materials)*

**20030057755** Thomas Jefferson National Accelerator Facility, Newport News, VA, USA

**Measuring  $G(\sup n)(\sub E)$  at High Momentum Transfers**

Reitz, B.; 2000; 10 pp.; In English

Report No.(s): DE2003-804052; No Copyright; Avail: Department of Energy Information Bridge

Experiment E02-013 at Thomas Jefferson National Accelerator Facility will extend the measured range of the neutron electric form factor  $G(\sup n)(\sub E)$  to  $Q(\sup 2)=3.4$  (GeV/c)(<sup>2</sup>) through a measurement of the cross section asymmetry in the reaction(<sup>3</sup>(rvec H)e((rvec e), e(prime)n). Recent theoretical investigations, motivated by the results on the ratio of the proton electric and magnetic form factor, predict higher values of  $G(\sup n)(\sub E)$  compared to older predictions. The experiment utilizes a polarized (<sup>3</sup>He target and the polarized CEBAF electron beam. Scattered electrons will be detected in the BigBite spectrometer, recoiling neutrons in an array of scintillators. The experimental and theoretical developments needed to perform the measurement and the extract  $G(\sup n)(\sub E)$  from(<sup>3</sup>He will be described. Concepts of extending the measurement of  $G(\sup n)(\sub E)$  to even higher momentum transfers will be discussed.

NTIS

*Linear Accelerators; Momentum; Extraction*

**20030057758** Brookhaven National Lab., Upton, NY

**Physics Opportunities and Detector Issues**

Davis, M. S.; Deshpande, A.; Ozaki, S.; Venugoplan, R.; January 2002; In English; Proceedings of the Electron Ion Collider Workshops Held at Brookhaven National Laboratory, Feb. 26-Mar. 2002

Report No.(s): DE2003-804085; BNL-52663-V-2; No Copyright; Avail: National Technical Information Service (NTIS)

The fifth in the series of Electron Ion Collider Workshops was held at Brookhaven National Laboratory on February 26 - March 2, 2002. The first two days, Feb. 26th & 27th, were dedicated to the accelerator and the interaction point design issues (hence forth called the EIC Accelerator Workshop). On February 28th, March 1st and 2nd the focus shifted to the physics of polarized e-p scattering, un-polarized e-A scattering, and the detector issues (from now on called the EIC Physics Workshop). The aim of the Workshop was to refine the physics goals of this proposed collider facility identified in previous meetings (see list below) and to begin dedicated efforts on the design of the accelerator, interaction region, and proposals for detectors in view of the physics case. The Workshop proceedings are separated into two volumes. Volume I includes the summaries and slides from the presentations of the Accelerator Workshop, while Volume II includes summaries and selected slides from the EIC Physics Workshop.

NTIS

*Electrons; Conferences; Scattering; Ionic Collisions*

**20030057766** Lawrence Livermore National Lab., Livermore, CA, Nevada Univ., Reno, NV, USA

**Lifetime of the  $1s_{2p} 1P(\sub 10)$  Excited Level in  $Fe^{24+}$**

Graf, A.; Beiersdorfer, P.; Harris, C. L.; Hwang, D. Q.; Neill, P. A.; Jul. 02, 2002; 12 pp.; In English

Report No.(s): DE2003-15003127; UCRL-JC-149240; No Copyright; Avail: Department of Energy Information Bridge

Measurements of the spectrum of Fe(sup 24+) in the 1. 845 Angstrom range obtained on the EBIT-1 electron beam ion trap at Lawrence Livermore National Laboratory were used for determining the radiative lifetime of the 1s2p (sup 1)P(sub 1) excited state.

NTIS

*Iron Isotopes; Excitation; Line Spectra*

**20030057771** Fermi National Accelerator Lab., Batavia, IL, USA

**Heavy Quark Production at CDF**

Bishai, M.; Dec. 2002; In English

Report No.(s): DE2002-805823; FERMILAB-CONF-02/315-E; No Copyright; Avail: National Technical Information Service (NTIS)

Heavy quark production cross-sections, correlations and polarizations have been measured at the Collider Detector at Fermilab (CDF) using 118 pb(sup -1) of data collected from the 1992 to 1995 Run I of the Fermilab Tevatron. There is still disagreement between theoretical predictions of bottom and charm hadro-production cross-sections and the Run I results. The observed transverse momentum spectrum of the prompt J/(psi) production polarization is still not understood. Run II of the Tevatron began in July of 2001 and the CDF Run II detector has collected 70 pb(sup -1) of physics quality data since January 2002. Large statistics of onia states have been collected. Exclusive B meson decay modes have been reconstructed and the SVT level 2 displaced track trigger has produced large samples of D mesons. The prompt charm and b(yields) cX fractions in both charmonium and D meson samples have been measured. Run II is now poised to greatly enhance the knowledge of heavy quark production dynamics well beyond the reach of the Run I detector.

NTIS

*Quarks; Charm (Particle Physics); Particle Accelerators; Detectors; Heavy Nuclei*

**20030057772** Lawrence Livermore National Lab., Livermore, CA

**TFMC Tcs Data: How do We Compare Conductor Performance to the Strand and What Conclusions for ITER We May Draw?**

Martovetsky, N.; Jan. 07, 2003; 34 pp.; In English

Report No.(s): DE2003-15003147; UCRL-ID-151220; No Copyright; Avail: Department of Energy Information Bridge

This memo is to assess the TFMC test results and compare it with the strand performance. The TFMC is not an ideal object for studying performance of the CICC in a sense that the instrumentation priority was considered secondary to reliability and therefore a lot of assumptions and modeling need to be made to make the comparison against the LMI strand possible. To compare the CICC performance to strand we need to know at least current in the strands, magnetic field and electric field distribution along the strands, temperature profile and strain distribution. In the TFMC we have much less uniform magnetic field and less determined temperature than in the CSMC Inserts, so role of modeling is greater.

NTIS

*Strands; Performance Tests; Electric Current*

**20030057773** Fermi National Accelerator Lab., Batavia, IL, USA, Kernforschungszentrum G.m.b.H., Karlsruhe, Germany  
**Top Quark Physics with CDF**

Wagner, W.; Dec. 2002; In English

Report No.(s): DE2002-805825; No Copyright; Avail: National Technical Information Service (NTIS)

In this contribution to the proceedings of the HCP conference I will give a brief overview on the CDF upgrade for Run II relevant to top quark physics analyses. I will discuss the CDF top physics program, with particular emphasis to the search for single top quark production. This includes a review of single top quark analyses in Run I.

NTIS

*Conferences; Quarks; Detectors; Particle Production*

**20030057778** Argonne National Lab., IL

**Technical Concepts for a Long-Wave Target Station for the Spallation Neutron Source**

Nov. 2002; In English

Report No.(s): DE2003-807349; ANL-02/16; ORNL/SNS-TM-2001/163; No Copyright; Avail: National Technical Information Service (NTIS)

The Spallation Neutron Source (SNS), a major new user facility for materials research funded by the U.S. Department



of Energy (DOE), is under construction at Oak Ridge National Laboratory (ORNL). The SNS will operate at a proton beam power of 1.4 MW delivered in short pulses at 60 Hz; this power level is an order of magnitude higher than that of the current most intense pulsed spallation neutron facility in the world, ISIS at the Rutherford-Appleton Laboratory in the UK: 160 kW at 50 Hz. When completed in 2006, the SNS will supply the research community with neutron beams of unprecedented intensity and a powerful, diverse instrument suite with exceptional capabilities. Together, these will enable a new generation of experimental studies of interest to chemists, condensed matter physicists, biologists, materials scientists, and engineers, in an ever-increasing range of applications. The Long-Wavelength Target Station (LWTS) complements the High-Power Target Station (HPTS) facility, which is already under construction, and will leverage the significant investment in the remainder of the complex, providing important new scientific opportunities. The fully equipped SNS will offer capabilities for neutron scattering studies of the structure and dynamics of materials with sensitivity, resolution, dynamic range, and speed that are unparalleled in the world.

NTIS

*Spallation; Targets; Neutron Sources; Neutron Scattering; Neutron Beams*

**20030057790** Fermi National Accelerator Lab., Batavia, IL, USA, University of Northern Illinois, De Kalb, IL, USA  
**SO(10) GUT Models and Their Present Success in Explaining Mass and Mixing Data**

Albright, C. H.; Dec. 2002; 14 pp.; In English

Report No.(s): DE2002-805829; FERMILAB-CONF-02/326-T; No Copyright; Avail: Department of Energy Information Bridge

Some features of SO(10) GUT models are reviewed, and a number of such models in the literature are compared. While some have been eliminated by recent neutrino data, others are presently successful in explaining the quark and lepton mass and mixing data. A short description of one very predictive model is given which illustrates some of the features discussed. Future tests of the models are pointed out including one which contrasts sharply with those models based on an L(sub e)-L(sub mu)-L(sub tau) type symmetry.

NTIS

*Particle Theory; Standard Model (Particle Physics); Mass Distribution; Symmetry*

**20030057853** Lawrence Livermore National Lab., Livermore, CA

**Thermal Stress Analyses for an NLC Positron Target with a 3mm Radius Beam**

Stein, W.; Sunwoo, A.; Sheppard, J. C.; Bharadwaj, V.; Schultz, D.; Aug. 28, 2002; In English

Report No.(s): DE2003-15002785; UCRL-ID-150018; No Copyright; Avail: National Technical Information Service (NTIS)

The power deposition of an incident electron beam in a tungsten-rhenium target and the resultant thermal shock stresses in the material have been modeled with a transient, dynamic, structural response finite element code. The Next Linear Collider electron beam is assumed split into three parts, with each part impinging on a 4 radiation lengths thick target. Three targets are required to avoid excessive thermal stresses in the targets. Energy deposition from each beam pulse occurs over 265 nanoseconds and results in heating of the target and pressure pulses straining the material. The rapid power deposition of the electron beam and the resultant temperature profile in the target generates stress and pressure waves in the material that are considerably larger than those calculated by a static analysis. The 6.22 GeV electron beam has a spot radius size of 3 mm and results in a maximum temperature jump of 147 degrees Centigrade.

NTIS

*Thermal Stresses; Positrons; Targets; Electron Beams; Radii*

**20030057876** Fermi National Accelerator Lab., Batavia, IL, USA, Deutsches Elektronen-Synchrotron, Hamburg, Germany  
**Precise Predictions for Selectron Pair Production**

Freitas, A.; vonManteuffel, A.; Nov. 2002; 12 pp.; In English

Report No.(s): DE2003-804163; FERMILAB-CONF-02/270-T; No Copyright; Avail: Department of Energy Information Bridge

At a future linear collider, the masses and couplings of scalar leptons can be measured with high accuracy, thus requiring precise theoretical predictions for the relevant processes. In this work, after a discussion of the expected experimental precision, the complete one-loop corrections to muon and selectron pair production in the MSSM are presented and the effect of different contributions in the result is analyzed.

NTIS

*Leptons; Pair Production; Scalars; Couplings*

**20030057878** Creare, Inc., Hanover, NH

**MR Elastography System for Breast Cancer Detection**

Kline-Schoder, Robert J.; Oct. 2002; 41 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-00-1-0677

Report No.(s): AD-A410815; No Copyright; Avail: CASI; [A03](#), Hardcopy

Early diagnosis of breast cancer, which is critical for favorable clinical outcomes, is difficult because tumors and healthy tissue respond similarly to X-rays and ultrasound. One physical property that clearly distinguishes healthy from cancerous tissue is mechanical stiffness or hardness. Researchers have attempted to combine external mechanical stimulation and Magnetic Resonance Imaging (MRI) to quantitatively measure the Young's modulus of tissue throughout both the breast and the prostate. This technique, Magnetic Resonance Elastography (MRE) has been called 'palpation at a distance.' One of the most challenging technical aspects of MRE is the efficient solution of the 'inverse problem,' i.e., quantitatively determining Young's modulus from MRI-measured tissue displacement data. Creare developed analytical techniques to improve the efficiency and robustness of the inverse problem solution. One technique, which utilizes an incompressible formulation of the tissue equations of motion, an adjoint method for calculating the gradient of the goodness-of-fit metric, and a quasi-Newton minimization algorithm, appears to provide a substantial improvement in efficiency over techniques used previously.

DTIC

*Algorithms; Cancer; Diagnosis; Goodness Of Fit; Magnetic Resonance; Mammary Glands; Prostate Gland; Stiffness; Tumors*

**20030057908** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Halo Particle Confinement in the VLHC Using Optical Stochastic Cooling**

Zholents, A.; Barletta, W.; Chattopadhyay, S.; Zolotarev, M.; 2002; 6 pp.; In English

Report No.(s): DE2003-807399; No Copyright; Avail: Department of Energy Information Bridge

Beam halo particles following the extreme trajectories near the physical aperture limit radiate Smith-Purcell radiation when moving over a diffraction grating. This grating can be used as a pick-up and a kicker for optical stochastic cooling of the halo particles. In this application cooling would have the effect of slowing down the halo particle diffusion onto the aperture. Cooling efficiency would quickly diminish with the distance from the aperture and would only affect the halo particles. A preliminary analysis of this system is considered.

NTIS

*Accelerators; Confinement; Cooling*

**20030057920** California Univ., Santa Barbara, CA

**Microwave Confocal Detection and Thermal Therapy for Breast Cancer: Adaptive Phased Array System for In-Vivo Mapping/Targeting Telomerase Activity**

York, Robert A.; Jul. 2002; 13 pp.; In English

Contract(s)/Grant(s): DAMD17-01-1-0491

Report No.(s): AD-A410798; No Copyright; Avail: CASI; [A03](#), Hardcopy

Microwave hyperthermia holds promise in the treatment of malignant breast tumors, with fewer side effects using non-ionizing radiation. However technical limitations continue to limit its use. This project seeks to overcome two such limitations. The first area of research is developing biocompatible vectors with high microwave absorbing and scattering materials, enhancing in-vivo localization of target cells, where the activity of specific markers is present. The second area of research seeks to optimize the microwave energy delivery system, studying the efficiency of pulsed versus continuous energy deposition for frequency from 30 MHz to 3 GHz, where the hyperthermia has shown best therapeutic results and detection systems are designed. First, we identify and measure biocompatible materials that would enhance the absorption and/or the scattering of microwave photons in water based inhomogeneous medium. We first expanded our understanding of dipolar polarization and conduction mechanisms, determining the efficiency of microwave heating. A measurement system was then established and a series of measurements was taken on water-soluble conductive polymers. The first measurements were promising. Future work will focus on the absorption mechanism as well as including these materials in liposomes, optimizing the external delivery system.

DTIC

*Detection; Hyperthermia; Ionizing Radiation; Therapy; Tumors; Mammary Glands; Microwaves; Cancer; Thermodynamic Properties*

**20030057948** Fermi National Accelerator Lab., Batavia, IL, USA

**Summary of Radiation Damage Studies on Rare Earth Permanent Magnets**

Volk, J. T.; Nov. 2002; 8 pp.; In English

Report No.(s): DE2003-804712; FERMILAB-CONF-01/430; No Copyright; Avail: Department of Energy Information Bridge

Rare Earth Permanent Magnets (REPM) have been widely used in accelerators since the early 1980s. Wigglers, Undulators and Quadrupoles have been used in light source and damping rings. Currently there are proposals for permanent magnet quadrupoles for use in the NLC and VLHC. The advantages of permanent magnets are zero operating costs and reduce capital costs by eliminating power supplies can cables. The main disadvantage is the loss of strength of the magnets due to radiation damage. With the proposed use of permanent magnets for both the NLC and VLHC the issue flux loss due to radiation damage needs to be fully understood. There exists many papers on the subject. There are many difficulties in drawing conclusions from all of these data. First there is the difference methods of dosimetry, second different types of magnets and magnetic arrangements, and third different manufacturers of magnet material. This paper provides a summary of the existing literature on the subject.

NTIS

*Permanent Magnets; Radiation Damage; Rare Earth Alloys*

**20030057970** Naval Postgraduate School, Monterey, CA

**An Electromagnetic Interference Analysis of Uninterruptible Power Supply Systems in a Data Processing Environment**

Beran, Edward W.; Dec. 2002; 125 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411197; No Copyright; Avail: CASI; [A06](#), Hardcopy

The levels of Electromagnetic Interference (EMI) generated by two standard models of Uninterruptible Power Supplies (UPS) were examined. Conducted current measurements were made on all conductors exiting and entering two standard UPS units between the frequency range of 60-Hz up to 50 MHz. EMI reduction actions were undertaken on both units, and the reduction in EMI current resulting from these actions was determined. The before and after mitigation results were compared with EMI limits suggested by available specifications, standards, and other related documents. The results show that a significant reduction in the level of EMI can be achieved in low-to-modest size UPSs using inexpensive, standard, and commercially available filters, provided the filters are installed in an effective manner. The reduction of EMI to harmless levels at radio-receiving and data-processing sites is shown to be feasible.

DTIC

*Electromagnetic Interference; Radio Signals; Radio Reception*

**20030058014** Lawrence Livermore National Lab., Livermore, CA

**Search for Defocusing During a Single Pulse of a 2 kA Relativistic Electron Beam due to Ions Accelerated from a Target**

Lauer, E. J.; Caporaso, G. J.; Chambers, F. W.; Chen, Y. J.; Falabella, S.; Sep. 05, 2002; 40 pp.; In English

Report No.(s): DE2003-15002787; UCRL-ID-150026; No Copyright; Avail: Department of Energy Information Bridge

The DARHT accelerator will deliver several intense relativistic electron beam pulses to an x-ray conversion target during a few microseconds. Plasma from the target can cause a partial neutralization of the vacuum self-Er field resulting in an unacceptably large beam radius at the target. The Livermore group has been developing barrier foils to block the plasma from moving upstream. Positive ions accelerated upstream from the foil in the self-Ez field during a single pulse could defocus the beam. In May, 2001 LANL used a sensitive two foil experiment to search for such effects. They measured significant time dependent effects using conducting foils. In January, 2002, the Livermore group repeated the experiment using the ETA II accelerator. We expected to see similar effects and planned to collect data that we could model. We saw no significant effect from conducting foils unless the beam radius was small enough to damage the foil.

NTIS

*Relativistic Electron Beams; Particle Accelerator Targets; Positive Ions*

**20030058029** Naval Research Lab., Washington, DC

**LOFAR Scientific Memorandum Number 1: Cluster-Formation Synchrotron Radiation. A Contaminant for Epoch of Reionization Experiments and a Signal for Probing Cluster Formation and the Gamma-Ray Background**

Lazio, T. J.; Cordes, James M.; Dec. 20, 2002; 9 pp.; In English

Report No.(s): AD-A411908; NRL/MR/7120-02-8645; No Copyright; Avail: CASI; [A02](#), Hardcopy

The process of assembly of the largest clusters of galaxies, M approx. greater than 10(exp 14) solar mass, should have produced shocks that accelerated electrons to TeV energies. In turn, these electrons will produce synchrotron emission. A

recent analysis by Waxman and Loeb predicts that this intergalactic synchrotron background will have an amplitude of order 10K and characteristic fluctuation size of 0.1 deg-1 deg at frequencies near 100MHz. This cluster-formation synchrotron radiation can be targeted in LOFAR and SKA observations as a source of information on cluster formation that will complement detailed gamma-ray studies. Existing low-frequency VLA observations already have detected what are probably the brightest examples of such cluster-formation synchrotron radiation. Conversely, the predicted amplitude of the cluster-formation synchrotron radiation is roughly 100 times larger than that predicted for the signature of the epoch of reionization in the (redshifted) H I line, but the angular scales are comparable. We suggest two strategies that may, singly or in combination, suffice to remove this contaminant from experiments designed to detect or map the H I signature of the EoR. Either strategy is demanding, though, as the accuracies required are probably 1 part in 5000 or better.

DTIC

*Galactic Clusters; Background Radiation; H Lines; Synchrotron Radiation*

**20030058030** Kansas Univ., Lawrence, KS

**Construction of Vacuum Deposition System for Research of Hg-Based High Temperature Superconductors Coated Conductors**

Wu, Judy; Jun. 30, 2002; 6 pp.; In English

Contract(s)/Grant(s): F49620-01-1-0226; Proj-3484

Report No.(s): AD-A411002; AFRL-SR-AR-TR-03-0052; No Copyright; Avail: CASI; [A02](#), Hardcopy

This DURIP grant, with \$96k from DOD and \$32k of the University of Kansas matching fund, has been utilized to construct a high-vacuum thin film evaporation chamber. Construction of the major part of the chamber was completed before the expiration of the grant. Installation of the second e-gun was completed at the end of 2001. Installation of the RHEED system will be completed by the first quarter of 2003 due to late delivery of the hardware. A picture of the chamber is shown in Fig. 1. Several research projects have been initiated recently after the chamber was tested. This allows the Pt to extend her research on high-temperature superconducting thin films, particularly Hg-HTS thin films, to coated conductors, which has been considered a critical enabling technology for high power microwave sources in future Air Force systems. The goal to leverage the expertise developed in Pt's laboratory in epitaxy of Hg-HTS thin films and apply it to coated conductor applications has been met. The details of the research enabled by this chamber are described in the following. Several manuscripts are under development based on the recent results obtained from this chamber.

DTIC

*High Temperature Superconductors; Vacuum Deposition; Superconducting Films; Coatings*

**20030058038** University of Southern California, Los Angeles, CA

**Ultrawideband Radio Ranging Studies**

Scholtz, Robert A.; Feb. 10, 2003; 45 pp.; In English

Contract(s)/Grant(s): N00014-00-1-0221

Report No.(s): AD-A411997; No Copyright; Avail: CASI; [A03](#), Hardcopy

The research grant supported the study of UWB radio ranging advantages and issues caused primarily by the wide radio frequency bandwidth and fine time resolution capabilities of these systems. Significant progress was made in understanding how to cooperatively range in a dense multipath environment. In addition, UWB propagation measurements were made in a shipboard environment to determine the difficulties in positioning using RF signals in a large metallic enclosure, and issues in sharing a large RF bandwidth with other narrowband radio systems were explored.

DTIC

*Bandwidth; Narrowband; Radio Frequencies; Ranging; Radio Beacons*

**20030058716** California Univ., San Diego, La Jolla, CA

**Design and Performance Analysis of Multicarrier CDMA Systems**

Milstein, Laurence B.; Aug. 2002; 4 pp.; In English

Contract(s)/Grant(s): DAAG55-98-1-0473

Report No.(s): AD-A412291; ARO-37582.9-C1; No Copyright; Avail: CASI; [A01](#), Hardcopy

The research being conducted is designed to yield major improvements in the capabilities of military wireless communications systems. The new system is designed around a physical layer based upon a wideband direct sequence (DS) multicarrier (MC) code division multiple access (CDMA) link. Among other things, an MC signal does not require a contiguous spectrum: this means, for example, that an MC CDMA network can be overlaid upon an existing set of narrowband

signals simply by leaving appropriate gaps in the placement of the multiple carriers. Such a characteristic will allow the military to employ the same frequencies as used by various commercial systems, thereby making use of the technology advancements in those frequency bands, and yet not be limited in deployment because of excessive interference from conventional narrowband signals. We have emphasized the effect of estimation errors in determining channel state information for use in optimal receiver design for MC CDMA systems, and have performed analyses of performance, as measured by the average probability of error of the system. We have also included the use of space-time spreading.

DTIC

*Communication Networks; Telecommunication; Code Division Multiple Access; Design Analysis*

**20030058748** Stanford Linear Accelerator Center, Stanford, CA, USA, Boston Univ., Boston, MA, USA, Wisconsin Univ., Madison, WI, USA

**Electroweak Symmetry Breaking by Strong Dynamics and the Collider Phenomenology**

Barklow, T. L.; Chivukula, R. S.; Goldstein, J.; Han, T.; Dec. 2002; In English

Report No.(s): DE2002-806225; No Copyright; Avail: National Technical Information Service (NTIS)

We discuss the possible signatures in the electroweak symmetry breaking sector by new strong dynamics at future hadron colliders such as the Tevatron upgrade, the LHC and VLHC, and  $e(\text{sup}+)e(\text{sup}-)$  linear colliders. Examples include a heavy Higgs-like scalar resonance, a heavy Technicolor-like vector resonance and pseudo-Goldstone states, non-resonance signatures via enhanced gauge-boson scattering and fermion compositeness.

NTIS

*Broken Symmetry; Particle Accelerators; Electroweak Interactions (Field Theory)*

**20030058752** Air Force Research Lab., Edwards AFB, CA, USA

**Status of US Testing of the High Performance Hall System SPT-140 Hall Thruster**

Hargus, W., Jr.; Jankovsky, R.; Mason, L.; Snyder, J.; Malone, S.; Jan. 13, 2000; 7 pp.; In English

Contract(s)/Grant(s): F04611-97-C-0064; Proj-4373

Report No.(s): AD-A410594; AFRL/PRS-AFRL-PR-ED-TY-1999-0252; No Copyright; Avail: CASI; [A02](#), Hardcopy

The High Performance Hall System (HPHS) program supports the development and flight qualification of a 4.5 kW electric propulsion system that includes the SPT-140 Hall thruster. The Air Force Research Laboratory (AFRL) and International Space Technology, Inc (ISTI) are co-funding the HPHS program which is being conducted by a team led by Atlantic Research Corporation (ARC). The team includes ISTI, Experimental Design Bureau Fakel (Fakel), and Space Systems Loral (S/SL). The Research Institute of Applied Mechanics and Electrodynamics (RIAME) also provided support for this project. The SPT-140 is being designed, developed, manufactured, and tested by Fakel in Kaliningrad, Russia, where extensive performance testing and advanced development have been performed. In addition to the testing in Russia, a suite of experiments on the development model and the qualification model thrusters, sponsored by the U.S. Government, has occurred during 1999 and is scheduled to occur in 2000. These experiments include thruster performance, plume characterization, electromagnetic compatibility, and life characterization.

DTIC

*Electric Propulsion; Hall Thrusters; Aerospace Engineering; Propulsion System Performance*

**20030058768** Lawrence Livermore National Lab., Livermore, CA

**Fourier Transforms of Pulses Containing Exponential Leading and Trailing Profiles**

Warsaw, S. I.; Jul. 15, 2001; 40 pp.; In English

Report No.(s): DE2003-15002784; UCRL-ID-149577; No Copyright; Avail: Department of Energy Information Bridge

In this monograph we discuss a class of pulse shapes that have exponential rise and fall profiles, and evaluate their Fourier transforms. Such pulses can be used as models for time-varying processes that produce an initial exponential rise and end with the exponential decay of a specified physical quantity. Unipolar examples of such processes include the voltage record of an increasingly rapid charge followed by a damped discharge of a capacitor bank, and the amplitude of an electromagnetic pulse produced by a nuclear explosion. Bipolar examples include acoustic N waves propagating for long distances in the atmosphere that have resulted from explosions in the air, and sonic booms generated by supersonic aircraft. These bipolar pulses have leading and trailing edges that appear to be exponential in character.

NTIS

*Fourier Transformation; Electromagnetic Pulses; Sound Waves*

**20030058772** British Columbia Univ., Vancouver, British Columbia, Canada

**Top and Higgs Physics at the Tevatron**

Savard, P.; Dec. 2002; In English

Report No.(s): DE2002-806220; FERMILAB-CONF-02/292-E; No Copyright; Avail: National Technical Information Service (NTIS)

The authors present a summary of their experimental understanding of the top quark and discuss the significant improvements expected in Run II at the Fermilab Tevatron Collider. They also discuss prospects for a Higgs boson discovery at the Tevatron.

NTIS

*Higgs Bosons; Particle Accelerators*

**20030058776** Continuous Electron Beam Accelerator Facility, Newport New, VA, USA, Old Dominion Univ., Norfolk, VA, USA

**Covariant Description of the Deuteron**

VanOrden, J. W.; 2002; 22 pp.; In English

Report No.(s): DE2003-756920; CEBAF-TH-94-20; No Copyright; Avail: Department of Energy Information Bridge

An introduction to the use of Bethe-Salpeter and quasipotential equations in the description of electron scattering from the deuteron is provided. The basic formalism and many technical issues are introduced in the context of a simple scalar theory. Results for bound-state wave functions and scattering phases shifts for a variety of quasipotential prescriptions are presented and qualitative characteristics of these solutions are discussed. The elastic form factors for the bound state in this model are calculated using the spectator or Gross equation.

NTIS

*Deuterons; Covariance; Form Factors*

**20030058782** Harbin Inst. of Tech., China, Brookhaven National Lab., Upton, NY

**Thermal Uniformity of Liquid Helium in Electron Bubble Chamber**

Wang, L.; Jia, L.; Jul. 2002; 10 pp.; In English

Report No.(s): DE2003-804087; BNL-69210; No Copyright; Avail: Department of Energy Information Bridge

A cryogenic research apparatus to measure the movement of electrons under a high electric field in a liquid helium bath was designed and built at the Brookhaven National Laboratory and the Nevis Laboratory of Columbia University. The liquid helium chamber is a double walled cylindrical container equipped with 5 optics windows and 10 high voltage cables. To shield the liquid helium chamber against the external heat loads and to provide the thermal uniformity in the liquid helium chamber, the double walled jacket was cooled by a pumped helium bath. The helium chamber was built into a commercial LN<sub>2</sub>/LHE cryostat. This paper presents the design and the numerical simulation analysis on thermal uniformity of the electron bubble chamber.

NTIS

*Bubble Chambers; Cryogenics; Design Analysis*

**20030058784** Brookhaven National Lab., Upton, NY

**Performance Data of a Pulsed Power Photo-Injector**

Smedley, J.; Srinivasan-Rao, T.; Tsang, T.; Farrell, J. P.; Batchelor, K.; Oct. 2002; 10 pp.; In English

Report No.(s): DE2003-804090; BNL-69311; No Copyright; Avail: Department of Energy Information Bridge

There has been a lot of interest in compact sources of high brightness, relativistic electron beams. One approach for developing such a source is to apply a high gradient that remains constant during the generation and acceleration of the electron beam. In this paper, we describe high voltage pulse generators that deliver up to 5 MV with 1 ns pulse duration. These devices are synchronizable to an external trigger with jitter of (approx) 0.5 ns and can establish gradients in excess of 1 GV/m between two electrodes without breakdown. In the presence of field gradients up to 0.5 GV/m, electron beams of bunch lengths ranging from 1 ns to 0.3 ps and diameter < 300(micro) m have been generated by irradiating the cathode with UV lasers. Characteristics of these electron beams as well as those produced via field emission at gradients up to 1 GV/m will be discussed.

NTIS

*Cathodes; Pulse Generators; Electron Beams; Voltage Generators*

**20030058794** Iowa State Univ. of Science and Technology, Ames, IA

**[Theory of Random Laser Systems]**

Soukoulis, C. M.; 2001; 122 pp.; In English

Report No.(s): DE2002-803829; No Copyright; Avail: Department of Energy Information Bridge

This graduate work focuses on the theory of random laser systems which is a very new direction in condensed matter physics. The topics in random laser systems are about the electromagnetic (EM) wave propagation in random and amplifying media. The development of this direction is based on the background of the two very important branches of modern condensed matter physics: one is localization of waves, and the other is laser physics.

Author (revised)

*Condensed Matter Physics; Electromagnetic Wave Transmission; Lasers*

**20030058807** Brookhaven National Lab., Upton, NY

**Rare Kaon and Pion Decays**

Littenberg, L.; 2002; 36 pp.; In English

Report No.(s): DE2003-804092; BNL-69399; No Copyright; Avail: Department of Energy Information Bridge

The author discusses the status of and prospects for the study of rare decays of kaons, muons, and pions. Studies of rare kaon decays are entering an interesting new phase wherein they can deliver important short-distance information. It should be possible to construct an alternative unitarity triangle to that determined in the B sector, and thus perform a critical check of the Standard Model by comparing the two. Rare muon decays are beginning to constrain supersymmetric models in a significant way, and future experiments should reach sensitivities which this kind of model must show effects, or become far less appealing.

NTIS

*Kaons; Muons; Pions; Particle Decay*

**20030058809** Algarve Univ., Faro (Portugal), Brookhaven National Lab., Upton, NY, USA

**Elliptic Flow from Color Glass Condensate**

Krasnitz, A.; Nara, Y.; Venugopalan, R.; 2002; 8 pp.; In English

Report No.(s): DE2003-804089; BNL-69381; No Copyright; Avail: Department of Energy Information Bridge

We show that an observable fraction of the measured elliptic flow may originate in classical gluon fields at the initial stage of a peripheral high-energy nuclear collision. This mechanism complements the contribution of late stage mechanisms, such as those described by hydrodynamics, to the observed elliptic flow.

NTIS

*Gluons; Color; Glass; Collisions*

**20030058810** Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

**Research Perspectives at Jefferson Lab: 12 GeV and Beyond**

deJager, K.; 2002; 10 pp.; In English

Report No.(s): DE2003-804423; No Copyright; Avail: Department of Energy Information Bridge

The plans for upgrading the CEBAF accelerator at Jefferson Lab to 12 GeV are presented. The research program supporting that upgrade are illustrated with a few selected examples. The instrumentation under design to carry out that research program is discussed. Finally, a conceptual design of a future upgrade which combines a 25 GeV fixed-target facility and an electron-ion collider facility at a luminosity of up to  $10^{35} \text{cm}^{-2} \text{s}^{-1}$  and a CM energy of over 40 GeV.

NTIS

*Linear Accelerators; Targets; Research And Development*

**20030058814** Muenster Univ., Germany, California Univ., Berkeley, CA

**First-Principles Calculation of Optical Absorption Spectra in Conjugated Polymers: Role of Electron-Hole Interaction**

Rohlfing, M.; Tiago, M. L.; Louie, S. G.; Sep. 20, 2000; 14 pp.; In English

Report No.(s): DE2003-805106; No Copyright; Avail: Department of Energy Information Bridge

Experimental and theoretical studies have shown that excitonic effects play an important role in the optical properties of conjugated polymers. The optical absorption spectrum of trans-polyacetylene, for example, can be understood as completely dominated by the formation of exciton bound states. We review a recently developed first-principles method for computing the excitonic effects and optical spectrum, with no adjustable parameters. This theory is used to study the absorption spectrum

of two conjugated polymers: trans-polyacetylene and poly-phenylene-vinylene (PPV).

NTIS

*Optical Properties; Holes (Electron Deficiencies); Electromagnetic Absorption; Light (Visible Radiation)*

**20030058815** Fermi National Accelerator Lab., Batavia, IL, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

**Betatron Motion with Coupling of Horizontal and Vertical Degrees of Freedom**

Bogacz, S. A.; Lebedev, V. A.; Nov. 2002; 8 pp.; In English

Report No.(s): DE2003-804898; FERMILAB-CONF-01/439; No Copyright; Avail: Department of Energy Information Bridge

The Courant-Snyder parametrization of one-dimensional linear betatron motion is generalized to two-dimensional coupled linear motion. To represent the 4X4 symplectic transfer matrix the following ten parameters were chosen; four beta-functions, four alpha-functions and two betatron phase advances which have a meaning similar to the courant-Snyder parametrization. Such a parametrization works equally well for weak and strong coupling and can be useful for analysis of coupled betatron motion in circular accelerators as well as in transfer lines. Similarly, the transfer matrix, the bilinear form describing the phase space ellipsoid and the second order moments are related to the eigen-vectors. Corresponding equations can be useful in interpreting tracking results and experimental data.

NTIS

*Electron Beams; Oscillations; Betatrons; Degrees Of Freedom*

**20030058819** Lehigh Univ., Bethlehem, PA

**Modernization of Research Facility for Environment Assisted Fracture**

Wei, Robert P.; Jul. 19, 2001; 3 pp.; In English

Contract(s)/Grant(s): F49620-00-1-0193

Report No.(s): AD-A412087; AFRL-SR-AR-TR-03-0066; No Copyright; Avail: CASI; [A01](#), Hardcopy

Modernization of the research facility for environment assisted fracture has been completed under this DURIP/AFOSR grant. The modernization included the replacement of controllers for two automated electrohydraulic testing machines, modernization of the AC potential drop system for crack length measurement, and the addition of a high-speed, digital storage oscilloscope for measuring transient events. Coupled with prior acquisitions and the facilities for chemical and microstructure analyses, these additions have brought the environment assisted fracture facility back up to the state-of-the-art to support cutting-edge research and education. This line of research is key to the development of advanced methodology for life-cycle design and management of engineered systems for use in defense and civilian applications.

DTIC

*Research Facilities; Management Systems; Crack Propagation; Dimensional Measurement; Microstructure; Fracturing*

**20030058941** Naval Postgraduate School, Monterey, CA

**Barrel Wear Reduction in Rail Guns: An Investigation of Silver Paste Liquid-Metal Interface**

Smith, Michael W., Jr; Dec. 2002; 62 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411065; No Copyright; Avail: CASI; [A04](#), Hardcopy

This thesis tests the effects a commercial silver paste has on the damage at the projectile-rail interface of a 4' long rail gun test section. Projectiles (0.635 x 0.635 x 0.953 cm) were pushed through the rail test section at 34 plus or minus 19 m/s, while average current densities of 18 - 32 kA per square centimeter) was passed through the projectile - rail interface material. The specific objective is to examine rail and projectile damage at current densities near or above those ( $\sim 25$  kA/per square centimeter) anticipated for a naval rail gun. Voltages across the rails were monitored and changes in conductivity when solid electrical contact was broken were observed.

DTIC

*Liquid Metals; Silver; Wear; Guns (Ordnance); Pastes*

**20030058943** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA

**Stress Intensities and Crack Growth in Photoelastic Motor Grain Models**

Smith, C. W.; Constantinescu, D. M.; Liu, C. T.; Feb. 25, 2002; 6 pp.; In English

Contract(s)/Grant(s): Proj-2302

Report No.(s): AD-A411104; AFRL-PR-ED-AB-2002-040; No Copyright; Avail: CASI; [A02](#), Hardcopy

Two dimensional thermal shrinkage tests on photoelastic models and tensile tests on single fin sections of motor grain



have suggested that, for a specific fin geometry consisting of a small edge radius coalescing with a large central fin tip radius, the critical locus for stress in a homogeneous model lies at the points of confluence for the two radii on the fin surface. On the other hand, some motor grain manufacturers have reported cracks emanating from the fin tip along its own axis of symmetry as a result of defects collected there during the casting process. One aspect of the problem just beginning to be studied is how cracks grow from these two critical points. Cotterell classified cracks that extended in a particular direction as Class I cracks, i.e., cracks located on the axis of symmetry of a fin were cracks that were always under Pure Mode I loading due to symmetry in both load and geometry. Other cracks, such as those emanating from the points of coalescence of the two fin tip radii (off-axis cracks) were initially called Class II cracks, the growth direction being initially unknown due to mixed mode states along the crack border, but after turning and growing in a new direction become Class I cracks. A series of experiments on photoelastic motor grain models under internal pressure were conducted on models containing such cracks in which the frozen stress method was used together with a two-parameter algorithm to extract the Mode I and Mode II stress intensity factors (SIFs) at certain points along the crack borders. The experiments showed that both SIF values and crack geometry during growth were quite variable due to shear modes during the class II stage for the off-axis cracks. On the other hand, the 'symmetric' cracks on the fin axis were quite predictable in their behavior, as were the off-axis cracks after eliminating the shear modes.

DTIC

*Stress Intensity Factors; Photoelasticity; Crack Propagation; Crack Geometry; Rocket Engines; Fracture Mechanics; Motors*

**20030059031** Lawrence Livermore National Lab., Livermore, CA

**Surface-Sensitive, Element-Specific Magnetometry with X-Ray Linear Dichroism**

Schumann, F. O.; Willis, R. F.; Tobin, J. G.; Oct. 06, 1999; 22 pp.; In English

Report No.(s): DE2003-791447; UCRL-JC-135969; No Copyright; Avail: Department of Energy Information Bridge

Here it is shown that the magnetic linear dichroism in x-ray photoemission (XMLD) signal can be used to measure the element specific magnetic moments in ultra thin alloy films. Comparison with recent SQUID data provides a quantitative check that demonstrates that the total magnetization derived from summing the constituent elemental moments is correct.

NTIS

*Magnetic Measurement; X Rays; Dichroism*

## 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*.

**20030057791** Swedish Defence Research Establishment, Stockholm, Sweden

**Underwater Signatures**

Alin, N.; Claesson, H.; Ivansson, S.; Fureby, C.; Karasalo, I.; Mar. 2002; In Swedish

Report No.(s): PB2003-103169; FOI-R-0450-SE; No Copyright; Avail: National Technical Information Service (NTIS)

A ship or submarine has a number of signatures-active and passive acoustic, pressure, wake, static electric (UEP), static magnetic, extreme low-frequency electromagnetic (ELFE)-and other signatures like internal waves and changed biological activity and spillage. The rapid development of intelligent sensor systems, with data fusion capability coupled with demands to participate in international operations, gives rise to new requirements for stealth and signature reduction for future systems, tactics and weapon platforms. Experimental as well as theoretical studies are performed within the project Underwater signatures. Acoustical, hydrodynamical as well as electromagnetic signatures are considered for ships and submarines. The studies focused upon (1) fundamental mechanisms and principles for passively and actively generated underwater signatures; (2) environmental effects upon signal generation and propagation; (3) coupling between signatures of different types in connection with generation and reduction of signatures. Particular emphasis is given to prospects of and threats from surveillance systems based upon multisensor technology including combined utilization of signatures of different types. The present report aims at giving an overview of the work after the first quarter. It is based upon experience from many years of research concerning signatures, marine platforms and weapon systems at the research groups Underwater acoustics, Computational Physics and Magnetism at FOI.

NTIS

*Signatures; Underwater Acoustics; Target Recognition; Warfare; Magnetic Materials*

**20030057957** Naval Research Lab., Bay Saint Louis, MS

**Spatial and Temporal Variability in Bottom Roughness: Implications to High Frequency Subcritical Penetration and Backscatter**

Williams, Kevin L.; Jackson, Darrell R.; Thorsos, Eric I.; Tang, Dajun; Briggs, Kevin B.; Sep. 20, 2002; 9 pp.; In English Report No.(s): AD-A410803; NRL/PP/7430-02-4; No Copyright; Avail: CASI; A02, Hardcopy

Quantitative prediction of high frequency, low grazing angle penetration into, and scattering from, sand sediments requires knowledge of the roughness of the water/sand interface. Since the sediment roughness evolves due to hydrodynamic and biological processes, concurrent, co-located measurement of roughness and acoustic penetration/backscattering is essential for testing acoustic models or using such models to determine the likelihood of buried target detection. Here, we examine both roughness and acoustic measurements carried out during a month-long 1999 Sediment Acoustics experiment (SAX99). A ripple field was present throughout the experimental period but changed wavelength and orientation as a result of a storm event (i.e., the ripple field is temporally non-stationary). The predicted impact of this change in the ripple field on acoustic penetration at shallow grazing angles is presented. The small-scale roughness important for backscattering was measured at several locations near to, but not co-located with, acoustic backscattering measurements. These roughness measurements indicate changes with location. The effect of this spatial non-stationary on tests of alternative backscattering models is discussed. Finally, simple sonar equation predictions of high frequency, low grazing angle buried mine detection are carried out using various combinations of interface roughness conditions.

DTIC

*Acoustic Measurement; Acoustic Scattering; Backscattering; Spatial Distribution; Surface Roughness; Temporal Distribution*

**20030058047** Wyle Labs., Inc., Arlington, VA

**Measurements of Sonic Booms Due to ACM Training at White Sands Missile Range**

Plotkin, Kenneth J.; Desai, Vijay R.; Moulton, Carey L.; Lucas, Michael J.; Brown, Ronald; Sep. 1989; 138 pp.; In English Contract(s)/Grant(s): F33615-89-C-0574; Proj-7757

Report No.(s): AD-A411476; WR-89-18; AFRL-HE-WP-TR-2001-0158; No Copyright; Avail: CASI; A07, Hardcopy

A study was conducted to measure and document the C-weighted day-night level (CDNL) of sonic booms due to air combat maneuver (ACM) training. Measurements took place in the Lava/Mesa airspace at the White Sands Missile Range, NM, where the primary ACM activity is F-15s from Holloman AFB. Thirty-five automatic sonic boom monitors (a combination of USAF BEAR and SBM-1 units) were deployed for a period of six months. All operations schedule and airspace clearance data were collected so that sonic booms could be correlated with specific events; A sample of air combat maneuver instrumentation (ACMI) tracking data was also collected. During the six-month measurement period, 4,600 ACM sorties were flown, 72% of which were F-15s. A total of 591 sonic boom events were recorded. For those missions for which ACM! tracking data were obtained, sonic boom ray tracing calculations agreed well with the measured booms. The results were projected to planned supersonic operations at the Reserve, NM, and Valentine, TX, Military Operating Areas (MOAs) It was found that, at full capacity of 300 ACM sorties/month in each MOA, CDNL would be below 50 dB at all locations. Near the center of the supersonic area at Reserve, a sonic boom would be heard an average of once every three days. At Valentine, where supersonic operations will be divided between two areas, a sonic boom would be heard about once a week.

DTIC

*Maneuvers; Sonic Booms; Acoustic Measurement*

**20030058053** Engineering Research and Consulting, Inc., Edwards AFB, CA, USA

**Preliminary Visualizations of Acoustic Waves Interacting with Subcritical and Supercritical Cryogenic Jets**

Chehroudi, Bruce; Talley, Doug; May 2002; 7 pp.; In English

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

Report No.(s): AD-A410959; AFRL-PR-ED-TP-2002-013; No Copyright; Avail: CASI; A02, Hardcopy

The effect of large amplitude acoustic waves on subcritical and supercritical cryogenic jets was studied. A general trend was observed that acoustic waves cause the time averaged cross section of the jet to flatten in a direction where the minor axis becomes aligned with the direction of propagation of the waves. It was also found that the presence of acoustic waves shortened the breakup length of the jets compared with non-acoustically forced jets. The above trend was observed with decreasing magnitude as pressure increases from subcritical to supercritical pressures, until the trend became nearly indiscernible at the highest supercritical pressure evaluated. An increase in the mass flow rate of the jet also tended to decrease the magnitude of the trends observed.

DTIC

*Sound Waves; Supercritical Pressures; Cryogenics*

**20030058054** Naval Postgraduate School, Monterey, CA

**The Influence of Shallow Water Variability on Short Range Water-Borne Propagation**

Karpi, Stephen C.; Dec. 2002; 71 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411327; No Copyright; Avail: CASI; [A04](#), Hardcopy

Interest in enhancing the forecasting capabilities of both active and passive sonar systems employed in littoral regions has greatly escalated over the past 10 years. This requires a need for improvements in the general understanding of the influence of shallow water variability on acoustic propagation. This work examines the influence on the relatively short-range water-borne propagation paths of shallow water variability. Both internal wave fluctuations and random sound speed perturbations will be considered. The effects of littoral variability on acoustic propagation will be quantified in terms of spatial (vertical) coherence functions. Since the effects of the water-column variability is of interest, the direct water-borne propagation path will be solely analyzed. The data to be examined will be generated numerically based on an acoustic propagation model employing environmental data taken from the East China Sea as part of the ONR-sponsored ASIAEX experiments.

DTIC

*Shallow Water; Sound Transmission; Acoustic Velocity*

**20030058722** Maryland Univ., College Park, MD

**Vehicle Classification Using a Biological Model of Hearing**

Depireux, D. A.; Shamma, S. A.; Aug. 1999; 7 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-97-1-0501

Report No.(s): AD-A411944; No Copyright; Avail: CASI; [A02](#), Hardcopy

The Army is interested in using acoustic sensors in the battlefield to perform vehicle tracking and classification using passive arrays of acoustic microphones and seismic sensors. Here, we present a prototype vehicle acoustic signal classification. To analyze acoustic features of the vehicle signal, we adopt biologically motivated feature extraction models. Physiological and psychophysical research have shown that primary auditory cortex performs to the first order a multi-scale decomposition of the incoming auditory spectra, on axes of log-frequency and time. This decomposition, based on the spectra emerging from a realistic model of the cochlea, is then used as a input to a classifier. Different vector quantization (VQ) clustering algorithms are implemented and tested for real world vehicle acoustic signal, such as Learning VQ, Tree- Structured VQ and Parallel TSVQ. Experiments on the Acoustic-seismic Classification Identification Data Set (ACIDS) database show that both PTSVQ and LVQ achieve high classification rates. The advantage of using biologically-based representation and classification algorithms include noise-robustness and existing low-power VLSI implementations. We present classification results and performance levels. The VQ schemes presented here have the advantage of not having to choose explicitly the features that distinguish one target from another. The burden is shifted to having to choose the 'best' representation for the classifier.

DTIC

*Classifying; Vehicles; Sound Detecting And Ranging*

**20030058730** Connecticut Univ., Storrs, CT

**Breast Cancer Diagnosis Using Ultrasound and Diffusive Light**

Zhu, Quing; Sep. 2002; 99 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAMD17-00-1-0217

Report No.(s): AD-A411487; No Copyright; Avail: CASI; [A05](#), Hardcopy

Tumor blood volume and micro-vascular density are parameters anatomically and functionally associated with tumor angiogenesis. During the last decade, rigorous modeling of the light propagation in the near infrared region, combined with the advancements of light source and detectors, has improved the diffused light measurements and made possible the application of tomographic techniques for characterizing and imaging tumor angiogenesis 1-6. If a single wavelength is used, optical absorption related to angiogenesis and other normal blood vessels can be measured. If two or more optical wavelengths are used, both oxy-hemoglobin and deoxy-hemoglobin concentrations can be measured simultaneously. In addition, optical scattering is related to cell activations because scattering is sensitive to any particles that are of the size of the optical wavelength. However, the NIR technique has not been widely used in clinics and the fundamental problem remains the intense light scattering. As a result, diffused light probes a wide region instead of propagating along a straight line. Localization or imaging based on tomographic inverse scattering approaches suffers from low spatial resolution and the inversion problem is, in general, underdetermined and ill-posed.

DTIC

*Ultrasonics; Diagnosis; Light Scattering; Optical Properties; Clinical Medicine; Inverse Scattering; Tomography; Blood Volume; Mammary Glands; Cancer*

**20030058743** Naval Postgraduate School, Monterey, CA

**Obstacle Avoidance Control for the REMUS Autonomous Underwater Vehicle**

Fodrea, Lynn R.; Dec. 2002; 79 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A411361; No Copyright; Avail: CASI; [A05](#), Hardcopy

Future Naval operations necessitate the incorporation of autonomous underwater vehicles into a collaborative network. In future complex missions, a forward look capability will be required to map and avoid obstacles such as sunken ships. This thesis examines obstacle avoidance behaviors using a forward-looking sonar for the autonomous underwater vehicle REMUS. Hydrodynamic coefficients are used to develop steering equations that model REMUS through a track of specified points similar to a real-world mission track. Control of REMUS is accomplished using line of sight and state feedback controllers. A two-dimensional forward-looking sonar model with a 1200 horizontal scan and a 110 meter radial range is modeled for obstacle detection. Sonar mappings from geographic range-bearing coordinates are developed for implementation in MATLAB simulations. The product of bearing and range weighting functions form the gain factor for a dynamic obstacle avoidance behavior. The overall vehicle heading error incorporates this obstacle avoidance term to develop a path around detected objects. REMUS is a highly responsive vehicle in the model and is capable of avoiding multiple objects in proximity along its track path.

DTIC

*Underwater Vehicles; Avoidance; Sonar; Sound Detecting And Ranging*

**20030058744** Naval Postgraduate School, Monterey, CA

**Assessing the Performance of Omni-Directional Receivers for Passive Acoustic Detection of Vocalizing Odontocetes: Initial Analysis**

Garcia, Jorge F.; Dec. 2002; 60 pp.; In English; Original contains color illustrations  
Report No.(s): AD-A411369; No Copyright; Avail: CASI; [A04](#), Hardcopy

The purpose of this study was to evaluate the performance of inexpensive, passive, omni-directional receivers as a means to detect vocalizing Odontocetes using conditional statistics. To evaluate and predict performance, it was necessary to establish probability of detection as a function of a) signal to noise ratio or range at a given source level and b) probability of false alarm. For this purpose, a model of the probability distribution function of the detector output was derived from experimental data. For the experiment a series of short duration digital recordings of selected odontocete vocalizations were broadcast underwater from a moving platform. The vocalizations were monitored and digitally recorded at a stationary underwater array consisting of three vertically distributed hydrophones. Over a period of three days, several hundred iterations of each signal with the transmitter at ranges varying from 300 meters to 12000 meters were recorded. A monitoring hydrophone (co-located with the transmitter) was used to monitor the signal source level. The raw data was fed to two 'automatic detectors' consisting of different data processing routines developed in MATLAB. The output of each detector was subjected to statistical analysis. Other factors also considered in the analysis were: signal used, range, and wind (as a proxy indicator of noise generated by surface wave action). A statistical test was employed to systematically find a best fit probability distribution function model of detector output. From this empirical model, detector performance was estimated.

DTIC

*Receivers; Sound Detecting And Ranging*

**20030058780** Pennsylvania State Univ., University Park, PA

**Intensity Probe 02-20 Using Miniature Hollow Spheres**

Van Tol, David J.; Lauchle, Gerald C.; Gabrielson, Thomas B.; Jan. 2003; 17 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): N00014-00-G-0058/0024

Report No.(s): AD-A410730; ARL/PSU/TR-03-001; No Copyright; Avail: CASI; [A03](#), Hardcopy

A probe is designed to measure the acoustic intensity at the primary frequencies (20-30 kHz) of a parametric array. It is designed to operate at depths up to 61 m with a pressure sensitivity of less than -235dB re 1V/mPa while not disturbing the acoustic field of interest. Higher sensitivity would result in saturation when exposed to the expected sound pressure levels. The sensitivity and depth requirements were met, while the acoustic field disturbance issue is not yet fully resolved.

DTIC

*Miniaturization; Probes; Sonar; Pressure Measurement; Acoustic Scattering*

**20030058781** Naval Research Lab., Bay Saint Louis, MS

**Fluctuations of High-Frequency Acoustic Pulses in Three Shallow-Water Experiments**

Wilson, Marcia A.; Mar. 6, 2003; 42 pp.; In English

Report No.(s): AD-A411719; NRL/MR/7180--03-8297; No Copyright; Avail: CASI; [A03](#), Hardcopy

High-frequency acoustic propagation and scattering experiments were conducted near Panama City, Florida, in August of 1991 and 1993, and in Eckernförde Bay, Germany in May 1993. Environmental measurements were made in conjunction with acoustic measurements. The water depth at all sites was approximately 30 m. Sources and receiver arrays were mounted 6 to 8 m from the bottom and were separated by about 80 m. Data were obtained from 20 to 180 kHz. Means, standard deviations, and coefficients of variation of 100 to 150 direct path pulses for each frequency characterize two scales of temporal variability in the data. The short term variability with a period of several seconds was attributed to wind waves while the larger scale changes with a period of several minutes were related to internal waves. The amplitude of the fluctuations depended on a combination of factors including the depth and slope of the thermocline, turbulence from internal waves, wind waves, tides, and current interactions, and whether or not multipath arrivals interacted at the receiver array. Spatial variability was noted among several closely spaced hydrophones. Differences among frequencies depended on environmental factors that were changing with time of day when data were collected, as well as wavelength and beam pattern effects.

DTIC

*Acoustic Measurement; Acoustic Propagation; Shallow Water; Sound Waves; Underwater Acoustics*

**20030058845** National Taiwan Univ., Taipei, Taiwan, Province of China

**Contrast-Based Ultrasonic Blood Flow Measurements Based on Inflow/Outflow Time Intensities**

Yeh, Chih-Kuang; Wang, Sheng-Wuei; Li, Pai-Chi; Oct. 25, 2001; 5 pp.; In English

Report No.(s): AD-A412141; No Copyright; Avail: CASI; [A01](#), Hardcopy

Ultrasonic contrast specific blood flow measurement techniques offer new opportunities to assess blood flow information based on evaluation of time-intensity curves (TICs). Such curves are measured to estimate concentration of the microbubbles in the blood pool. Based on the indicator-dilution theory, hemodynamic parameters such as the volume flow rate can be directly related to the time constant estimated from the TICs. In this paper, the applicability of the indicator-dilution theory is studied with an in vitro experiment setup. Moreover, the linear system assumption of the blood mixing mechanism is also tested. Several flow phantoms are constructed and a self-made, albumin based contrast agent is used. The TIC is measured by using B-mode images obtained from a commercial ultrasound system. It is found that with a bolus injection and a single mixing chamber, the estimated time constants agree with the theory despite that the effective mixing volume may be smaller than the actual mixing chamber volume in some conditions. More importantly, discrepancy also exists with a prolonged injection and/or two mixing chambers with cascade connection. In other words, the linear system assumption is still questionable even under the controlled in vitro experimental conditions. Potential sources of the discrepancy require further investigation in order to develop contrast specific quantitative blood flow measurement techniques.

DTIC

*Ultrasonics; Blood Circulation; Flow Measurement; Time Constant; Bubbles; Concentration (Composition)*

**20030058957** Defence Science and Technology Organisation, Salisbury, Australia

**Analysis of a Generic Warhead Part I: Experimental and Computational Assessment of Free Field Overpressure**

Anderson, J. G.; Katselis, G.; Caputo, C.; Jul. 2002; 48 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411875; DSTO-TR-1313; DODA-AR-012-345; No Copyright; Avail: CASI; [A03](#), Hardcopy

Experimental and numerical results are presented for the free field blast generated by a 7.8 kg cylindrical charge of Composition B high explosive. In the experiments, overpressure and shock front time of arrival measurements have been recorded. Overpressure measurements in the far field provide pressure histories at discrete locations. Peak overpressure in the near field is calculated from time of arrival measurements. In addition, the numerical model was used to generate overpressure histories and two-dimensional contour plots of the blast wave.

DTIC

*Warheads; Far Fields; Overpressure; Mathematical Models*

**20030059010** Lawrence Livermore National Lab., Livermore, CA

**Use of Imploding Spheres: An Alternative to Explosives as Acoustic Sources at Mid-Latitude SOFAR Channel Depths**

Harben, P. E.; Boro, C.; Dorman, L.; Pulli, J.; May 12, 2000; 16 pp.; In English

Report No.(s): DE2003-793868; UCRL-ID-139032; No Copyright; Avail: Department of Energy Information Bridge

The hydroacoustic nuclear explosion monitoring regime, like its counterpart in seismic monitoring, requires ground truth calibration. Model predictions of traveltimes, blockages, reflections, diffractions, and waveform envelopes need to be verified with ground truth experiments, particularly in the high latitudes where models often fail. Although pressure detonated explosives are a simple, reliable, and flexible method to generate an impulsive hydroacoustic calibration source at a desired depth; safety procedures, specialized training, and local regulations often preclude their use. This leaves few alternatives since airgun and other seismic marine sources are designed for use only at shallow depths and hence do not effectively couple into the SOFAR channel, a necessary requirement for long range propagation. Imploding spheres could be an effective source at mid-ocean depths and below but development of a method to reliably break such spheres has been elusive. We designed and tested a prototype system to initiate catastrophic glass sphere failure at a prescribed depth. The system firmly holds a glass sphere in contact with a piston-ram assembly. The end cap on the cylinder confining the piston and opposing the ram has a rupture disk sealed to it. The rupture disk is calibrated to fail within 5% of the calibrated failure pressure, 1000 psi in our tests. Failure of the rupture disk results in a sudden inrush of high pressure water into the air-filled piston chamber, driving the piston -- and attached ram -- towards the glass sphere.

NTIS

*Explosions; Spheres; Underwater Acoustics; Implosions*

**20030059013** NASA Langley Research Center, Hampton, VA, USA

**Application of Passive Porous Treatment to Slat Trailing Edge Noise**

Khorrami, Mehdi R.; Choudhari, Meelan M.; May 2003; 14 pp.; In English

Contract(s)/Grant(s): 762-20-11-04

Report No.(s): NASA/TM-2003-212416; NAS 1.15:212416; L-18303; No Copyright; Avail: CASI; [A03](#), Hardcopy

Porous trailing-edge treatment is investigated as a passive means for slat noise reduction by using time-accurate simulations based on Reynolds-averaged Navier-Stokes equations. For the model scale high-lift configuration used during previous experiments in the Low-Turbulence Pressure Tunnel at NASA Langley Research Center, application of the proposed treatment over a minute fraction of the slat surface area is shown to mitigate the noise impact of the trailing edge, with no measurable aerodynamic penalty. Assessment of the pressure fluctuations in the vicinity of the treated edge indicates a potential noise reduction in excess of 20 dB. The primary mechanism underlying this reduction is related to the reduced strength of Strouhal shedding from the finite thickness trailing edge. A secondary effect of the treatment involves an upward shift in the Strouhal-shedding frequency to a frequency band of reduced auditory sensitivity in a full-scale application.

Author

*Aeroacoustics; Aerodynamic Noise; Frequencies; Low Turbulence; Noise Reduction*

## 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](#).

**20030058736** Boston Univ., Boston, MA

**Screening for Breast Cancer Using Near-Field Infrared Spectroscopy of a Single Strand of Hair**

Erramilli, Shyamsunder; Hong, M. K.; Aug. 2002; 9 pp.; In English

Contract(s)/Grant(s): DAMD17-00-1-0159

Report No.(s): AD-A411480; No Copyright; Avail: CASI; [A02](#), Hardcopy

A recent Australian study has used synchrotron x-ray diffraction to identify changes in the structure of hair that may be linked to either the occurrence of breast cancer, or the increased predisposition to breast cancer because of the presence of a mutation of the BRCA1 gene. We have successfully developed a new infrared method for the detection in a single strand of hair the presence of lipid deposits that were the putative cause of the observed x-ray patterns. Our study provides an independent test of the proposed link between hair structure and breast cancer. We have found that our table-top infrared technique does offer an alternative to expensive synchrotron x-ray sources for this purpose. However, our tests show that we find the presence of lipids in healthy patients as well. We performed independent x-ray studies in collaboration with researchers at Cornell University, who have confirmed our finding that the x-ray scattering patterns are observed in hair from

healthy patients. Taken together Our work suggests that (i) IR microscopy is extremely promising, but (ii) the Australian study is likely to be wrong - a disappointing result for breast cancer patients.

DTIC

*Infrared Spectroscopy; Mammary Glands; X Ray Diffraction; Cancer*

**20030058865** Ploitehnica Univ., Bucharest, Romania

**Brain Arteries Movement Detection With Gated Gradient Echo Sequence: Standardization, Registration and Subtraction of Serial Magnetic Resonance Images**

Ionescu, Razvan; Alarcon, Cristian; Langevin, Francois; October 25, 2001; 5 pp.; In English

Report No.(s): AD-A412551; No Copyright; Avail: CASI; [A01](#), Hardcopy

In order to make evident pulsing brain arteries movements associated with heart activity, intramodality MR registration and subtraction has to be used to detect small differences between serial MR brain images. A new voxel-based rigid-body registration algorithm, including: (1) a standardization of grey levels procedure by means of similarity measure optimization, (2) a new full 2-D convolution cubic interpolation zooming procedure, (3) a low computational cost multi-scale iterative procedure, that uses the zoomed versions of images to be registered, is proposed. It allows up to 1/8 pixel accuracy.

DTIC

*Brain; Gradients; Arteries; Head Movement*

**20030058880** NASA Ames Research Center, Moffett Field, CA, USA

**Gas Phase Spectroscopy of Cold PAH Ions: Contribution to the Interstellar Extinction and the Diffuse Interstellar Bands**

Biennier, L.; Salama, F.; Allamandola, L. J.; Scherer, J. J.; OKeefe, A.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 113-116; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Polycyclic Aromatic Hydrocarbon molecules (PAHs) are ubiquitous in the interstellar medium (ISM) and constitute the building blocks of interstellar dust grains. Despite their inferred important role in mediating the energetic and chemical processes in the ISM, their exact contribution to the interstellar extinction, and in particular to the diffuse interstellar bands (DIBs) remains unclear. The DIBs are spectral absorption features observed in the line of sight of stars that are obscured by diffuse interstellar clouds. More than 200 bands have been reported to date spanning from the near UV to the near IR with bandwidths ranging from 0.4 to 40 Angstroms (Tielens & Snow 1995). The present consensus is that the DIBs arise from free flying, gas-phase, organic molecules and/or ions that are abundant under the typical conditions reigning in the diffuse ISM. PAHs have been proposed as possible carriers (Allamandola et al. 1985; Leger & DHendecourt 1985). The PAH hypothesis is consistent with the cosmic abundance of Carbon and Hydrogen and with the required photostability of the DIB carriers against the strong VUV radiation field in the diffuse interstellar clouds. A significant fraction of PAHs is expected to be ionized in the diffuse ISM.

Author

*Diffuse Interstellar Bands; Polycyclic Aromatic Hydrocarbons; Vapor Phases; Spectroscopy; Cold Plasmas; Interstellar Extinction*

**20030058905** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Measurement of Absolute Excitation Cross Sections in Highly-Charged Ions Using Electron Energy Loss and Merged Beams**

Chutjian, A.; Smith, Steven J.; Lozano, J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 47-50; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

There is increasing emphasis during this decade on understanding energy balance and phenomena observed in high electron temperature plasmas. The UV spectral return from FUSE, the X-ray spectral return from the HETG on Chandra and the LETGS 011 XMM-Newton are just beginning. Line emissions are almost entirely from highly-charged ions (HCIs) of C, N, O, Ne, Mg, S, Si, Ca, and Fe. The Constellation-X mission will provide X-ray spectroscopy up to photon energies of 0.12 nm (10 keV) where primary line emitters will be HCIs. A variety of atomic parameters are required to model the stellar and solar plasma. These include cross sections for excitation, ionization, charge-exchange, X-ray emission, direct and indirect recombination, lifetimes and branching ratios, and dependences on l, m mixing by external E and B fields. In almost all cases the atomic quantities are calculated, and few comparisons to experiment have been carried out. Collision strengths and Einstein A-values are required to convert the observed spectral intensities to electron temperatures and densities in the stellar plasma. The JPL electron energy-loss and merged beam approach has been used to measure absolute collision strengths in a

number of ions, with critical comparison made to the best available theories.

Author

*Electron Beams; Ionization Cross Sections; Atomic Excitations; Ionic Collisions; Electron Transitions*

**20030058906** Kentucky Univ., Lexington, KY, USA

**A National Facility for Astrophysical Atomic Data Needs**

Ferland, Gary J.; Schultz, David R.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 51-55; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Nearly all astronomical environments are far from equilibrium. As a result, the emission we observe is sensitive to details within the source that created it. This is why spectroscopy is such a powerful tool for understanding the physics of the cosmos, but it also presents a challenge because the spectrum is sensitive to the atomic processes that determine its emission. Although some of the needed atomic data can be provided by existing theory codes, much must be studied experimentally, especially those involving collisions. Currently no national US facility exists for such investigations. NASA researchers currently must look to Europe for such facilities. We propose a coordinated program, based at Oak Ridge National Laboratory (ORNL), which would provide a national focus for efforts to generate the needed atomic data. The central facility would be a storage ring that would directly measure the needed processes. A data center and internet-based community of astrophysical modelers would be associated with the facility and provide both dissemination of data and guidance in future data needs. The center could build upon ORNL, resources that fall within its current fusion program and so accomplish its goals at relatively modest cost.

Author

*Storage Rings (Particle Accelerators); Research Facilities; Atomic Collisions*

**20030058907** SRI International Corp., Menlo Park, CA, USA

**Charge Transfer Collisions in Ionospheres, Exospheres, and Interstellar Clouds**

Huestis, David L.; Spirko, Jeffery A.; Hickman, A. Peet; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 65-66; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The ionization potentials of O(3)P1 and H atoms are equal to within the current experimental uncertainty. This means that the charge transfer reactions  $O + H(+)$  (reversible reaction)  $O(+) + H$  have very large cross sections in both directions, and thus play central roles in interactions with the solar wind and atomic escape in the exospheres of Venus, Earth, and Mars, as well as in interstellar clouds. We are performing ab initio electronic structure calculations and quantum mechanical coupled channels calculations, including spin-orbit coupling, of differential and momentum transfer cross sections for charge exchange and fine structure excitation in this system. The work builds on previous theoretical and photodissociation spectroscopy studies of the OH(+) molecule and parallels our previous calculations on collisions of O(+) with O. For several transitions, collision mechanisms based on curve crossings have been identified. The results indicate that long range coupling terms in the OH(+) potentials (internuclear distances of 10-15 a(sub 0)) contribute to the cross sections.

Derived from text

*Charge Transfer; Exosphere; Interstellar Matter; Molecular Clouds; Planetary Ionospheres; Atomic Collisions*

**20030058913** National Inst. of Standards and Technology, Gaithersburg, MD, USA

**Atomic Oscillator Strengths by Emission Spectroscopy and Lifetime Measurements**

Wiese, W. L.; Griesmann, U.; Kling, R.; Musielok, J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 104-106; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Over the last seven years, we have carried out numerous oscillator strength measurements for some light and medium heavy elements. Most recently we have determined numerous transitions of Mn II and are now working on Cl I. For the emission measurements, we have applied either a high-current wall-stabilized arc, or a high-current hollow cathode, or a Penning discharge. The latter two sources were used for branching ratio measurements from common upper levels, while the wall-stabilized arc was operated at atmospheric pressure under the condition of partial local thermodynamic equilibrium, which allows the measurement of relative transition probabilities. Absolute data were obtained by combining the emission results with lifetime data measured by other research groups, especially the University of Hannover, with which we have closely collaborated. This group uses the laser induced fluorescence (LIF) technique. Our emission spectra were recorded for the light elements with a 2 m grating spectrometer, or, for Mn II, with an FT 700 vacuum ultraviolet Fourier transform spectrometer. The radiometric calibration was carried out with a tungsten strip lamp for the visible part of the spectrum and with a deuterium lamp for the ultraviolet. All measurements were made under optically thin conditions, which was checked by doubling the path length with a focusing mirror setup. Typical uncertainties of the measured oscillator strengths are



estimated to be in the range 15%-20% (one-standard deviation). However, discrepancies with advanced atomic structure theories are sometimes much larger. We present some sample comparisons, mainly with such advanced calculations.

Derived from text

*Emission Spectra; Light Elements; Oscillator Strengths; Spectroscopic Analysis; Atomic Structure; Electron Transitions*

**20030058931** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Microwave, Millimeter, Submillimeter, and Far Infrared Spectral Databases**

Pearson, J. C.; Pickett, H. M.; Drouin, B. J.; Chen, P.; Cohen, E. A.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 145-148; In English; See also 20030058868; No Copyright; Avail: CASI; A01, Hardcopy

The spectrum of most known astrophysical molecules is derived from transitions between a few hundred to a few hundred thousand energy levels populated at room temperature. In the microwave and millimeter wave regions, spectroscopy is almost always performed with traditional microwave techniques. In the submillimeter and far infrared microwave technique becomes progressively more technologically challenging and infrared techniques become more widely employed as the wavelength gets shorter. Infrared techniques are typically one to two orders of magnitude less precise but they do generate all the strong features in the spectrum. With microwave technique, it is generally impossible and rarely necessary to measure every single transition of a molecular species, so careful fitting of quantum mechanical Hamiltonians to the transitions measured are required to produce the complete spectral picture of the molecule required by astronomers. The fitting process produces the most precise data possible and is required in the interpret heterodyne observations. The drawback of traditional microwave technique is that precise knowledge of the band origins of low lying excited states is rarely gained. The fitting of data interpolates well for the range of quantum numbers where there is laboratory data, but extrapolation is almost never precise. The majority of high resolution spectroscopic data is millimeter or longer in wavelength and a very limited number of molecules have ever been studied with microwave techniques at wavelengths shorter than 0.3 millimeters. The situation with infrared technique is similarly dire in the submillimeter and far infrared because the black body sources used are competing with a very significant thermal background making the signal to noise poor. Regardless of the technique used the data must be archived in a way useful for the interpretation of observations.

Author

*Astrophysics; Data Bases; Far Infrared Radiation; Microwaves; Millimeter Waves; Submillimeter Waves*

**20030059024** Lawrence Livermore National Lab., Livermore, CA

**Radiative Strength Functions and Level Densities**

Schiller, A.; Becker, J. A.; Bernstein, L. A.; Voinov, A.; Guttormsen, M.; August 28, 2002; 16 pp.; In English  
Report No.(s): DE2003-15002773; UCRL-JC-147589; No Copyright; Avail: Department of Energy Information Bridge

Radiative strength functions and level densities have been extracted from primary gamma-ray spectra for (sup 27,28) Si, (sup 56,57) Fe, (sup 96,97) Mo, and several rare earth nuclei. An unexpectedly strong (approximately 1mbMeV) resonance at 3 MeV in the radiative strength function has been observed for well-deformed rare earth nuclei. The physical origin of this resonance and its connection to the scissors mode is discussed.

NTIS

*Gamma Ray Spectra; Nuclear Structure; Energy Levels; Resonance Lines*

**20030059025** Lawrence Livermore National Lab., Livermore, CA

**Advances Toward Inner-Shell Photo-Ionization X-Ray Lasing at 45 Å**

Moon, S. J.; Weber, F. A.; Celliers, P. M.; Eder, D. C.; Jul. 18, 2002; 14 pp.; In English

Report No.(s): DE2003-15002774; UCRL-JC-147936; No Copyright; Avail: Department of Energy Information Bridge

The inner-shell photo-ionization (ISPI) scheme requires photon energies at least high enough to photo-ionize the K-shell, approximately 286 eV, in the case of carbon. As a consequence of the higher cross-section, the inner-shell are 'selectively' knocked out, leaving a hole state  $1s2S(\text{sup } 2)2p(\text{sup } 2)$  in the singly charged carbon ion. This generates a population inversion to the radiatively connected state  $1s(\text{sup } 2)2s(\text{sup } 2)2p$  in  $C^+$ , leading to gain on the  $1s-2p$  transition at 45 angstroms. The resonant character of the lasing transition in the single ionization state intrinsically allows much higher quantum efficiency compared to other schemes. Competing processes that deplete the population inversion include auto-ionization, Auger decay, and in particular collisional ionization of the outer-shell electrons by electrons generated during photo-ionization. The competing processes rapidly quench the gain. Consequently, the pump method must be capable of populating the inversion

at a rate faster than the competing processes. This can be achieved by an ultra-fast high intensity laser that is able to generate an ultra-fast, bright x-ray source.

NTIS

*X Ray Lasers; Photoionization; Electron States; Atomic Energy Levels; Photon-Electron Interaction*

## 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*.

**20030058000** Air Force Research Lab., Edwards AFB, CA, USA

#### **Comparison of Orbit Transfer Vehicle Concepts Utilizing Mid-Term Power and Propulsion Options**

Gulczynski, Frank S., III; Schilling, John H.; Dec. 16, 2002; 11 pp.; In English

Report No.(s): AD-A410972; AFRL-PR-ED-TP-2002-311; No Copyright; Avail: CASI; A03, Hardcopy

The recent announcement of a national nuclear space flight initiative has rekindled interest in nuclear propulsion options within the spacecraft propulsion community. Therefore, the Air Force Research Laboratory Propulsion Directorate (AFRL/PRSS) has decided to reexamine the value of utilizing nuclear propulsion for orbit transit and the repositioning of future Air Force space assets. A trade study was conducted with the assumption that technologies had matured to the 2010 level. A comparison was made between advanced chemical, solar thermal, solar electric, and nuclear electric for expendable, integral, and reusable mission concepts, with a particular interest in options that resulted in trip times of 60 to 100 days. Results show that for expendable stages both solar thermal and, to a greater degree, solar electric propulsion systems can provide a significant increase in payload delivered from LEO to GEO within the required trip times. The solar electric concepts utilize clustered Hall thrusters, thin film photovoltaic solar arrays for power generation, and advanced power processing topologies for power conversion. Solar electric systems were also highly advantageous for integral systems. For reusable vehicles, where payload and fuel are supplied to a reusable propulsion tug module, similar results were calculated based on trip time. However, with a reusable stage, other considerations related to component degradation in the space environment must be considered. This consideration results in a rapid degradation of the thin film arrays used for solar electric stages due to Van Allen belt radiation, whereas the reactors utilized for the nuclear electric options are hardened to prevent radiation damage to payload and thus are protected from the natural space environment. Nuclear reactors also have a large initial dry mass penalty that limits their applicability for transporting small payloads.

DTIC

*Spacecraft Propulsion; Nuclear Propulsion; Reusable Spacecraft; Expendable Stages (Spacecraft)*

**20030058008** Fermi National Accelerator Lab., Batavia, IL, USA, British Columbia Univ., Vancouver, British Columbia, Canada

#### **Recent Progress on FFAGS for Rapid Acceleration**

Dec. 2002; 14 pp.; In English

Report No.(s): DE2002-805677; No Copyright; Avail: Department of Energy Information Bridge

Muon acceleration is one of the more difficult stages to develop for a Neutrino Factory or Muon Collider. The large transverse and longitudinal admittances which must be designed into the system and the rapidity with which acceleration must take place because of muon decay preclude the use of conventional synchrotron design. The approach here employs fixed-field architectures for muon acceleration; specifically, a fixed-field alternating gradient or FFAG accelerator. This paper explores the FFAG option, in particular addressing an adjustment in the rf phase which, although characteristic of fixed-field machines, becomes problematic in the context of rapid acceleration.

NTIS

*Muons; Particle Acceleration; Neutrinos*

**20030058754** Lawrence Livermore National Lab., Livermore, CA

#### **Beam Physics in X-ray Radiography Facilities**

Jiuan Chen, Y.; Caporaso, G. J.; Chambers, F. W.; Falabella, S.; Goldin, F. J.; Dec. 02, 2002; In English

Report No.(s): DE2003-15002762; UCRL-JC-149928; No Copyright; Avail: National Technical Information Service (NTIS)

Performance of x-ray radiography facilities requires focusing the electron beams to sub-millimeter spots on the x-ray

converters. Ions extracted from a converter by impact of a high intensity beam can partially neutralize the beam space charge and change the final focusing system. We will discuss these ion effects and mitigation.

NTIS

*Radiography; Electron Beams; Space Charge; X Rays*

**20030058757** Johns Hopkins Univ., Baltimore, MD

**RF Safety of Wires in Interventional MRI: Using a Safety Index**

Yeung, Christopher J.; Susil, Robert C.; Atalar, Ergin; Oct. 25, 2001; 4 pp.; In English

Report No.(s): AD-A412080; No Copyright; Avail: CASI; A01, Hardcopy

With the rapid growth of interventional MRI, radiofrequency (RF) heating at the tips of guidewires, catheters, and other wire-shaped devices has become an important safety issue. Previous studies have identified some of the variables that affect the relative magnitude of this heating but none could predict the absolute of heating but none could predict the absolute amount of heating to formulate safety margins. This study presents the first theoretical model of wire tip heating that can accurately predict its absolute value. The method of moments was used to find the induced currents on insulated and bare wires that were completely embedded in the tissue. The induced currents caused an amplification of the local specific absorption rate (SAR) distribution near the wire. This SAR gain was combined with a semi-analytic solution to the bioheat transfer equation to generate a safety index. The safety index is a measure of the worst case in vivo temperature change that can occur with the wire in place. It can be used to set limits on the spatial peak SAR of pulse sequences that are used with the interventional wire. Under worst-case conditions with resonant wires in a poorly perfused tissue, only about 100 mW/kg/C spatial peak SAR may be used at 1,5 T. But for <10 em wires with insulation thickness >30\% of the wire radius flint are placed in well perfused tissues, normal operating conditions of 4 W/kg spatial peak SAR are possible at 1,5 T. We propose a simple way to ensure safety when using an interventional wire: set a limit on the SAR of allowable pulse sequences flint is a factor of a safety index below the tolerable temperature increase.

DTIC

*Safety Management; Radio Frequencies; Magnetic Resonance; Imaging Techniques*

**20030058800** Fermi National Accelerator Lab., Batavia, IL, USA, Carleton Univ., Ottawa, Ontario, Canada, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Davis, CA, USA

**Report of the Subgroup on Alternative Models and New Ideas**

Chertok, M.; Dienes, K.; Godfrey, S.; Kalyniak, P.; Kaplan, D.; Dec. 2002; In English

Report No.(s): DE2002-806228; FERMILAB-CONF-01/450; No Copyright; Avail: National Technical Information Service (NTIS)

We summarize some of the work done by the P3 subgroup on Alternative Models and New Ideas. The working group covered a broad range of topics including a constrained Standard Model from an extra dimension, a discussion of recent ideas addressing the strong CP problem, searches for doubly charged higgs bosons in e(gamma) collisions, and an update on discovery limits for extra neutral gauge bosons at hadron colliders. The breadth of topics rejects the many ideas and approaches to physics beyond the Standard Model.

NTIS

*Nuclear Physics; Standard Model (Particle Physics); Elementary Particles; Particle Theory*

## 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*.

**20030057764** Lawrence Livermore National Lab., Livermore, CA

**Electronic Flash Lamp System to Replace the Traditional, Explosively Driven Light Source**

Stigman, W. L.; Kihara, R.; Scarpetti, R. D.; Sep. 25, 2002; 12 pp.; In English

Report No.(s): DE2003-15003125; UCRL-JC-148511; No Copyright; Avail: Department of Energy Information Bridge

Electronic flash lamps are being developed at the Lawrence Livermore National Laboratory (LLNL). These lamps are intended to replace the traditional explosively driven Argon-gas filled light sources (Argon candles) that are currently used to provide illumination for high speed rotating mirror-framing cameras. At Livermore, we are developing an electronic flash lamp system that can match or exceed the light output of a traditional Argon candle. These systems utilize a Plasma Arc Lamp

developed by PRISM Science Inc of Chatham, MA, USA. In the past, high-speed photography requiring explosively driven light sources were a one-time-only event that destroyed fixtures and optical alignment. The electronic flash lamp system, utilizing the Plasma Arc Lamp, will replace the explosively driven lighting systems and provide the capability to dry run experimental setups and repeat tests without damage to the experimental set-up. The electronic flash lamp system eliminates the problem of collateral damage to the experiment and does not add to the overall amount of explosives needed for a single test. Since the Pulsed-Power driver is remotely located, only the flash lamp itself is destroyed when the explosive shot is fired. The flexible geometry of this light source also enables the user to create complex light patterns as well as photograph very large areas with a single lighting system.

NTIS

*Light Sources; Flash Lamps; Structural Design*

**20030057775** Lawrence Livermore National Lab., Livermore, CA

**Modeling of Intellite 3 Layer Deformable Mirror**

Papavasiliou, A. P.; Apr. 15, 2002; 18 pp.; In English

Report No.(s): DE2003-15003245; UCRL-ID-147752; No Copyright; Avail: Department of Energy Information Bridge

This is a report on modeling of the Intellite three layer membrane mirror design. The goal of this project was to provide Intellite with a model that will allow them to design a mirror with confidence.

NTIS

*Deformable Mirrors; Product Development*

**20030057782** Lawrence Livermore National Lab., Livermore, CA

**Modeling of Adaptive Optics-Based Free-Space Communications Systems**

Wilks, S. C.; Morris, J. R.; Brase, J. M.; Olivier, S. S.; Henderson, J. R.; Aug. 06, 2002; 14 pp.; In English

Report No.(s): DE2003-15002768; UCRL-JC-146575; No Copyright; Avail: Department of Energy Information Bridge

We introduce a wave-optics based simulation code written for air-optic laser communications links, that includes a detailed model of an adaptive optics compensation system. We present the results obtained by this model, where the phase of a communications laser beam is corrected, after it propagates through a turbulent atmosphere. The phase of the received laser beam is measured using a Shack-Hartmann wavefront sensor, and the correction method utilizes a MEMS mirror. Strehl improvement and amount of power coupled to the receiving fiber for both 1 km horizontal and 28 km slant paths are presented.

NTIS

*Adaptive Optics; Space Communication*

**20030057784** Lawrence Livermore National Lab., Livermore, CA

**Suppressing Anomalous Localized Waffle Behavior in Least Square Wavefront Reconstructors**

Gavel, D.; Oct. 08, 2002; 16 pp.; In English

Report No.(s): DE2003-15002879; UCRL-JC-147287; No Copyright; Avail: Department of Energy Information Bridge

A major difficulty with wavefront slope sensors is their insensitivity to certain phase aberration patterns, the classic example being the waffle pattern in the Fried sampling geometry. In this paper we analyze the behavior of least-squares reconstructors with regard to their mode spaces. We introduce a new technique that is successful in producing a mode space that segregates the waffle-like behavior into a few 'high order' modes, which can then be projected out of the reconstructor matrix. This technique can be adapted so as to remove any specific modes that are undesirable in the final reconstructor (such as piston, tip, and tilt for example) as well as suppress (the more nebulously defined) localized waffle behavior.

NTIS

*Adaptive Optics; Telescopes*

**20030057785** Lawrence Livermore National Lab., Livermore, CA

**Development of Large-Aperture, Light-Weight Fresnel Lenses for Gossamer Space Telescopes**

Dixit, S.; Hyde, R.; Weisberg, A.; Early, J.; Rushford, M.; Apr. 20, 2002; 18 pp.; In English

Report No.(s): DE2003-15002884; UCRL-JC-148223; No Copyright; Avail: Department of Energy Information Bridge

In order to examine more distant astronomical objects, with higher resolution, future space telescopes require objectives with significantly larger aperture than presently available. NASA has identified a progression in size from the 2.4m aperture objective currently used in the HUBBLE space telescope, to 25m and greater in order to observe, e.g., extra-solar planets. Since weight is a crucial factor for any object sent into space, the relative weight of large optics over a given area must be

reduced. In this paper we discuss our development of large aperture Fresnel lenses for use in future space telescopes such as the Gossamer.

NTIS

*Spaceborne Telescopes; Fresnel Lenses*

**20030057786** Lawrence Livermore National Lab., Livermore, CA

**Solid-State Heat-Capacity-Laser Review**

Rotter, M. D.; Dane, C. D.; May 07, 2002; In English

Report No.(s): DE2003-15002885; UCRL-JC-148318; No Copyright; Avail: National Technical Information Service (NTIS)

We describe our recent progress in the area of solid-state heat-capacity-lasers (SSHCL). In particular, we examine the physics of heat-capacity operation of a solid state laser and give the present technology status of our 10 kW flashlamp-pumped laser. The current status of work leading to a diode-pumped Nd:GGG HCL is also described.

NTIS

*Specific Heat; Solid State Lasers*

**20030057787** Lawrence Livermore National Lab., Livermore, CA

**Adaptive Optics Control Strategies for Extremely Large Telescopes**

Gavel, D. T.; Jul. 26, 2001; 15 pp.; In English

Report No.(s): DE2003-15002890; UCRL-JC-144864; No Copyright; Avail: Department of Energy Information Bridge

Adaptive optics for the 30-100 meter class telescopes now being considered will require an extension in almost every area of A 0 system component technology. In this paper, we present scaling laws and strawman error budgets for A 0 systems on extremely large telescopes (ELTs) and discuss the implications for component technology and computational architecture. In the component technology area, we discuss the advanced efforts being pursued at the NSF Center for Adaptive Optics (CfAO) in the development of large number of degrees of freedom deformable mirrors, wavefront sensors, and guidestar lasers. It is important to note that the scaling of present wavefront reconstructor algorithms will become computationally intractable for ELTs and will require the development of new algorithms and advanced numerical mathematics techniques. We present the computational issues and discuss the characteristics of new algorithmic approaches that show promise in scaling to ELT A 0 systems.

NTIS

*Adaptive Optics; Telescopes*

**20030057798** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, INTEL Corp., Santa Clara, CA, USA, SEMATECH, Austin, TX

**Vendor Capability for Low Thermal Expansion Mask Substrates for EUV Lithography**

Blaedel, K. L.; Taylor, J. S.; Hector, S. D.; Yan, P. Y.; Ramamoorthy, A.; Apr. 12, 2002; 18 pp.; In English

Report No.(s): DE2003-15003024; UCRL-JC-148082; No Copyright; Avail: Department of Energy Information Bridge

Development of manufacturing infrastructure is required to ensure a commercial source of mask substrates for the timely introduction of EUVL. Improvements to the low thermal expansion materials that compose the substrate have been made, but need to be scaled to production quantities. We have been evaluating three challenging substrate characteristics to determine the state of the infrastructure for the finishing of substrates. First, surface roughness is on track and little risk is associated with achieving the roughness requirement as an independent specification. Second, with new flatness-measuring equipment just coming on line, the vendors are poised for improvement toward the SEMI P37 flatness specification. Third, significant acceleration is needed in the reduction of defect levels on substrates. The lack of high-sensitivity defect metrology at the vendors' sites is limiting progress in developing substrates for EWL.

NTIS

*Masking; Substrates; Extreme Ultraviolet Radiation; Lithography*

**20030057801** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, Military Univ. of Technology, Warsaw, Poland, California Univ., Livermore, CA, USA

**Recent X-Ray Laser Characterization Experiments at LLNL**

Smith, R. F.; Dunn, J.; Nilsen, J.; Fiedorowicz, H.; Bartnik, A.; Sep. 26, 2002; 10 pp.; In English

Report No.(s): DE2003-15003026; UCRL-JC-148030; No Copyright; Avail: Department of Energy Information Bridge

We report on a series of experiments, using the COMET picosecond facility, designed to characterize and develop

different x-ray laser sources. This work encompasses collisional pumping of slab and gas puff targets.

NTIS

*X Ray Lasers; Photons*

**20030057802** Lawrence Livermore National Lab., Livermore, CA, Colorado State Univ., Fort Collins, CO, USA, Alberta Univ., Edmonton, Alberta, Canada, Military Univ. of Technology, Warsaw, Poland

**Numerical Modeling of Table-Top X-Ray Lasers**

Shlyaptsev, V. N.; Dunn, J.; Moon, S.; Osterheld, A. L.; Rocca, J. J.; Apr. 29, 2002; 12 pp.; In English

Report No.(s): DE2003-15003027; UCRL-JC-148114; No Copyright; Avail: Department of Energy Information Bridge

In this work we report numerical modeling results of laser-generated transient inversion and capillary discharge X-ray lasers. We have found the importance of plasma kinetics approaches in transient X-ray lasers physics by expanding the physical model beyond hydrodynamics approximation. Using Particle and Fokker-Planck codes the clear evidence of the Langdon effect was inferred from the recent experimental data obtained with the Ni-like Pd X-ray laser. In the search for more efficient X-ray lasers we looked closely at alternative target designs utilizing low density targets. In conjunction with recent experiments at LLNL the numerical investigations of gas puff targets has been performed.

NTIS

*X Ray Lasers; Mathematical Models*

**20030057804** Lawrence Livermore National Lab., Livermore, CA

**100-Picometer Interferometry for EUVL**

Sommargren, G. E.; Phillion, S. W.; Johnson, M. A.; Nguyen, N. Q.; Barty, A.; Mar. 18, 2002; 20 pp.; In English

Report No.(s): DE2003-15003028; UCRL-JC-14810; No Copyright; Avail: Department of Energy Information Bridge

Future extreme ultraviolet lithography (EUVL) steppers will, in all likelihood, have six-mirror projection cameras. To operate at the diffraction limit over an acceptable depth of focus each aspheric mirror will have to be fabricated with an absolute figure accuracy approaching 100pm rms. We are currently developing visible light interferometry to meet this need based on modifications of our present phase shifting diffraction interferometry (PSDI) methodology where we achieved an absolute accuracy of 250pm. The basic PSDI approach has been further simplified, using lensless imaging based on computational diffractive back-propagation, to eliminate auxiliary optics that typically limit measurement accuracy. Small remaining error sources, related to geometric positioning, CCD camera pixel spacing and laser wavelength, have been modeled and measured. Using these results we have estimated the total system error for measuring off-axis aspheric EUVL mirrors with this new approach to interferometry.

NTIS

*Interferometry; Adaptive Optics*

**20030057809** Lawrence Livermore National Lab., Livermore, CA

**Identification and Elimination of Fluorescent Surface-Damage Precursors on DKDP Optics**

Nostrand, M. C.; Thompson, S.; Siekhaus, W.; Fluss, M.; Hahn, D.; Nov. 15, 2002; 14 pp.; In English

Report No.(s): DE2003-15003121; UCRL-JC-148498; No Copyright; Avail: Department of Energy Information Bridge

Fluorescing surface defects that led to damage upon 351-nm laser exposure below 7 J/cm<sup>2</sup> (3-11s) in DKDP optics were reported in these proceedings by this group a year ago. Subsequent laser damage experiments have correlated the density of these damage precursors to single-point diamond finishing conditions. Every diamond-finishing schedule contains brittle-mode cutting and ductile-mode cutting in a taper-down sequence. Finishing experiments have traced the occurrence of these defects to insufficient ductile-mode removal of subsurface damage incurred during prior brittle-mode cutting. Additionally, a correlation between defect fluorescence, laser-induced damage, and defect morphology has been established. Laser-induced damage tests also suggest a correlation between growth method and damage probability. Current experiments indicate that damage-prone defects can be minimized with the proper choice of diamond finishing conditions.

NTIS

*Optics; Laser Materials; Damage*

**20030057828** Lawrence Livermore National Lab., Livermore, CA, California Univ., La Jolla, CA, USA, Georgia Inst. of Tech., Atlanta, GA, Wisconsin Univ., Madison, WI, USA

**IFE Chamber Technology: Status and Future Challenges**

Meier, W. R.; Raffrary, A. R.; Abdel-Khalik, S.; Kulcinski, G.; Latkowski, J. F.; Nov. 15, 2002; In English

Report No.(s): DE2003-15003134; UCRL-JC-149819; No Copyright; Avail: National Technical Information Service (NTIS)

Significant progress has been made on addressing critical issues for inertial fusion energy (IFE) chambers for heavy-ion, laser and Z-pinch drivers. A variety of chamber concepts are being investigated including dry-wall (currently favored for laser IFE), wetted-wall (applicable to both laser and ion drivers), and thick-liquid-wall (favored by heavy ion and z-pinch drivers). Recent progress and remaining challenges in developing IFE chambers are reviewed.

NTIS

*Heavy Ions; Ionization Chambers*

**20030057848** Lawrence Livermore National Lab., Livermore, CA

**Methods for Mitigating Growth of Laser-initiated Surface Damage on Fused Silica Optics at 351nm**

Hrubesh, L. W.; Norton, M. A.; Molander, W. A.; Donohue, E. E.; Maricle, S. M.; Dec. 12, 2001; 18 pp.

Report No.(s): DE2002-15002010; No Copyright; Avail: Department of Energy Information Bridge

We report an experimental investigation of mitigating surface damage growth at 351nm for machine-finished DKDP optics. The objective was to determine which methods could be applied to pre-initiated or retrieved-from-service optics, in order to stop further damage growth for large aperture DKDP optics used in high-peak-power laser applications. The test results, and the evaluation thereof, are presented for several mitigation methods applied to DKDP surface damage. The mitigation methods tested were CW-CO<sub>2</sub> laser processing, aqueous wet-etching, short-pulse laser ablation, and micro-machining. We found that micro-machining, using a single crystal diamond tool to completely remove the damage pit, produces the most consistent results to halt the growth of surface damage on DKDP. We obtained the successful mitigation of laser-initiated surface damage sites as large as 0.14mm diameter, for up to 1000 shots at 351nm and fluences in the range of 2 to 13J per square centimeter, approximately 11 ns pulse length. Data obtained to-date indicates that micro-machining is the preferred method to process large-aperture optics.

NTIS

*Carbon Dioxide Lasers; Continuous Wave Lasers; Micromachining; Silica Glass; Laser Damage; Optics*

**20030057866** Lawrence Livermore National Lab., Livermore, CA

**Catastrophic Failure of Contaminated Fused Silica Optics at 355 nm**

Genin, F. Y.; Kozlowski, M. R.; Brusasco, R.; Dec. 03, 1996; 16 pp.; In English

Report No.(s): DE2003-16372; UCRL-JC-125417; No Copyright; Avail: Department of Energy Information Bridge

For years, contamination has been known to degrade the performance of optics and to sometimes initiate laser-induced damage to initiate. This study has started to quantify these effects for fused silica windows used at 355 nm. Contamination particles (Al, Cu, TiO<sub>2</sub> and ZrO<sub>2</sub>) were artificially deposited onto the surface and damage tests were conducted with a 3 ns Nd:YAG laser. The damage morphology was characterized by Nomarski optical microscopy. The results showed that the damage morphology for input and output surface contamination is different. For input surface contamination, both input and output surfaces can damage. In particular, the particle can induce pitting or drilling of the surface where the beam exits. Such damage usually grows catastrophically. Output surface contamination is usually ablated away on the first shot but can also induce catastrophic damage. Plasmas are observed during illumination and seem to play an important role in the damage mechanism. The relationship between fluence and contamination size for which catastrophic damage occurred was plotted for different contamination materials. The results show that particles even as small as 10 micrometers can substantially decrease the damage threshold of the window and that metallic particles on the input surface have a more negative effect than oxide particles.

NTIS

*Contamination; Silica Glass; Optics; Morphology; Structural Failure; Microscopy*

**20030057885** Pennsylvania Univ., Philadelphia, PA

**Fluorescent Heterogeneities in Turbid Media: Limits for Detection With Dual-Interfering Sources Excitation**

Intes, X.; Chen, Yu; Li, Xingde; Chance, B.; Oct. 25, 2001; 4 pp.; In English; Original contains color illustrations

Report No.(s): AD-A410790; No Copyright; Avail: CASI; A01, Hardcopy

A quantitative comparison between the single source and the dual-interfering sources configurations for the detection of fluorescent heterogeneities embedded in a piecewise highly scattering homogeneous fluorescent background was carried out. The study is based upon simulations using analytical solutions of the frequency domain diffuse photon density waves and practical signal-to-noise ratio considerations. Results show that the dual-interfering sources outperformed single source techniques for the detection of heterogeneities in terms of fluorophore concentration and lifetime contrast. To detect the same

inhomogeneity, less concentration and lifetime contrast are required with dual-interfering sources.

DTIC

*Fluorescence; Photon Density; Photon Beams*

**20030057905** Lawrence Livermore National Lab., Livermore, CA, British Columbia Univ., Vancouver, British Columbia, Canada

**Equation of State Measurements of Hydrogen Isotopes on Nova**

Collins, G. W.; DaSilva, L. B.; Celliers, P.; Cauble, R.; Gold, D.; 2002; In English

Report No.(s): DE2003-16530; No Copyright; Avail: National Technical Information Service (NTIS)

High intensity lasers can be used to perform measurements of materials at extremely high pressures if certain experimental issues can be overcome. We have addressed those issues and used the Nova laser to shock-compress liquid deuterium and obtain measurements of density and pressure on the principal Hugoniot at pressures from 300 kbar to more than 2 Mbar. The data are compared with a number of equation of state models. The data indicate that the effect of molecular dissociation of the deuterium into a monatomic phase may have a significant impact on the equation of state near 1 Mbar.

NTIS

*Hydrogen Isotopes; Lasers*

**20030058006** Swedish Defence Research Establishment, Linköping

**Underwater Laser Beam Profiles after Transmission through a Wavy Sea Surface**

Tuldahl, M.; Dec. 2001; 38 pp.; In English

Report No.(s): PB2003-103207; FOI-R-0316-SE; No Copyright; Avail: CASI; [A03](#), Hardcopy

The effects of surface waves on laser beam transmission through the sea surface are experimentally examined. The purpose is to obtain experimental data for validation of laser pulse propagation models. Such data require simultaneous measurements of the time and space variability of the air-sea interface. Two significant consequences of transmission through the sea surface are investigated: beam widths at different depths averaged over several surface wave periods, and surface wave focusing or defocusing quantified by the irradiance fluctuations as a fractional fluctuation (standard deviation divided by the mean). The irradiance fractional fluctuations show a near-surface maximum and decay with depth. A submerged screen, filmed by an underwater video camera, is used to measure the downwelling irradiance profiles. The laser beam diameter at the water surface is 42 cm, and irradiance profiles are measured from 1.2 m to 3 m depth. All measurements are performed with the laser beam directed vertically downwards. Transmission for off-nadir angles is not tested in this experiment and no polarization effects are measured. The measurements are made in calm winds, 1 m/s to 3 m/s. The surface waves are measured with a video camera, and the dominant seasurface wavelength is about 0.25 m.

NTIS

*Laser Beams; Underwater Optics; Surface Waves; Water Waves; Transmission*

**20030058010** Lawrence Livermore National Lab., Livermore, CA

**Large Aperture Diagnostic System for Gain and Wavefront Measurements on NIF/LMJ Amplifiers**

Zapata, L. E.; McCracken, R.; Erlandson, A.; Guenet, J. L.; Grebot, E.; Dec. 17, 1997; 14 pp.; In English

Report No.(s): DE2003-16373; UCRL-JC-124519; No Copyright; Avail: Department of Energy Information Bridge

We are in the midst of constructing an amplifier laboratory (Amplab) that will be the physics and engineering proving ground for full sized segmented glass amplifiers of designs that will outfit the National Ignition Facility (NIF) and Laser Megajoule (LMJ) projects. Amplab will demonstrate the cornerstone mechanical, electrical and optical concepts that support the NIF and LMJ amplifier schemes. Here we address the optical diagnostics that will be used to characterize optical performance of the amplifiers. We describe the apparatus that will be used in pulsed measurements of gain distribution and wave-front distortions. The large aperture diagnostic system or LADS, is now being built through a collaborative effort between CEL-V and LLNL. The LADS will provide measurements of gain and wave front distortions over the full extracting aperture of the NIF and LMJ prototype amplifiers. The LADS will be able to address each of eight apertures via motorized stages and following semi-automated alignment, take data on the aperture of interest. The LADS should be operational in mid-'97 at LLNL and will be used to characterize the optical performance of the very first full scale prototype 4 x 2 NIF and LMJ amplifiers. It will be transported to Bordeaux, France to make similar measurements during activation of the first 8-aperture LMJ-like facility (LIL) that is planned to start in the near future.

NTIS

*Wave Fronts; Light Amplifiers; Amplification*



**20030058011** Lawrence Livermore National Lab., Livermore, CA

**Manufacturing Diamond Films Using Copper Vapour Lasers**

McLean, W.; Havstad, M. A.; Warner, B. E.; Jan. 08, 1996; 18 pp.; In English

Report No.(s): DE2003-16374; UCRL-JC-125215; No Copyright; Avail: Department of Energy Information Bridge

Fifty nanosecond pulses of visible light have been used to produce hard, hydrogen-free diamondlike-carbon (DLC) films at irradiances between 5 times 10 to the 8th power and 5 times 10 to the 15th power W/cubic meters square. The films were characterized by a number of techniques including: Raman spectroscopy, Electron Energy Loss Spectroscopy (EELS), atomic force microscopy, and spectroscopic ellipsometry. The cost for manufacturing DLC with high average power, high-pulse repetition frequency, visible light is low enough to compete with other diamond thin film production methods.

NTIS

*Diamond Films; Metal Vapor Lasers*

**20030058806** Lawrence Livermore National Lab., Livermore, CA

**Science and Technology Review: Award-Winning Science and Technology 2001 R and D 100 Awards**

Sep. 2001; In English

Report No.(s): DE2003-791653; No Copyright; Avail: National Technical Information Service (NTIS)

This issue contains the following articles: (1) 'Technology Transfer Takes a Team.' (2) 'Zeroing In on Genes.' With Gene Recovery Microdissection, sequencing an entire genome to find its genes will no longer be necessary. (3) 'Big Glass for a Big Laser.' Together, Livermore and two leading laser glass producers have developed a revolutionary new method for making big pieces of high-quality laser glass. (4) 'Lasershot Makes Its Mark.' The Lasershot Marking System creates permanent, high-resolution identification marks on safety-critical metal parts, without weakening the part. (5) 'Tracking the Global Spread of Advanced Technology.' The Center for Global Security Research takes on the challenge of analyzing and raising awareness of the potential national security threats posed by advances in science and technology.

NTIS

*Technology Transfer; Laser Applications; Technology Assessment*

**20030058822** Lawrence Livermore National Lab., Livermore, CA

**Reminiscing About the Early Years of the X-Ray Laser**

Nilsen, J.; Jun. 26, 2002; 10 pp.; In English

Report No.(s): DE2003-802839; UCRL-JC-148426; No Copyright; Avail: Department of Energy Information Bridge

To put the development of the X-ray laser in historic context this paper presents some of the motivation and history of the development of the X-ray laser from the perspective of a scientist at Lawrence Livermore National Laboratory where the k t X-ray laser was demonstrated in the early 1980s using a nuclear device as the driver.

NTIS

*X Ray Lasers; Nuclear Devices*

**20030058959** Florida Univ., Gainesville, FL, USA

**Lateral Migration Radiography Image Signatures for the Detection and Identification of Buried Land Mines**

Dugan, Edward T.; Jacobs, Alan M.; January 2002; 77 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): DAAG-55-98-1-0400

Report No.(s): AD-A412409; ARO-38830.7-MA-LMD; No Copyright; Avail: CASI; A05, Hardcopy

Lateral migration radiography (LMR), a new form of Compton backscatter x-ray imaging, is applied to the detection and identification of buried land mines. Uncollimated detectors provide images that are due primarily to single-scatter photons from the soil surface or near-surface. Collimated detectors provide images that are due primarily to multiple-scatter photons from the near-surface or sub-surface. Noise removal and image enhancement techniques including simple weighted filters, Weiner filters, optimal filters and neural networks have been successfully employed on LMR images. Information from both the uncollimated and collimated detector images is used to effectively remove surface clutter and enhance mine detection and identification. An innovative rotating collimator for the x-ray source has been developed to provide rapid side-to-side scanning of the source beam without having to move the x-ray generator in this direction. Acquisition of detailed images of a 40 cm by 40 cm area takes from 30 to 60 seconds, depending on desired resolution. The construction and testing of a portable LMR system for out door mine detection was completed. This system includes the x- ray generator; rotating source collimator; large area scintillator detectors; system frame assembly; motors and sensors for side-to-side and front-to-rear scanning; x-ray generator scan and data acquisition and processing systems; a standoff-to-vehicle IR modem communication system; and a

portable electric generator power system. System weight (not including the vehicle) is about 160 kg, but this initial portable system was significantly over-designed; system weight for a prototype should be in the range of 100 kg. X-ray generator power requirement is from 200 to 800 watts. This portable system successfully acquired images of mines buried in an indoor soil box and then in out-of-door tests. Very good image results were obtained when the system was employed on the vehicular test lanes at Fort A.P. H7

DTIC

*Image Processing; Radiography; Mines (Ordnance); Mine Detectors*

**20030059001** Utah State Univ., Logan, UT, USA

**Array Based Design of Multi-Wavelength Fluorescence System**

Estes, C.; Powers, L.; Oct. 25, 2001; 3 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412073; No Copyright; Avail: CASI; [A01](#), Hardcopy

A method for exciting and collecting fluorescence from a surface using multiple excitations and emission wavelengths has been developed. Broadband excitation light is filtered to excite fluorophores in microbes. High efficiency collection reflectors allow detection of minimal amounts of microbial contamination. A working prototype is described.

DTIC

*Microorganisms; Fluorescence; Excitation; Broadband; Light (Visible Radiation)*

**20030059012** Fermi National Accelerator Lab., Batavia, IL, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

**Beam Rounders for Circular Colliders**

Burov, A.; Derbenev, Y.; Dec. 2002; 8 pp.; In English

Report No.(s): DE2002-805674; FERMILAB-CONF-01/437; No Copyright; Avail: Department of Energy Information Bridge

By means of linear optics, an arbitrary uncoupled beam can be locally transformed into a round (rotation-invariant) state and then back. This provides an efficient way to round beams in the interaction region of circular colliders.

NTIS

*Particle Accelerators; Beams (Radiation)*

**20030059033** Defence Science and Technology Organisation, Edinburgh, Australia

**Infrared Illumination Feasibility Study**

Dortmans, P. J.; Castles, T. D.; Garside, D.; Parker, K.; Galister, M.; March 2003; 28 pp.; In English; Original contains black and white illustrations

Report No.(s): DSTO-TN-0484; DODA-AR-012-593; Copyright; Avail: CASI; [A03](#), Hardcopy

A comprehensive study of 40 mm infrared (IR) illumination mortar rounds recently undertaken indicated that this calibre of ammunition provided no significant benefit for observation or small arms engagement (range <300 m). However it was unclear as to whether such a conclusion was valid for larger calibre IR illumination ammunition where reconnaissance, surveillance and intelligence and indirect fire play a significant role. Before commissioning such a study, the Fire Support BOS at the Combined Arms Training and Development Centre requested a feasibility study to determine value in performing a large scale IR illumination field trial. A limited study comparing the performance of 81 mm mortar-delivered IR illumination (range 400- 1500 m) with equivalent white-light illumination was undertaken. The report discusses the design, conduct and outcomes of that study. It concludes that there is little expected benefit in pursuing a large-scale trial until examples of IR illuminating ammunition suitable for specific tactical applications become available.

Author

*Illuminating; Infrared Radiation; Ammunition; Military Technology*

75

**PLASMA PHYSICS**

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

**20030057770** Lawrence Livermore National Lab., Livermore, CA

**Overview of Stellarator Divertor Studies: LDRD Project 01-ERD-069**

Fenstermacher, M. E.; Rognlien, T. D.; Koniges, A.; Umansky, M.; Hill, D. N.; Jan. 21, 2003; In English

Report No.(s): DE2003-15003146; UCRL-ID-151627; No Copyright; Avail: National Technical Information Service (NTIS)

A summary is given of the work carried out under the LDRD project 01-ERD-069 entitled Stellarator Divertor Studies. This project has contributed to the development of a three-dimensional edge-plasma modeling and divertor diagnostic design capabilities at LLNL. Results are demonstrated by sample calculations and diagnostic possibilities for the edge plasma of the proposed U.S. National Compact Stellarator Experiment device. Details of the work are contained in accompanying LLNL reports that have been accepted for publication.

NTIS

*Stellarators; Plasma Control*

**20030057774** Lawrence Livermore National Lab., Livermore, CA

**99-ERD-049 LDRD Report**

Patel, P. K.; Price, D. F.; Mackinnon, A. J.; Springer, P. T.; Apr. 17, 2002; 10 pp.; In English

Report No.(s): DE2003-15003242; UCRL-ID-147510; No Copyright; Avail: Department of Energy Information Bridge

Recent advances in laser and optical technologies have now enabled the current generation of high intensity, ultrashort-pulse lasers to achieve focal intensities of  $16^7 - 102^7$  W/cm<sup>2</sup> in pulse durations of 100-500fs. These ultraintense laser pulses are capable of producing highly relativistic plasma states with densities, temperatures, and pressures rivaling those found in the interiors of stars and nuclear weapons. Developing the techniques to recreate such extreme states of matter in the laboratory, under controlled and well-characterized conditions, is a prerequisite for obtaining the experimental data necessary to validate and benchmark theoretical models for atomic kinetics, equations of state, and opacities.

NTIS

*Relativistic Plasmas; Optical Density*

**20030057926** Princeton Univ., NJ

**Calculations of Neutral Beam Ion Confinement for the National Spherical Torus Experiment**

Redi, M. H.; Darrow, D. S.; Egedal, J.; Kaye, S. M.; White, R. B.; Jun. 2002; In English

Report No.(s): DE2003-803990; PPPL-3714; No Copyright; Avail: National Technical Information Service (NTIS)

The spherical torus (ST) concept underlies several contemporary plasma physics experiments, in which relatively low magnetic fields, high plasma edge q, and low aspect ratio combine for potentially compact, high beta and high performance fusion reactors. An important issue for the ST is the calculation of energetic ion confinement, as large Larmor radius makes conventional guiding center codes of limited usefulness and efficient plasma heating by RF and neutral beam ion technology requires minimal fast ion losses.

NTIS

*Fusion Reactors; Ions; Confinement; Plasmas (Physics); Neutral Beams*

**20030057927** Princeton Univ., NJ

**Recent Progress on the National Spherical Torus Experiment**

Gates, D. A.; Bell, M. G.; Bell, R. E.; Bialek, J.; Bigelow, T.; Jul. 2002; In English

Report No.(s): DE2003-803991; PPPL-3716; No Copyright; Avail: National Technical Information Service (NTIS)

No abstract available

NTIS

*Plasmas (Physics); Beam Injection*

**20030057954** Science Research Lab., Inc., Somerville, MA

**High Efficiency Pulsed Plasma Thruster for Satellite Attitude Control and Maneuver**

Petr, Rodney; Jacob, Jonah; Choudhary, Praveen; Jan. 2003; 56 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): MDA972-00-C-0055; ARPA ORDER-K436/00

Report No.(s): AD-A411137; SRL-2-F-2003; No Copyright; Avail: CASI; A04, Hardcopy

The primary objective of this project was to develop Gas-Fed Pulsed Plasma Thrusters (GF-PPT) that can be used with water vapor or hydrazine as fuel, with vapor pressures of less than 1 Torr necessary to operate the thruster. This propulsion technology can be used to perform orbit phase changes or plane (inclination) changes for near and intermediate-earth orbit satellites. GF-PPT technology is particularly suited for large DELTA-V, in-plane, orbit phase changes. This technology can therefore complement resistojet technology and allow rapid constellation redeployment to insure prompt satellite coverage of conflicts at any location on the surface of the earth with a constellation of satellites optimized for minimum size and cost. This

report discusses GF-PPT thruster performance scaling, as well as hardware and power electronics that were developed in this project.

DTIC

*Efficiency; Pulsed Plasma Thrusters; Maneuverability*

**20030058758** Lawrence Livermore National Lab., Livermore, CA

**Particle and Heat Transport in a Dense Wall-Confined MTF Plasma (Theory and Simulations)**

Ryutov, D. D.; Barnes, D. C.; Bauer, B. S.; Hartman, C. W.; Kirkpatrick, R. C.; Sep. 25, 2002; In English

Report No.(s): DE2003-15002772; UCRL-JC-147417-REV-1; No Copyright; Avail: National Technical Information Service (NTIS)

Plasma beta in Magnetized Target Fusion (MTF) systems is sometimes much greater than 1, and the plasma may be in direct contact with the imploding liner. Plasma processes are strongly dominated by inter-particle collisions. Under such conditions, the plasma microturbulence, behavior of alpha particles, and plasma equilibria are very different from conventional fusion systems. The present paper contains the most comprehensive analysis of the corresponding phenomena to date. 2D numerical simulations of plasma convection in the targets of a diffuse pinch type demonstrate an onset of convection in this configuration.

NTIS

*Particle Collisions; Plasma Dynamics; Plasma Physics; Plasmas (Physics); Heat Transfer*

**20030059463** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Heavy Ion Cocktail Beams at the 88 Inch Cyclotron**

Leitner-Wutte, D.; McMahan, M. A.; Argento, D.; Gimpel, T.; Guy, A.; 2002; 8 pp.; In English

Report No.(s): DE2003-805142; No Copyright; Avail: Department of Energy Information Bridge

Cyclotrons in combination with ECR ion sources provide the ability to accelerate 'cocktails' of ions. A cocktail is a mixture of ions of near-identical mass-to-charge (m/q) ratio. The different ions cannot be separated by the injector mass-analyzing magnet and are tuned out of the ion source together. The cyclotron is then utilized as a mass analyzer by shifting the accelerating frequency. This concept was developed soon after the first ECR ion source became operational at the 88-Inch Cyclotron and has since become a powerful tool in the field of heavy ion radiation effects testing. Several different 'cocktails' at various energies are available at the 88-Inch cyclotron for radiation effect testing, covering a broad range of linear energy transfer and penetration depth. Two standard heavy ion cocktails at 4.5 MeV/nucleon and 10 MeV/nucleon have been developed over the years containing ions from boron to bismuth. Recently, following requests for higher penetration depths, a 15MeV/nucleon heavy ion cocktail has been developed.

NTIS

*Cyclotrons; Ion Beams; Ion Accelerators*

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*.

**20030057768** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

**Structural and Magnetic Properties MnAs Nanoclusters Formed By Mn Ion Implantation in GaAs**

Serres, A.; Benassayag, G.; Respaud, M.; Armand, C.; Pesant, J. C.; January 2002; 14 pp.; In English

Report No.(s): DE2002-803857; No Copyright; Avail: Department of Energy Information Bridge

No abstract available

NTIS

*Gallium Arsenides; Ion Implantation; Magnetic Properties; Semiconductors (Materials); Nanotechnology; Manganese Ions*

**20030057826** Lawrence Livermore National Lab., Livermore, CA, Ames Lab., IA, USA, Iowa State Univ. of Science and Technology, Ames, IA, USA

**Rate Equation Theory for Island Sizes and Capture Zone Areas in Submonolayer Deposition: Realistic Treatment of Spatial Aspects of Nucleation**

Evans, J. W.; Li, M.; Bartlett, M. C.; Dec. 05, 2002; 12 pp.; In English

Report No.(s): DE2003-15003122; UCRL-JC-151210; No Copyright; Avail: Department of Energy Information Bridge

Extensive information on the distribution of islands formed during submonolayer deposition is provided by the joint probability distribution (JPD) for island sizes,  $s$ , and capture zone areas,  $A$ . A key ingredient determining the form of the JPD is the impact of each nucleation event on existing capture zone areas. Combining a realistic characterization of such spatial aspects of nucleation with a factorization ansatz for the JPD, we provide a concise rate equation formulation for the variation with island size of both the capture zone area and the island density.

NTIS

*Nucleation; Deposition; Substrates*

**20030057830** Lawrence Livermore National Lab., Livermore, CA, Stanford Univ., Stanford, CA, USA, California Univ., Santa Barbara, CA, USA

**Bulk Materials Analysis using High-Energy Positron Beams**

Glade, S. C.; Askoka-Kumar, P.; Nieh, T. G.; Sterne, P. A.; Wirth, B. D.; Nov. 11, 2002; 18 pp.; In English

Report No.(s): DE2003-15003142; UCLR-JC-151599; No Copyright; Avail: Department of Energy Information Bridge

This article reviews some recent materials analysis results using high-energy positron beams at Lawrence Livermore National Laboratory. We are combining positron lifetime and orbital electron momentum spectroscopic methods to provide electron number densities and electron momentum distributions around positron annihilation sites. Topics covered include: correlation of positron annihilation characteristics with structural and mechanical properties of bulk metallic glasses, compositional studies of embrittling features in nuclear reactor pressure vessel steel, pore characterization in Zeolites, and positron annihilation characteristics in alkali halides.

NTIS

*Metallic Glasses; Materials Science*

**20030057992** New Mexico Highlands Univ., Las Vegas, NM, USA

**Development of Novel High Temperature Superconducting Detectors Based on Flux Activation and Ultrafast Dynamics**

Frankel, Anatoly; Dec. 31, 1998; 14 pp.; In English

Contract(s)/Grant(s): F49620-96-1-0225

Report No.(s): AD-A411219; No Copyright; Avail: CASI; [A03](#), Hardcopy

It is proposed to study quasiparticle (QP) relaxation dynamics and flux mechanism of HTS using pump/probe femtosecond spectroscopy and nonequilibrium photoresponse in the presence of a magnetic field (and/or bias current). By adding a magnetic field, the number of vortices in a superconductor will be significantly increased. The first investigation will be to determine how quasiparticle-vortex interaction changes the QP relaxation process. The second investigation will be to study interactions of high energy quasiparticles and phonons with vortices, to understand the energy transfer mechanism from the electrons and phonons to vortices, and to determine vortex core excitation energy levels, as well as vortex motion (dissipation) time constant. The studies of QP relaxation dynamics and flux mechanism will help to determine the intrinsic speed limit of a superconducting detector, and help the construction of a sensitive flux activation detector.

DTIC

*Detectors; High Temperature; Flux (Rate); Superconductors (Materials)*

**20030058923** Cornell Univ., Ithaca, NY, USA

**Influence of Impurities on the mm-Wave Absorption in Amorphous Ice**

Agladze, N. I.; Wrubel, J. P.; Sievers, A. J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 185-188; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Mm-wave properties of both high and low density amorphous phases of ice are investigated as a function of impurities. Doping with ionic (LiCl) or molecular (methanol) impurities decreases the difference in the mm-wave absorption coefficient between the HDA and LDA ice phases so that the HDA spectrum can be used as an analog for impure ice.

Author

*Millimeter Waves; Absorptivity; Ice; Lithium Chlorides; Methyl Alcohol*

**20030059022** Lawrence Livermore National Lab., Livermore, CA

**Solid State Experiments at High Pressure and Strain Rates**

Kalantar, D. H.; Remington, B. A.; Colvin, J. D.; Mikaelian, K. O.; Weber, S. V.; Nov. 24, 1999; 32 pp.; In English

Report No.(s): DE2003-791440; UCRL-JC-136355; No Copyright; Avail: Department of Energy Information Bridge

Experiments have been developed using high powered laser facilities to study the response of materials in the solid state

under extreme pressures and strain rates. Details of the target and drive development required for solid state experiments and results from two separate experiments are presented. In the first,  $\text{Cu}$  foils were compressed to a peak pressure of 180 GPa and accelerated. A pre-imposed modulation at the embedded RT unstable interface was observed to grow. The growth rates were fluid-like at early time, but suppressed at later time. This result is suggestive of the theory of localized heating in shear bands, followed by dissipation of the heat, allowing for recovery of the bulk material strength. In the second experiment, the response of Si was studied by dynamic x-ray diffraction. The crystal was observed to respond with uni-axial compression at a peak pressure 11.5-13.5 GPa.

NTIS

*Solid State; Lasers; High Pressure; Strain Rate*

## 77

### PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics*, *73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

**20030057754** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

#### **Jets and Dijets in Au+Au and p+p Collisions at RHIC**

Hardtke, D.; January 2002; In English

Report No.(s): DE2003-807437; No Copyright; Avail: National Technical Information Service (NTIS)

At high energy density, nuclear matter may undergo a phase transition to a deconfined state consisting of free quarks and gluons. This Quark-Gluon Plasma may be experimentally accessible using the collisions of heavy nuclei at high energies. In order to investigate this new state of matter, processes whose rates are calculable in the absence of nuclear effects are particularly useful. The production of large transverse momentum jets, in the limit of no nuclear effects, should scale with the number of binary nucleon-nucleon collisions with a rate calculable from perturbative quantum chromodynamics (QCD). A deviation from this binary scaling expectation for jet production or a modification of jet properties would indicate the presence of initial and/or final state nuclear effects.

NTIS

*Models; Hadrons; Jets; Particle Collisions*

**20030057756** California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA

#### **Azimuthal Anisotropy of Charged and Identified High $p_T$ Hadrons in Au+Au Collisions at RHIC**

Filimonov, K.; 2002; 8 pp.; In English

Report No.(s): DE2003-807444; No Copyright; Avail: Department of Energy Information Bridge

We report new results on  $v_2(p_T)$  for Au+Au collisions at  $\sqrt{s_{NN}} = 200$  GeV for charged hadrons, pions, kaons, (anti)protons,  $K_s^0$ , and  $\Lambda$ . The analysis is extended to  $p_T = 12$  GeV/c for charged hadrons and  $p_T = 4$  GeV/c for identified particles. A comparison of the azimuthal anisotropy of charged hadrons measured at  $\sqrt{s_{NN}} = 130$  and 200 GeV is presented. The  $p_T$ -dependence of baryon versus meson elliptic flow is discussed.

NTIS

*Anisotropy; Hadrons*

**20030057875** Fermi National Accelerator Lab., Batavia, IL, USA

#### **Condition for Production of Circulating Proton Beam with Intensity Greater than Space Charge Limit**

Dudnikov, V.; Nov. 2002; 10 pp.; In English

Report No.(s): DE2003-804696; FERMILAB-CONF-02/257; No Copyright; Avail: Department of Energy Information Bridge

Transverse e-p instability in proton rings could be damped by increasing the beam density and the rate of secondary particles production above the threshold level, with the corresponding decrease of unstable wavelength  $\lambda$  below the transverse beam size  $h$  (increase of beam density  $n_b$  and ion density  $n_i$  above the threshold level:  $n_b$  plus  $n_i$  greater than  $\beta^2 / (r_e h^2)$ , where  $r_e$  equals  $e^2 / mc^2$ ). In this paper, we review experimental observations of transverse instability of proton beams in various rings. We also discuss methods which can be used to damp the instability.

NTIS

*Proton Beams; Space Charge; Storage Rings (Particle Accelerators); Stability*

**20030057880** Fermi National Accelerator Lab., Batavia, IL, USA

**Control Architecture of the DO Experiment**

Barlett, J. F.; Krzywdzinski, S.; Savage, G.; Sirotenko, V. I.; Zhang, D.; Nov. 2002; 8 pp.; In English

Report No.(s): DE2003-804903; FERMILAB-CONF-01/441; No Copyright; Avail: Department of Energy Information Bridge

From a controls viewpoint, contemporary high energy physics collider detectors are comparable in complexity to small to medium size accelerators: however, their controls requirements often differ significantly. DO, one of two collider experiments at Fermilab, has recently started a second, extended running period that will continue for the next five years. EPICS, an integrated set of software building blocks for implementing a distributed control system, has been adapted to satisfy the slow controls system, has been adapted to satisfy the slow controls needs of the DO detector by (1) extending the support for new device types and an additional field bus, (2) by the addition of a global event reporting system that augments the existing EPICS alarm support, and (3) by the addition of a centralized database with supporting tools for defining the configuration of the control system. This paper discusses the control architecture of the current DO experiment, how the EPICS system was extended to meet the control requirements of a large, high-energy physics detector, and how a formal control system contributes to the management of detector operations.

NTIS

*Particle Accelerators; Control; Control Systems Design; Detectors; Laboratories*

**20030057887** California Univ., Livermore, CA, USA, California Univ., Lawrence Berkeley National Lab., Berkeley, CA, USA, California Univ., Berkeley, CA, Mission Research Corp., Albuquerque, NM, USA

**Simulation of Chamber Transport for Heavy-Ion Fusion**

Sharp, W. M.; Callahan, D. A.; Tabak, M.; Yu, S. S.; Peterson, P. F.; 2000; In English

Report No.(s): DE2003-805136; No Copyright; Avail: National Technical Information Service (NTIS)

Beams for heavy-ion fusion (HIF) are expected to require substantial neutralization in a target chamber. Present targets call for higher beam currents and smaller focal spots than most earlier designs, leading to high space-charge fields. Collisional stripping by the background gas expected in the chamber further increases the beam charge. Simulations with no electron sources other than beam stripping and background-gas ionization show an acceptable focal spot only for high ion energies or for currents far below the values assumed in recent HIF power-plant scenarios. Much recent research has, therefore, focused on beam neutralization by electron sources that were neglected in earlier simulations, including emission from walls and the target, photoionization by radiation from the target, and pre-neutralization by a plasma generated along the beam path. The simulations summarized here indicate that these effects can significantly reduce the beam focal-spot size.

NTIS

*Particle Accelerator Targets; Heavy Ions; Space Charge; Fusion*

**20030058861** Florida Univ., Gainesville, FL

**Technical Feasibility of Centrifugal Techniques for Evaluating Hazardous Waste Migration**

Goforth, G. F.; Vicevich, R.; Townsend, F. C.; Bloomquist, D.; Dec. 1987; 170 pp.; In English

Contract(s)/Grant(s): F08635-83-C-0136

Report No.(s): AD-A411005; ESL-TR-87-76; No Copyright; Avail: CASI; A08, Hardcopy

This study was designed and executed to assess the technical feasibility of using centrifugal techniques to predict the transport characteristics of hazardous waste through soil. Advection is generally the major mechanism of contaminant migration from a waste source. For soluble contaminants, advection occurs within the aqueous phase. For immiscible fluid contaminants, such as the jet fuel JP-4, migration rates are often independent of the rates of water movement. Advection in saturated and unsaturated soils can be predicted from physical models or from measurements of the hydraulic conductivity in conjunction with knowledge of existing hydraulic gradients. A flexible wall permeameter was designed and utilized for determining saturated hydraulic conductivity of soil samples in the centrifuge and on the laboratory bench. Fundamental relationships of hydrodynamic pressure distribution and fluid kinematics within a soil volume undergoing radial acceleration were derived and verified during the study. Reagent grade decane was utilized as a surrogate for JP-4 jet fuel.

DTIC

*Hazardous Wastes; Jet Engine Fuels; Migration; Feasibility Analysis; Centrifugal Force*

**20030059040** Saclay Research Centre, Gif-sur-Yvette

**Introduction to the Generalized Parton Distributions**

Garcon, M.; 2002; In English

Report No.(s): DE2003-804713; No Copyright; Avail: National Technical Information Service (NTIS)

The concepts of Generalized Parton Distributions (GPD) are reviewed in an introductory and phenomenological fashion. These distributions provide a rich and unifying picture of the nucleon structure. Their physical meaning is discussed. The GPD are in principle measurable through exclusive deeply virtual production of photons (DVCS) or of mesons (DVMP). Experiments are starting to test the validity of these concepts. First results are discussed and new experimental projects presented, with an emphasis on this program at Jefferson Lab.

NTIS

*Partons; Distribution (Property)*

## 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*.

**20030059026** Defence Science and Technology Organisation, Edinburgh, Australia

#### **The Role of Operations Research and Analysis in Concept-Led Long-Range Planning**

Brown, Tony; Hibberd, Tony; February 2003; 26 pp.; In English

Report No.(s): DSTO-CR-0282; DODA-AR-012-559; Copyright; Avail: CASI; [A03](#), Hardcopy

Head Policy, Guidance and Analysis (HPGA) seeks to develop a strategic planning framework to better support Defence decision-making. This paper was written in response to HPGA's request for advice on the potential role of Operations Research (OR) and analysis in such a framework. A broad interpretation of OR is proposed that includes qualitative analysis of problems that are not amenable to the quantitative methods with which OR is more traditionally associated. Cultural and ownership issues that must be addressed if OR is to be successfully incorporated into Defence's decision-making processes are discussed. It is argued that OR and analysis should be conducted with a decision perspective, and that analysis should be embedded in all aspects of a strategic planning framework. Working definitions of terms and concepts are presented to provide a common lexicon for those involved in the development of long-range planning.

Author

*Management Planning; Operations Research; Decision Making*

## 81

### ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

**20030057842** National Heart, Lung and Blood Inst., Bethesda, MD, USA

#### **Report of the Special Emphasis Panel on Opportunities and Obstacles to Genetic Research in NHLBI Clinical Studies**

2003; 32 pp.; In English

Report No.(s): PB2003-104668; No Copyright; Avail: CASI; [A03](#), Hardcopy

In order for NHLBI-supported studies to respond effectively, quickly, and in a coordinated fashion to opportunities for genetic research, a significant number of serious potential impediments and issues must be addressed, ranging from informed consent to prioritizing and expediting requests for access to stored samples. As a consequence, the National Heart, Lung and Blood Institute (NHLBI) convened a Special Emphasis Panel (SEP) on the Opportunities and Obstacles to Genetic Research in NHLBI Clinical Studies to chart a course for future research efforts. The SEP was charged to: Address the critical issues, barriers, and needs to permit optimal use of collected clinical samples. Address issues relating to collecting and sharing samples in future NHLBI studies. Recommend a comprehensive master plan of activities to facilitate genetic in NHLBI clinical research. This document is intended to guide the decision-making process of the National Heart, Lung, and Blood Advisory Council.

NTIS

*Genetics; Clinical Medicine; Biomedical Data; Biochemistry*

**20030057871** Lawrence Livermore National Lab., Livermore, CA

#### **Science and Technology Review: Creating Primordial Plasma**

2003; In English

Report No.(s): DE2003-15002972; No Copyright; Avail: National Technical Information Service (NTIS)



Lawrence Livermore National Laboratory is operated by the University of California for the Department of Energy's National Nuclear Security Administration. At Livermore, we focus science and technology on assuring our nation's security. We also apply that expertise to solve other important national problems in energy, bioscience, and the environment. Science & Technology Review is published 10 times a year to communicate, to a broad audience, the Laboratory's scientific and technological accomplishments in fulfilling its primary missions. The publication's goal is to help readers understand these accomplishments and appreciate their value to the individual citizen, the nation, and the world. Contents: Translating Vision into Reality; Commentary by Glenn Mara A Question of Quarks; Island Paradise Regained; Features The Laboratory in the News; Patents and Awards; Abstracts; Research Highlight Understanding Cells in a New Way with Three-Dimensional Models.

NTIS

*Quarks; Research Management; Plasmas (Physics)*

**20030058013** Lawrence Livermore National Lab., Livermore, CA

**Science and Technology Review: Carbon Conversion a Source of Clean Electricity**

Jun. 2001; In English

Report No.(s): DE2003-791650; No Copyright; Avail: National Technical Information Service (NTIS)

This issue contains the following articles: (1) 'Addressing the Energy-Environment Challenge.' (2) 'Turning Carbon Directly into Electricity.' A new electrochemical process converts carbon particles, derived from any fossil fuel, directly into electricity without traditional steam-reforming reactors, boilers, and turbines. (3) 'Environmental Research in California and Beyond.' Numerous environmental research projects at Livermore begin by addressing California concerns and, as they proceed, arrive at solutions and develop analytical tools of use far beyond state borders. (4) 'This Nitrogen Molecule Really Packs Heat.' A buckyball of nitrogen could become a powerful new fuel or propellant. (5) 'PEREGRINE Goes to Work.' The US Food and Drug Administration recently approved a new system, developed at Livermore, for better radiation treatment of tumors.

NTIS

*Fossil Fuels; Energy Conversion; Carbon*

**20030058803** Lawrence Livermore National Lab., Livermore, CA

**Science and Technology Review: Getting the Big Computational Picture**

Oct. 2000; In English

Report No.(s): DE2003-791644; No Copyright; Avail: National Technical Information Service (NTIS)

This issue contains the following articles: (1) 'Visualization Tools Take on Supercomputing Challenges.' (2) 'A New World of Seeing.' See and understand is the mantra of the scientists and engineers who are building new visualization tools to better interpret supercomputer data. (3) 'The Many Faces of Carbon Dioxide.' (4) 'Award-Winning System Assays Radioactive Waste with Radiation.' (5) 'Nanoscale Chemistry Yields Better Explosives.'

NTIS

*Supercomputers; Technology Assessment; Scientific Visualization*

**20030058898** NASA Ames Research Center, Moffett Field, CA, USA

**Laboratory Astrophysics White Paper: Summary of Laboratory Astrophysics Needs**

Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 3-11; In English; See also 20030058868; No Copyright; Avail: CASI; A02, Hardcopy

The NASA Laboratory Astrophysics Workshop (NASA LAW) met at NASA Ames Research Center from 1-3 May 2002 to assess the role that laboratory astrophysics plays in the optimization of NASA missions, both at the science conception level and at the science return level. Space missions provide understanding of fundamental questions regarding the origin and evolution of galaxies, stars, and planetary systems. In all of these areas the interpretation of results from NASA's space missions relies crucially upon data obtained from the laboratory. We stress that Laboratory Astrophysics is important not only in the interpretation of data, but also in the design and planning of future missions. We recognize a symbiosis between missions to explore the universe and the underlying basic data needed to interpret the data from those missions. In the following we provide a summary of the consensus results from our Workshop, starting with general programmatic findings and followed by a list of more specific scientific areas that need attention. We stress that this is a 'living document' and that these lists are

subject to change as new missions or new areas of research rise to the fore.

Author

*Astrophysics; NASA Programs; Space Missions; Laboratories; Mission Planning*

## 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*.

**20030057897** Air Force Academy, CO

#### **USA Air Force Academy: A Bibliography 1990 - 1996**

White, Elwood L.; Jun. 1996; 59 pp.; In English

Report No.(s): AD-A410912; No Copyright; Avail: CASI; [A04](#), Hardcopy

USA Air Force Academy: A Bibliography 1990 - 1996 is presented.

DTIC

*Bibliographies; Indexes (Documentation)*

**20030057900** Air Force Academy, CO

#### **The USA Air Force Academy: A Bibliography 1996 - 2000**

White, Elwood L.; Jun. 2001; 65 pp.; In English

Report No.(s): AD-A410962; No Copyright; Avail: CASI; [A04](#), Hardcopy

No abstract available

*Bibliographies; Universities*

**20030058079** Naval Postgraduate School, Monterey, CA

#### **A Methodology for the Development of Secure Vertical Web Portals**

Wu, Peter A.; Dec. 2002; 126 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411183; No Copyright; Avail: CASI; [A07](#), Hardcopy

In this thesis we investigate the development of vertical web portals (vortals) that fulfill targeted organizational mission needs. This specific type of portal provides narrow-scoped data information and services while affording the user accessibility over a public network such as the Internet. As part of the investigation we present a methodology for architecting such portals with explicit consideration of security policy. The methodology along with some preliminary guidelines is intended to serve as a first approximation of a framework for both the development of vertical portals and the definition of doctrine on the application of vortals. We illustrate this methodology with an application to a Navy ship.

DTIC

*Information Systems; Computer Security*

**20030058760** Center for Army Analysis, Fort Belvoir, VA, USA

#### **An Agent-Based Modeling Approach to Quantifying the Value of Battlefield Information**

Kewley, Robert; Larimer, Larry; Carlton, William B.; Klimack, Bill; McGinnis, Michael L.; Feb. 2003; 24 pp.; In English

Report No.(s): AD-A410599; DSE-TR-02-11; USMA/DSE-TR-02-11; No Copyright; Avail: CASI; [A03](#), Hardcopy

This paper describes a methodology we chose to investigate whether an agent-based-model (ABM) could be used to suggest appropriate behaviors for a combat force equipped with a proposed information system. The decision agents within the model will use the information about enemy forces, friendly forces, and terrain provided by the proposed information system to adjust the friendly course of action to the updated situation. We first execute simulation runs using an existing scenario. We then transfer existing scenario to an ABM with intelligent agents that will refine the course of action by generating new unit positions and routes based upon the current situation. In the final step, we substitute the ABM developed course of action and behaviors back into scenario and execute another set of simulation runs. The performance of the friendly force using the proposed information system and ABM generated behaviors may be compared to the performance of the base case. This gives insight into the potential increase in combat effectiveness realized through the use of an information system.

DTIC

*Information Systems; Military Technology; Combat; Decision Making*

**20030058835** Defense Technical Information Center, Fort Belvoir, VA

**FY 2002 Customer Satisfaction Survey Report**

Aug. 2002; 31 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412116; No Copyright; Avail: CASI; [A03](#), Hardcopy

In April 2002, the Defense Technical Information Center (DTIC) conducted its annual customer satisfaction survey to help us better understand how to serve our user community. The overall objective of this survey was to receive insight in measuring the effectiveness of DTIC's products and customer services. This report summarizes the results of the FY 2002 Customer Satisfaction Survey (FY 2002 CS Survey). It also compares results from the FY 2001 and FY 1999 Customer Satisfaction Survey findings. In addition, the survey queried customers in six areas: Customer Service Experiences, Global Customer Service Performance, DTIC Products and Services, DTIC Online Services, User Demographics, Communication/Access and Information Requirements. Questions on the survey were geared toward customer service factors: accessibility, accuracy, courtesy, helpfulness, knowledge, professionalism, responsiveness, and speed of service. Other questions targeted aspects of DTIC's products (i.e., customer involvement, quality, access) as well as adequate, useful and prompt information distribution.

DTIC

*Services; Demography; User Requirements; Information Systems*

**20030058857** VERIDIAN ENGINEERING INC BUFFALO NY, Buffalo, NY, USA

**Intelligence Analyst Associate (IAA)-CYC Knowledge Extraction**

Neal, Jeannette; Rode, Benjamin; Crouner, Chris; Gunning, Dave; Jan. 2003; 76 pp.; In English; Original contains color illustrations

Contract(s)/Grant(s): F30602-99-D-0050; AF Proj. 459E

Report No.(s): AD-A412179; AFRL-IF-RS-TR-2002-318; No Copyright; Avail: CASI; [A05](#), Hardcopy

The objective of this project was to assess the feasibility of leveraging the capabilities and strengths of the Intelligence Analyst Associate (IAA) and the Cyc Knowledge Base (KB) in order to help alleviate the textual data overload that intelligence analysts experience. IAA has capabilities for processing large volumes of unstructured text, extracting information relevant to intelligence analysts, such as entities (people, organizations, locations, dates, and times) and simple events (subject, verbs, and objects), storing the extracted information in a structured database, and enabling the use of visualization and analysis tools. The Cyc KB is a formalized representation of a vast quantity of fundamental human knowledge (facts, rules, of thumb, and heuristics) and consists of terms and assertions which relate those terms. By leveraging the Cyc KB, significant capabilities were exploited that greatly benefited the IAA and its end users. These included the ability to represent domain dependent facts in the Cyc KB to identify, classify, and specify knowledge concerning relevant entities as well as the ability to represent rules in the KB and use the Cyc KB inference engine to allow information to be derived from identified entities and entity classifications. A 'plug-in, plug-out' system framework was developed that served as the processing framework and testbed for the information extraction components, similar to the framework used for the IAA system. One of the main goals was aimed at reducing the time it takes to run a document through the IAA-Cyc system. The prototype system developed under a previous effort processed documents at a rate of 1.5 minutes per sentence. The new system processes documents at a rate of four seconds per document in which a document is typically comprised of 30-50 sentences.

DTIC

*Information Retrieval; Knowledge Based Systems; Feasibility*

**20030058909** National Inst. of Standards and Technology, Gaithersburg, MD, USA

**NIST Databases on Atomic Spectra**

Reader, Joseph; Wiese, Wolfgang L.; Martin, William C.; Musgrove, Arlene; Fuhr, Jeffrey R.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 80-82; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

In recent years, the atomic spectroscopy data compiled by the National Institute of Standards and Technology (NIST) has migrated from print form to databases on the NIST website. The NIST website now contains the Atomic Spectra Database, and several complementary databases. The Atomic Spectra Database has been set up specifically to handle queries on energy levels and transitions. The data is displayed in formats similar to those used in previous NIST publications.

CASI

*Data Bases; Atomic Spectra; Internet Resources*

**20030059041** Naval Postgraduate School, Monterey, CA, USA

**Ten Years Worth of Procurement Reforms with Specific Attention to Selected DOD Programs**

Knox, Bernard D.; Dec. 2002; 136 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411097; No Copyright; Avail: CASI; **A07**, Hardcopy

DOD reduced force structure after the Cold War ended. More efficient and sophisticated weapons are necessary to support a smaller force. Acquisition reform legislation is designed to capture savings and usher in a Revolution in Business Affairs. Today a wide array of rogue nations, transnational actors, and domestic terrorism demand weapons procurement reform that is effective against a smaller and much less visible foe. The Department of Defense's goal is to deliver modern, high performance weapons systems at lower cost, on schedule and with higher performance. Better weaponry drives the reality that the nation and the Department find themselves in, an era of highly unpredictable security challenges. This research paper explores major procurement reforms and their effect on decreasing the amount of time and funds expended on current and future weapons systems. It looks for evidence of how the Department of the Navy's budget is impacted and what controls, if any, these reforms will have on future weapons procurement. The link between the Executive and legislative branches, DOD and program managers are examined to determine if procurement reform has helped.

DTIC

*Defense Program; Procurement; Weapon Systems; Warfare*

**20030059046** Lockheed Martin Tactical Defense Systems, Saint Paul, MN, USA

**Information-Theoretic Information Fusion**

Mahler, Ronald P.; Jun. 28, 2002; 67 pp.; In English

Contract(s)/Grant(s): DAAG55-98-C-0039

Report No.(s): AD-A411118; ARO-37629-EL.17; No Copyright; Avail: CASI; **A04**, Hardcopy

This Final Report summarizes research on information fusion based on finite-set statistics (FISST). FISST provides a fully unified, scientifically defensible, probabilistic foundation for the following aspects of multisource, multitarget, multiplatform data fusion: (1) multisource integration (detection, identification, and tracking) based on Bayesian filtering and estimation; (2) sensor management using control theory; (3) performance evaluation using information theory; (4) expert-systems theory (fuzzy logic, the Dempster-Shafer theory of evidence, rule-based inference); (5) distributed fusion; and (5) aspects of situation threat assessment. The core of FISST is a multisource-multitarget differential and integral calculus based on the fact that belief-mass functions are the multisensor-multitarget counterparts of probability-mass functions. One purpose of this calculus is to enable signal processing engineers to directly generalize conventional, engineering-friendly statistical reasoning to multisensor, multitarget, multi-evidence applications. A second purpose is to extend Bayesian (and other probabilistic) methodologies so that they are capable of dealing with (1) imperfectly characterized data and sensor models; and (2) two sensor models and true target models for multisource-multitarget problems. One consequence is that FISST encompasses certain expert-system approaches that are often described as 'heuristic'--fuzzy logic, the Dempster-Shafer theory of evidence, and rule-based inference--as special cases of a single probabilistic paradigm. Section A and Appendix 1 of the report summarize FISST and its basic consequences. Section B summarizes progress made during the course of the contract. Section 0 summarizes our progress in transitioning this USARO-funded basic research into practical applied-research funded by other DoD agencies.

DTIC

*Information Theory; Statistical Analysis; Probability Theory; Multisensor Fusion; Detection*

**84**

**LAW, POLITICAL SCIENCE AND SPACE POLICY**

Includes aviation law; space law and policy; international law; international cooperation; and patent policy.

**20030057847** State Dept., Washington, DC, USA

**Country Reports on Human Rights Practices, 2002: Guinea-Bissau**

Mar. 31, 2003; 16 pp.

Report No.(s): PB2003-105310; No Copyright; Avail: CASI; **A03**, Hardcopy

Guinea-Bissau's transition to a multiparty democracy was slowed by the domination of President Koumba Yala of the Partido de Renovacao Social (PRS), who was elected in January 2000 with a 72 percent electoral majority in a runoff election. In the 1999 legislative elections, the PRS won 38 of 102 National Assembly seats, and ended the 26-year domination of the African Party for the Independence of Guinea-Bissau and Cape Verde (PAIGC). Local and international observers considered

both elections to be generally free and fair, although there were reports of some irregularities in the 1999 election. During the year, the country was characterized by continuing political and economic instability. A new constitution, approved by the National Assembly in April 2001, was neither vetoed nor promulgated by the President, and the resulting ambiguity undermined the rule of law. Impulsive presidential interventions in ministerial operations continued to hamper effective governance. On November 14, the President dismissed the Government of Prime Minister Alamaro Nhasse, dissolved the National Assembly, and called for legislative elections. On November 16, the President appointed Prime Minister Mario Pires to lead a caretaker government. The Government was controlled by presidential decree at year's end. The Constitution provides for an independent judiciary; however, it was subject to political influence and corruption, and was undermined when the President replaced the President of the Supreme Court on two occasions during the year.

NTIS

*Ambiguity; Cape Verde; Drainage*

## 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.

**20030057852** Environmental Protection Agency, Ann Arbor, MI, USA

#### **Testing Stabilization/Solidification Processes for Mixed Waste**

Aug. 2000; 146 pp.; In English

Report No.(s): PB2003-104161; EPA/402/R-00/008; No Copyright; Avail: CASI; [A07](#), Hardcopy

The report contains information for four Stabilization/Solidification processes: calcium sulfo-aluminate based-cement stabilization, magnesium phosphate based-cement stabilization, Orthophthalic Polyester (OPE) Resin Encapsulation, and Epoxy Vinyl Ester Resin Encapsulation.

NTIS

*Stabilization; Waste Treatment; Waste Disposal; Radioactive Wastes*

**20030058763** Naval Research Lab., Stennis Space Center, MS

#### **Lane Navigation Using Electronic Charts: A Training Manual for the NRL moving-Map System**

Edwards, Stephanie S.; Myrick, Stephanie A.; Gendron, Martin L.; Jan. 31, 2003; 16 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411690; NRL/MR/7440--03-8287; No Copyright; Avail: CASI; [A03](#), Hardcopy

The Naval Research Laboratory (NRL) Moving Map (MM) navigation system integrates relatively low cost, commercial off-the-shelf (COTS) DGPS/GPS hardware with government off-the-shelf (GOTS) moving-map software. The system consists of a DGPS/GPS antenna and receiver capable of establishing exact position(s) within 5-meter accuracy. DGPS/GPS data is processed by a high performance, ruggedized, water-resistant computer running segments of the Falcon View program from the Portable Flight Planning System (PFPS) software suite. The system can be loaded with a full range of military standard format charts from the National Imagery and Mapping Agency (NIMA) and the National Oceanographic and Atmospheric Administration (NOAA), and various conversion chart imports (such as georectified GEOTIFF formats) of other non-military standard commercial products. Overlays depicting the battlefield geometry are used to enhance situational awareness.

DTIC

*Navigation Aids; Nautical Charts; Ships; Surface Navigation*

## 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*.

**20030058868** NASA Ames Research Center, Moffett Field, CA, USA

#### **Proceedings of the NASA Laboratory Astrophysics Workshop**

Salama, Farid, Editor; November 30, 2002; 285 pp.; In English; NASA Laboratory Astrophysics Workshop, 1-3 May 2002, Moffett Field, CA, USA; See also 20030058869 - 20030058936

Contract(s)/Grant(s): WU 344-89-02-23

Report No.(s): NASA/CP-2002-211863; A-0309205; NAS 1.55:211863; No Copyright; Avail: CASI; [A13](#), Hardcopy

This document is the proceedings of the NASA Laboratory Astrophysics Workshop, convened May 1-3, 2002 at NASA's Ames Research Center. Sponsored by the NASA Office of Space Science (OSS), this programmatic workshop is held periodically by NASA to discuss the current state of knowledge in the interdisciplinary field of laboratory astrophysics and to identify the science priorities (needs) in support of NASA's space missions. An important goal of the Workshop is to provide input to OSS in the form of a white paper for incorporation in its strategic planning. This report comprises a record of the complete proceedings of the Workshop and the Laboratory Astrophysics White Paper drafted at the Workshop.

Author

*Astrophysics; Laboratories; Conferences; Space Missions; NASA Programs*

## 89

### ASTRONOMY

Includes observations of celestial bodies; astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

**20030057793** Lawrence Livermore National Lab., Livermore, CA, Princeton Univ., NJ, NASA Goddard Space Flight Center, Greenbelt, MD, USA, Missouri Univ., Rolla, MO, USA

#### **New Insights into the X-Ray Spectra of Heliumlike and Neonlike Ions**

Beiersdorfer, P.; Chen, H.; Hey, D.; May, M. J.; Osterheld, A. L.; Apr. 11, 2002; 16 pp.; In English

Report No.(s): DE2003-15002895; UCRL-JC-148356; No Copyright; Avail: Department of Energy Information Bridge

Recent measurements of the K-shell and L-shell x-ray spectra of highly charged helium- like and neonlike ions are presented that were performed on the Livermore electron beam ion traps and the Princeton tokamaks. These measurements provide new insights into collisional and indirect line formation processes, identifications of forbidden lines, and a new plasma line diagnostic of magnetic field strength.

NTIS

*Ions; X Ray Spectra*

**20030057807** Lawrence Livermore National Lab., Livermore, CA, Oxford Univ., Oxford, UK, Texas Univ., Austin, TX, USA

#### **High-Redshift Clusters from NVSS: The TexOx Cluster (TOC) Survey**

Croft, S.; Rawlings, S.; Hill, G. J.; Feb. 11, 2003; 14 pp.; In English

Report No.(s): DE2003-15003029; UCRL-JC-151376; No Copyright; Avail: Department of Energy Information Bridge

The TexOx Cluster (TOC) survey uses overdensities of radiosources in the NVSS to trace clusters of galaxies. The links between radiosources and rich environments make this a powerful way to find clusters which may potentially be overlooked by other selection techniques. By including constraints from optical surveys, TOC is an extremely efficient way to find clusters at high redshift.

NTIS

*Galactic Clusters; Red Shift*

**20030058032** Naval Research Lab., Washington, DC

#### **Scientific Justification for a Beam-Forming Array on the Green Bank Telescope**

Stairs, L. H.; Condon, J. J.; Lockman, F. J.; Turner, B. E.; Bania, T. M.; Dec. 31, 2002; 29 pp.; In English; Original contains color illustrations

Report No.(s): AD-A411912; NRL/MR/7210-02-8644; No Copyright; Avail: CASI; [A03](#), Hardcopy

National Radio Astronomy Observatory (NRAO) plans to build a beam-forming array for the Green Bank Telescope (GBT) capable of producing seven beams at L-band. The physical size of 21-cm feeds at the GBT makes it impossible to support a system with more than three beams if they are formed in the traditional fashion by stacking feed horns side by side. The beam-forming array is the most natural, efficient, and logical way to gain the advantage, and would represent a breakthrough in technology. Such an instrument would open up many new survey possibilities in spectral line and continuum imaging and polarization, as well as searches for new pulsars along the Galactic Plane. This document presents justifications and sample observing parameters for these surveys along with required system specification.

DTIC

*Radio Telescopes; Antenna Arrays; Telescopes; Beamforming*

**20030058048** Instituto Nacional de Pesquisas Espaciais, Sao Jose dos Campos, Brazil

**A Map of the Galactic Emission at 408 MHz**

RodriguesdeSouza, Rogerio; 2003; 112 pp.; In Portuguese

Report No.(s): INPE-9560-TDI/835; Copyright; Avail: CASI; [A06](#), Hardcopy

We present a map of the Galactic Emission at 408 MHz prepared from the data collected with the radiotelescope of the Galactic Emission Mapping (GEM) project operating in the Owens Valley's desert (CA- USA) in April 1994. A total power receiver was used with the following characteristics: bandwidth of 28MHz, noise temperature of 112 K, gain of 57.8 KV(exp -1), and a sensitivity of 28.5 mK. The map displays a total of 29.40 hours of observations and covers an area of the sky between 0(sup h) less than alpha less than 24(sup h), and -3 deg 22 min is less than or equal to sigma is less than or equal to +77 deg 22 min. The beam resolution is 10.4 deg (HPBW) and the map pixelization is 1.6 deg. The data contamination level by radiofrequency interference was 36.58%, from a total of 53.46 hours of observations, while the Sun and the Moon contaminated 16.25% of the data.

Author

*Radio Astronomy; Extragalactic Radio Sources; Radio Emission; Mapping*

**20030058051** Colorado Univ., Boulder, CO, USA

**SN1987A: The Birth of a Supernova Remnant**

McCray, Richard; [2003]; 2 pp.; In English

Contract(s)/Grant(s): NAG5-8236; No Copyright; Avail: CASI; [A01](#), Hardcopy

This grant was intended to support the development of theoretical models needed to interpret and understand the observations by the Hubble Space Telescope and the Chandra X-ray telescope of the rapidly developing remnant of Supernova 1987A. In addition, we carried out a few investigations of related topics. The project was spectacularly successful. The models that we developed provide the definitive framework for predicting and interpreting this phenomenon. Following is a list of publications based on our work. Some of these papers include results of both theoretical modeling supported by this project and also analysis of data supported by the Space Telescope Science Institute and the Chandra X-ray Observatory. We first list papers published in refereed journals, then conference proceedings and book chapters, and also an educational web site.

Author

*Mathematical Models; Birth; Supernova 1987a; Supernova Remnants; Predictions*

**20030058843** Naval Research Lab., Washington, DC

**Radio Transients, Stellar End Products, and SETI Working Group Report**

Lazio, T. J. W.; Backer, D.; Cordes, J. M.; Jonas, J.; Kramer, M.; Dec. 20, 2002; 15 pp.; In English; Original contains color illustrations

Report No.(s): AD-A412151; NRL/MR/7210-02-8643; No Copyright; Avail: CASI; [A03](#), Hardcopy

This working group (WG) has identified the following projects as forefront science to be pursued with the Square Kilometer Array (SKA) and which drive specifications of the SKA. In particular, pulsars, transients, and some Search for Extraterrestrial Intelligence (SETI) activities require observing modes that differ markedly from those designed for imaging modes of sources that do not vary with time. Therefore, care must be taken in the conceptual and design phases of the SKA to ensure that science in these areas can be undertaken and optimized. As a notable historical example, we point out that the original discovery of pulsars involved an array optimized for detecting relatively fast (at that time) scintillations. By comparison, the Very Large Array (VLA) has not discovered any new pulsars, in part because its design has hampered the analysis of short timescale signals. Consequently, the vast majority of radio pulsar discoveries has been made with single-dish antennas. This should not be the case with the SKA!

DTIC

*Project Seti; Radio Interferometers; Extraterrestrial Radio Waves; Stellar Atmospheres; Aerospace Environments*

**20030058870** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

**Theoretical Studies of Pressure Broadened Alkali-Metal Atom Resonance Lines**

Babb, J. F.; Kirby, K.; Chung, H.-K.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 32-34; In English; See also 20030058868

Contract(s)/Grant(s): NSF AST 97-24713; No Copyright; Avail: CASI; [A01](#), Hardcopy

We discuss our recent calculations of pressure broadening of alkali-metal atomic resonance lines by perturbing gases and

their applications to studies of brown dwarf and extrasolar giant planet atmospheres.

Author

*Alkali Metals; Atomic Spectra; Line Spectra; Pressure Broadening; Resonance Lines*

**20030058872** California Univ., Berkeley, CA, USA

**Microscopic Processes in X-ray Modulated Star Formation**

Glassgold, A. E.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 56-59; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Charge transfer processes accompanying X-ray irradiation are important for understanding protostellar jets.

Author

*Star Formation; X Ray Irradiation; Hydrogen Ions; Charge Transfer; Microscopy*

**20030058875** California Univ., Berkeley, CA, USA

**Emission Line Spectra in the Soft X-ray Region 20 - 75 Angstroms**

Lepson, J. K.; Beiersdorfer, P.; Chen, H.; Behar, E.; Kahn, S. M.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 67-69; In English; See also 20030058868

Contract(s)/Grant(s): NASA Order W-19878; W-7405-Eng-48; No Copyright; Avail: CASI; [A01](#), Hardcopy

As part of a project to complete a comprehensive catalogue of astrophysically relevant emission lines in support of new-generation X-ray observatories using the Lawrence Livermore electron beam ion traps EBIT-I and EDIT-II, emission lines of argon and sulfur in the soft X-ray and extreme ultraviolet region were studied. Observations of Ar IX through Ar XVI and S VII through S XIV between 20 and 75 Angstrom are presented to illustrate our work.

Author

*Emission Spectra; Line Spectra; Sulfur; Ion Traps (Instrumentation); Spectroscopy; Argon*

**20030058885** California Univ., Berkeley, CA, USA

**Molecular Carbon in the Galaxy: New Laboratory and Observational Studies**

Saykally, Richard J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 155-156; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The possible roles of two distinct forms of carbon in the Interstellar Medium (ISM) is being explored in our laboratories. Polycyclic Aromatic Hydrocarbon (PAH) molecules, proposed as Unidentified Infrared (UIR) carriers are studied in the gas phase by IR emission spectroscopy, while pure carbon clusters are studied by a combination of IR cavity ringdown spectroscopy, FIR laser spectroscopy, and observational FIR astronomy.

Author

*Carbon; Emission Spectra; Infrared Radiation; Interstellar Matter; Polycyclic Aromatic Hydrocarbons; Spectroscopic Analysis*

**20030058886** Arizona Univ., Tucson, AZ, USA

**Sub-millimeter Spectroscopy of Astrophysically Interesting Metal-Containing Molecules**

Ziurys, L. M.; Brewster, M. A.; Sheridan, P. M.; Savage, C.; Halfen, D. T.; Apponi, A. J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 168-171; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-10333; No Copyright; Avail: CASI; [A01](#), Hardcopy

With the advent of SOFIA and Herschel, new spectral windows will be opened for spectroscopy in the sub-millimeter region. To conduct science in this band, laboratory measurements must be carried out to provide accurate transition frequencies for molecular identification and physical interpretation. We are presently conducting such measurements using gas-phase submm direct absorption techniques. Of particular interest are simple molecules containing iron-peak elements, including carbides, and metal hydride ions (MH<sup>+</sup>), both which possess favorable transitions at submm wavelengths.

Author

*Metal Hydrides; Ions; Carbides; Astronomical Spectroscopy; Submillimeter Waves*

**20030058894** SRI International Corp., Menlo Park, CA, USA

**The Atmosphere as Laboratory: Aeronomy by Astronomy**

Slanger, T. G.; Cosby, P. C.; Huestis, D. L.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 253-257; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy



Astronomical sky spectra, which are byproducts of long-slit observations with echelle spectrographs on large telescopes, provide a unique platform for studying the optical emissions of excited molecules and atoms in the terrestrial atmosphere that can greatly extend present knowledge based on laboratory spectra. This paper summarizes some of the advances that have been made in our understanding of the lower electronic states of O<sub>2</sub> and other species from the sky spectra and from direct observations of the Venus nightglow.

Author

*Oxygen; Spectrographs; Venus (Planet); Spectroscopic Analysis; Emission Spectra; Spectral Bands*

**20030058899** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **C-H Hot Bands in the Near-IR Emission Spectra of Leonids**

Freund, F. T.; Scoville, J.; Holm, R.; Seelemann, R.; Freund, M. M.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 245-248; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The reported infrared (IR) emission spectra from 1999 Leonid fireballs show a 3.4 micron C-H emission band and unidentified bands at longer wavelengths. Upon atmospheric entry, the Leonid meteorites were flash-heated to temperatures around 2400K, which would destroy any organics on the surface of the meteorite grains. We propose that the  $\nu(\text{sub})\text{CH}$  emission band in the Leonid emission spectra arises from matrix-embedded  $\text{C}(\text{sub } n)\text{-H-O}$  entities that are protected from instant pyrolysis. Our model is based on IR absorption  $\nu(\text{sub})\text{CH}$  bands, which we observed in laboratory-grown MgO and natural olivine single crystals, where they arise from  $\text{C}(\text{sub } n)\text{-H-O}$  units imbedded in the mineral matrix, indicative of aliphatic  $-\text{CH}_2-$  and  $-\text{CH}_3$  organics. Instead of being pyrolyzed, the  $\text{C}(\text{sub } n)\text{-H-O}$  entities in the Leonid trails become vibrationally excited to higher levels  $n = 1, 2, 3$  etc. During de-excitation they emit at 3.4 microns, due to the  $(0 \Rightarrow 1)$  transition, and at longer wavelengths, due to hot bands. As a first step toward verifying this hypothesis we measured the C-H vibrational manifold of hexane (C<sub>6</sub>H<sub>14</sub>). The calculated positions of the  $(2 \Rightarrow 1)$ ,  $(3 \Rightarrow 2)$ , and possibly  $(4 \Rightarrow 3)$  hot bands agree with the Leonid emission bands at 3.5, 3.8 and 4.1 microns.

Author

*Emission Spectra; Infrared Spectra; Leonid Meteoroids; Spectral Bands*

**20030058901** McDonald Observatory, Austin, TX, USA

#### **Atomic Data and Stellar Chemical Compositions**

Snedden, Christopher; Lawler, James E.; Cowan, John J.; Dinerstein, Harriet L.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 28-31; In English; See also 20030058868

Contract(s)/Grant(s): NSF AST-99-87162; NSF AST-98-19400; NSF AST-99-86974; NSF AST-97-31156; No Copyright; Avail: CASI; [A01](#), Hardcopy

New high resolution spectrographs for 8-meter telescopes, and NASA missions such as HST, FUSE, and SOFIA, provide spectra of unprecedented quality for stars and nebulae over a large metallicity range. Analyses of these spectra should yield a reconstruction of the origin and evolution with time of all major element groups in the Periodic Table. Rapid progress has been made in our understanding of the trends with metallicity and scatter at a given metallicity for some elements, but large abundance uncertainties remain for many others, due to lack of accurate atomic data for many transitions that are accessible in stellar spectra. We review some recent successes in campaigns to upgrade the atomic data for the first three ionization stages of many rare-earth elements, and show the application of these new data to solar and stellar abundances. Examples are given of abundances extracted from complex UV stellar spectra for elements important for nucleosynthesis studies, discoveries of previously unidentified features of heavy elements in planetary nebulae, and one of the many new frontiers in abundance work: investigations of the IR spectra of globular cluster stars. These examples demonstrate the need for further development of comprehensive sets of accurate atomic parameters for many species present in stars and nebulae.

Author

*Stellar Composition; Rare Earth Elements; Metallicity; Spectrographs; Stellar Spectra; Metallic Stars; Line Spectra; Infrared Spectra*

**20030058911** Massachusetts Inst. of Tech., Cambridge, MA, USA

#### **X-ray Spectroscopy of Trapped Ions with a Microcalorimeter on the NIST Electron Beam Ion Trap**

Takacs, E.; Gillaspay, J. D.; Ratliff, L.; Makonyi, K.; Laming, M.; Silver, E.; Schnopper, H.; Barbera, M.; Beeman, J.; Haller, E.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 96-100; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The electron beam ion trap (EBIT) was invented about 15 years ago (?). Judging from the wide range of experiments

performed on the machine since its inception, EBITs have become one of the most successful devices to produce, trap, and study the structure and interactions of highly charged ions. Today, EBITs exist in several different laboratories around the world and are used in a variety of fields of research where multiply charged ions are relevant. Recent astrophysical missions by NASA and ESA targeting the x-ray wavelength range of the electromagnetic spectrum opened up a new direction for EBIT research. Efforts at two U.S. EBIT sites, the Lawrence Livermore National Laboratory (LLNL) in Livermore and the National Institute of Standards and Technology (NIST) in Gaithersburg, have provided highly charged ion data for astrophysical applications. This report, summarizes some recent NIST results.

Author

*Electromagnetic Spectra; Electron Beams; Trapped Particles; X Ray Spectroscopy; Ion Traps (Instrumentation)*

**20030058915** Michigan State Univ., East Lansing, MI, USA

**EMILI: An Aid to Emission Line Identification in Emission-Line Regions**

Sharpee, Brian; Baldwin, Jack; Williams, Robert; vanHoof, Peter; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 85-88; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

We present results from EMILI, our software optimized to identify weak emission lines in planetary nebulae and H II regions. We discuss the steps carried out by the code to arrive at identifications, and planned future improvements.

Author

*Emission Spectra; H II Regions; Planetary Nebulae; Computer Programs*

**20030058918** California Univ., Berkeley, CA, USA

**Early Results from the APO Diffuse Interstellar Band Survey**

McCall, B. J.; Thorburn, J.; Hobbs, L. M.; Welty, D. E.; Snow, T. P.; Rachford, B. L.; Sonnentrucker, P.; Friedman, S.; Oka, T.; York, D. G.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 138-140; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The diffuse interstellar bands (DIBs) are absorption features observed in the visible spectra of nearly all reddened stars, and were first observed in the early decades of the 20th century when many lines in astronomical spectra were unassigned. As laboratory spectroscopy progressed, most of the stronger lines were identified with atomic or diatomic species - the DIBs are those lines (more numerous and generally broader) that remain unidentified. Since the DIBs have remained unassigned for over 75 years despite extensive laboratory efforts, we are trying a new approach. Our goal is to obtain moderate resolution ( $\lambda \Delta \lambda$  approximately equal to 37,500), high signal-to-noise spectra of a large sample of reddened stars. We are using the ARCES echelle spectrograph at the Apache Point Observatory, which offers complete spectral coverage from 3700-10,000 Angstroms. So far, we have taken data on 75 nights and have obtained S/N greater than 1000 on 63 stars, and S/N greater than 500 on 60 additional stars. Our hope is that this extensive DIB dataset, coupled with complementary measurements of known species at ultraviolet, visible, and infrared wavelengths, will yield new insights into the origin of the DIBs - this paper presents some of our early results.

Author

*Diffuse Interstellar Bands; Interstellar Extinction; Astronomical Observatories; Astrophysics*

**20030058924** Louisiana State Univ., LA, USA

**Unification: UV and IR Observations of Interstellar Dust Along the Same Sightlines**

Clayton, Geoffrey C.; Gordon, K. D.; Wolff, M. J.; Valencic, L.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 189-191; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

While efforts have been made to study interstellar dust in various Galactic environments at wavelengths from the x-ray to the radio, a single line of sight is rarely subjected to observations over a wide wavelength range. This is particularly true for the UV and IR regimes. The typical interstellar dust sightline used for UV studies has a small column of dust. These sightlines probe the diffuse ISM and avoid all but the very outer edges of dark or molecular clouds. IR studies of dust, on the other hand, concentrate on molecular bands of many different materials from H<sub>2</sub> to polycyclic aromatic hydrocarbons (PAHs). In general, large optical depths of dust in dense clouds are necessary for the formation of these molecules. So to a large extent studies of interstellar dust in the UV and IR have been two 'separate worlds.' The result has been models of dust grains which are strongly biased toward fitting observations in one wavelength regime or the other. The absence of sightlines for which both UV and IR data are available makes it difficult to reconcile the constraints derived separately from each wavelength regime. We are using the Maximum Entropy Method (MEM) in conjunction with a range of grain models: starting with simple grain

models consisting of separate populations of spherical dust grains and working towards more realistic (i.e., porous and composite) models of dust.

Derived from text

*Cosmic Dust; Maximum Entropy Method; Molecular Clouds; Ultraviolet Spectra; Infrared Spectra*

**20030058930** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Temperature Dependence of the Rate Constant for the CH<sub>3</sub> Recombination Reaction: A Loss Process in Outer Planet Atmospheres**

Cody, R. J.; Payne, W. A.; Thorn, R. P., Jr.; Romani, P. N.; Stief, L. J.; Nesbitt, F. L.; Iannone, M. A.; Tardy, D. C.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 238-240; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The methyl free radical (CH<sub>3</sub>) has been observed in the atmospheres of Saturn and Neptune by the ISO satellite. There are discrepancies between the column densities for the CH<sub>3</sub> radical derived from the ISO observations and the column densities derived from atmospheric photochemical models. For Neptune the model column density is 1.5 times that derived from ISO. For Saturn the model is 6 times that from ISO. The recombination of methyl radicals is the major loss process for methyl in these atmospheres. The serious disagreement between observed and calculated levels of CH<sub>3</sub> has led to suggestions that the atmospheric models greatly underestimated the loss of CH<sub>3</sub> due to poor knowledge of the rate of the reaction (1) CH<sub>3</sub> + CH<sub>3</sub> + M goes to C<sub>2</sub>H<sub>6</sub> + M at the low temperatures and pressures of these atmospheric systems. Although the reaction CH<sub>3</sub> + CH<sub>3</sub> + M goes to C<sub>2</sub>H<sub>6</sub> + M has been extensively studied both theoretically and experimentally, the laboratory conditions have been, with only a few exceptions, higher temperatures (T greater than 298K), higher pressures (P greater than or equal to 10 Torr - 13.3 mbar) or M=Ar rather than H<sub>2</sub> or He as the bath gas.

Derived from text

*Free Radicals; Temperature Dependence; Reaction Kinetics; Recombination Reactions; Solar System; Methyl Compounds; Planetary Atmospheres*

**20030059009** Hawaii Univ., Honolulu, HI, USA

**Origins, Evolution, and Fate of Brown Dwarfs**

Martin, Eduardo; January 2003; 2 pp.; In English; International Astronomical Union Symposium, 20-24 May 2002, Waikoloa, HI, USA

Contract(s)/Grant(s): NAG5-11466; No Copyright; Avail: CASI; [A01](#), Hardcopy

Research related to the origins, evolution and fate of brown dwarfs is presented. The topics include: 1) Imaging surveys for brown dwarfs; 2) Companion detection techniques; 3) Measurements of fundamental properties of brown dwarfs; 4) Classification schemes for ultracool dwarfs; 5) Origins and evolution of brown dwarfs; 6) Ultracool atmospheres and interiors; 7) Time variable phenomena in brown dwarfs; 8) Comparisons between brown dwarfs and planets; 9) Substellar mass functions; and 10) Future facilities.

Derived from text

*Brown Dwarf Stars; Stellar Evolution; Imaging Techniques; Solar System*

**20030059029** Lawrence Livermore National Lab., Livermore, CA

**Laboratory Study of the Diagnostic Utility of the 3C/3D Line Ratio in Fe XVII**

Brown, G. V.; Beiersdorfer, P.; Chen, H.; Reed, K. J.; Jun. 18, 2002; 10 pp.; In English

Report No.(s): DE2003-15002779; UCRL-JC-147249; No Copyright; Avail: Department of Energy Information Bridge

Fe XVII x-ray emission is present in a multitude of sources, such as the corona of the Sun, Capella, and Procyon. Two of the strongest lines observed in these spectra are the resonance and intercombination lines located at 15.01 and 15.26 (Lambda), respectively. As part of the laboratory astrophysics program at the electron beam ion traps EBIT-I & EBIT-II located at the Lawrence Livermore National Laboratory we have measured this line ratio for the case where the relative abundance of Fe XVI to Fe XVII is approximately 1. Our results show that an Fe XVI innershell satellite line coincides with the intercombination line and can significantly reduce the relative intensity, R, of the resonance to intercombination line. The fact that the apparent, relative intensity of the resonance and intercombination line in Fe XVII is sensitive to the strength of an Fe XVI innershell satellite, and therefore, the relative abundance of Fe XVI to Fe XVII, makes the line ratio a diagnostic of temperature, and explains the anomalously low ratios observed in the solar and stellar coronae.

NTIS

*Coronas; Atomic Spectra; Iron*

90  
**ASTROPHYSICS**

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

**20030057746** Lawrence Livermore National Lab., Livermore, CA

**Laboratory Astrophysics at the LLNL Electron Beam Ion Traps EBIT-I and EBIT-II**

Brown, G. V.; Boyce, K. R.; Kelley, R. L.; Porter, F. S.; Stahle, C. K.; Jun. 18, 2002; 12 pp.; In English  
Report No.(s): DE2003-15002776; UCRL-JC-147245; No Copyright; Avail: Department of Energy Information Bridge

In order to provide a complete, accurate set, of atomic data for interpreting spectra provided by missions such as XMM-Newton, the Chandra X-Ray Observatory, and Astro-E2, we have harnessed the Lawrence Livermore National Laboratory's electron beam ion traps EBIT-I, EBIT-II, and Super-EBIT for laboratory astrophysics. In support of this work we have developed a number of unique techniques, including the ability to experimentally simulate a Maxwellian distribution of electron energies and measuring low-energy charge exchange cross sections using the 'magnetic trapping mode'. We have also built, and operated a full suite of spectrometers spanning the 1-7000 Angstrom wavelength band, the most recent, being the NASA/Goddard Space Flight Center's Astxo-E 6 X 6 engineering spare microcalorimeter array.

NTIS

*Astrophysics; Electron Beams; Ion Beams; Ion Traps (Instrumentation)*

**20030057767** Lawrence Livermore National Lab., Livermore, CA

**Status and Future of ADMX: The US Microwave Cavity Axion Search Experiment**

Kinion, D.; Jan. 02, 2003; 12 pp.; In English  
Report No.(s): DE2003-15003143; UCRL-JC-151317; No Copyright; Avail: Department of Energy Information Bridge

The report is on the status of the Axion Dark-Matter Experiment (ADMX), the microwave-cavity-based axion search underway at Lawrence Livermore National Laboratory. The ADMX collaboration includes LLNL, the University of Florida, and M.I.T., and has been in operation since February, 1996.

NTIS

*Dark Matter; Microwaves*

**20030057779** Fermi National Accelerator Lab., Batavia, IL, USA, Chicago Univ., Chicago, IL, USA

**New Cosmology**

Turner, M. S.; Nov. 2002; 16 pp.; In English  
Report No.(s): DE2003-804702; FERMILAB-CONF-02/289-A; No Copyright; Avail: Department of Energy Information Bridge

Over the past three years we have determined the basic features of our Universe. It is spatially flat; accelerating; comprised of 1/3 a new form of matter, 2/3 a new form of energy, with some ordinary matter and a dash of massive neutrinos; and it apparently began from a great burst of expansion (inflation) during which quantum noise was stretched to astrophysical size seeding cosmic structure. This 'New Cosmology' greatly extends the highly successful hot big-bang model. Now we have to make sense of it. What is the dark matter particle. What is the nature of the dark energy. Why this mixture. How did the matter-antimatter asymmetry arise. What is the underlying cause of inflation (if it indeed occurred).

NTIS

*Universe; Big Bang Cosmology; Dark Matter; Neutrinos*

**20030057947** Chicago Univ., Chicago, IL, USA, Fermi National Accelerator Lab., Batavia, IL, USA

**Making Sense of the New Cosmology**

Turner, M. S.; Nov. 2002; 22 pp.; In English  
Report No.(s): DE2003-804700; FERMILAB-CONF-02/288-A; No Copyright; Avail: Department of Energy Information Bridge

Over the past three years we have determined the basic features of the Universe - spatially flat; accelerating; comprised of 1/3 a new form of matter, 2/3 a new form of energy, with some ordinary matter and a dash of massive neutrinos; and apparently born from a burst of rapid expansion during which quantum noise was stretched to astrophysical size seeding cosmic structure. The New Cosmology greatly extends the highly successful hot big-bang model. Now we have to make sense of all this: What is the dark matter particle. What is the nature of the dark energy. Why this mixture. How did the matter -

antimatter asymmetry arise. What is the underlying cause of inflation (if it indeed occurred).

NTIS

*Universe; Big Bang Cosmology*

**20030058761** Lawrence Livermore National Lab., Livermore, CA

**AO Observations of Three Powerful Radio Galaxies**

DeVreis, W.; vanBreugel, W.; Quirrenbach, A.; Aug. 01, 2002; 16 pp.; In English

Report No.(s): DE2003-15002782; UCRL-JC-149438; No Copyright; Avail: Department of Energy Information Bridge

The host galaxies of powerful radio sources are ideal laboratories to study active galactic nuclei (AGN). The galaxies themselves are among the most massive systems in the universe, and are believed to harbor supermassive black holes (SMBH). If large galaxies are formed in a hierarchical way by multiple merger events, radio galaxies at low redshift represent the end-products of this process. However, it is not clear why some of these massive ellipticals have associated radio emission, while others do not. Both are thought to contain SMBHs, with masses proportional to the total luminous mass in the bulge. It either implies every SMBH has recurrent radio-loud phases, and the radio-quiet galaxies happen to be in the low state, or that the radio galaxy nuclei are physically different from radio-quiet ones, i.e. by having a more massive SMBH for a given bulge mass.

NTIS

*Radio Galaxies; Adaptive Optics; Radio Emission; Red Shift*

**20030058766** Lawrence Livermore National Lab., Livermore, CA

**Emission Line Spectra in the Soft X-Ray Region 20-75 A**

Lepson, J. K.; Beiersdorfer, P.; Chen, H.; Behar, E.; Kahn, S. M.; Jun. 18, 2002; 10 pp.; In English

Report No.(s): DE2003-15002783; UCRL-JC-149432; No Copyright; Avail: Department of Energy Information Bridge

As part of a project to complete a comprehensive catalogue of astrophysically relevant emission lines in support of new-generation X-ray observatories using the Lawrence Livermore electron beam ion traps EBIT-I and EBIT-11, we studied emission lines of argon and sulfur in the soft X-ray and extreme ultraviolet region. Here we present observations of Ar IX through Ar XVI and S VII through S XIV between 20 and 75 A to illustrate our work.

NTIS

*Emission Spectra; Ion Beams; X Rays*

**20030058801** Lawrence Livermore National Lab., Livermore, CA

**Explosive Instability of Prominence Flux Ropes**

Hurricane, O. A.; Fong, B. H. L.; Cowley, S. C.; Sep. 04, 2002; 14 pp.; In English

Report No.(s): DE2003-15002778; UCRL-JC-149953; No Copyright; Avail: Department of Energy Information Bridge

The rapid, Alfvénic, time scale of erupting solar-prominences has been an enigma ever since they were first identified. Investigators have proposed a variety of different mechanisms in an effort to account for the abrupt reconfiguration observed. No one mechanism clearly stands out as the single cause of these explosive events. Recent analysis has demonstrated that field lines in the solar atmosphere are metastable to ballooning type instabilities. It has been found previously that in ideal MHD plasmas marginally unstable ballooning modes inevitably become explosive evolving towards a finite time singularity via a nonlinear 3D instability called Nonlinear Magnetohydrodynamic Detonation. Thus, this mechanism is a good candidate to explain explosive events observed in the solar atmosphere of our star or in others.

NTIS

*Ballooning Modes; Magnetohydrodynamic Stability; Plasma Diagnostics; Solar Prominences*

**20030058808** Instituto de Fisica Teorica, Sao Paulo, Brazil, Universidade Estadual de Paulista, Brazil

**Possible Origin of RHIC R(out)/R(sid) HBT Results**

Padula, S. S.; 2002; 8 pp.; In English

Report No.(s): DE2003-804086; BNL-69354-02/10; No Copyright; Avail: Department of Energy Information Bridge

The effects of opacity of the nuclei together with a blackbody type of emission along the system history are considered as a means to explain the ratio  $R(\text{sub out})/R(\text{sub sid})$  observed by STAR and PHENIX collaborations at RHIC. Within our model, no flow is required to explain the data trend of this ratio for large surface emissivities.

NTIS

*Stars; Heterojunction Devices; Bipolar Transistors; Quarks*

**20030058869** Cornell Univ., Ithaca, NY, USA

**Laboratory Astrophysics: Without it there is no Astronomical Science**

Harwit, Martin; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 17-20; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The historically earliest achievements of laboratory astrophysics are reviewed and some urgent needs in support of major space missions in the decade ahead are discussed.

Author (revised)

*Astrophysics; Histories; Astronomical Spectroscopy*

**20030058871** Stanford Univ., Stanford, CA, USA

**High Energy Lab Astrophysics Using Particle and Photon Beams**

Chen, Pisin; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 42-46; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Current frontier astrophysical phenomena typically involve one or more of the following conditions: (1) Very high intensity, high temperature processes; (2) Extremely high energy events; (3) Super strong field environments. Laboratory experiments can explore the most complex aspects of the problem as well as verify the validity of simulations designed for environments far from accessible in terrestrial conditions. Several outstanding astrophysical issues are reviewed, showing examples of possible lab experiments to help elucidate them.

Author

*Particle Beams; Photon Beams; High Energy Interactions; Experiment Design; Universe*

**20030058873** University of Western Michigan, Kalamazoo, MI, USA

**Improved Simulations of Astrophysical Plasmas: Computation of New Dielectronic Recombination Data**

Gorczyca, T. W.; Korista, K. T.; Zatsarinny, O.; Badnell, N. R.; Savin, D. W.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 60-61; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-10448; PPA/G/S/1997/00783; NAG5-5261; No Copyright; Avail: CASI; [A01](#), Hardcopy

Here we recap the works of two posters presented at the 2002 NASA Laboratory Astrophysics Workshop. The first was Shortcomings of the R-Matrix Method for Treating Dielectronic Recombination. The second was Computation of Dielectronic Recombination Data for the Oxygen-Like Isoelectronic Sequence.

Author

*Astrophysics; Computerized Simulation; Radiative Recombination; Photoionization; Plasmas (Physics)*

**20030058874** Oak Ridge National Lab., TN, USA

**Laboratory Measurements of Charge Transfer on Atomic Hydrogen at Thermal Energies**

Havener, C. C.; Vane, C. R.; Krause, H. F.; Stancil, P. C.; Mroczkowski, T.; Savin, D. W.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 62-64; In English; See also 20030058868

Contract(s)/Grant(s): DE-AC05-00OR-22725; NASA Order W-10060; No Copyright; Avail: CASI; [A01](#), Hardcopy

We describe our ongoing program to measure velocity dependent charge transfer (CT) cross sections for selected ions on atomic hydrogen using the ion-aloIn merged-beams apparatus at Oak Ridge National Laboratory. Our focus is on those ions for which CT plays an important role in determining the ionization structure, line emission, and thermal structure of observed cosmic photoionized plasmas.

Author

*Charge Transfer; Thermal Energy; Hydrogen Atoms; Astrophysics; Reaction Kinetics*

**20030058876** California Univ., Santa Cruz, CA, USA

**Empirical Near-UV Line Parameters from Hubble Spectroscopy**

Peterson, Ruth C.; Carney, Bruce W.; Dorman, Ben; Green, Elizabeth M.; Landsman, Wayne; Liebert, James; OConnell, Robert W.; Rood, Robert T.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 73-76; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Laboratory astrophysics is critical to our Hubble Treasury program GO-9455, whose goal is to characterize the age and metallicity of old stellar systems. We are calculating from first principles the near-UV spectra for a wide variety of old stars, and coadding these using weights derived from stellar isochrones to model mono-age, mono-metallicity composite systems. However, our calculations do not match near-UV spectra of solar-type stars, for which laboratory identifications of atomic

lines become incomplete. We will continue our empirical pseudo-identifications of these unknown near-UV lines using observed echelle spectra of individual stars. A much better solution would be additional near-UV laboratory identifications for neutral and first-ionized species of iron-peak elements.

Author

*Ultraviolet Astronomy; Ultraviolet Spectra; Hubble Space Telescope; Stellar Systems; Metallicity; Late Stars; Stellar Spectra; Ultraviolet Spectroscopy; Astronomical Spectroscopy*

**20030058877** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

**New Atomic Data for Doubly Ionized Iron Group Atoms by High Resolution UV Fourier Transform Spectroscopy**

Smith, Peter L.; Pickering, Juliet C.; Thorne, A. P.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 89-92; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-4348; No Copyright; Avail: CASI; [A01](#), Hardcopy

Currently available laboratory spectroscopic data of doubly ionized iron-group element were obtained about 50 years ago using spectrographs of modest dispersion, photographic plates, and eye estimates of intensities. The accuracy of the older wavelength data is about 10 mÅngstroms at best, whereas wavelengths are now needed to an accuracy of 1 part in 10(exp 6) to 10(exp 7) (0.2 to 2 mÅngstroms at 2000 Ångstroms). The Fourier transform (FT) spectroscopy group at Imperial College, London, and collaborators at the Harvard College Observatory have used a unique VUV FT spectrometer in a program focussed on improving knowledge of spectra of many neutral and singly and doubly ionized, astrophysically important, iron group elements. Spectra of Fe II and Fe III have been recorded at UV and VUV wavelengths with signal-to-noise ratios of several hundred for the stronger lines. Wavelengths and energy levels for Fe III are an order of magnitude more accurate than previous work; analysis is close to completion. f-values for Fe II have been published.

Author

*Fourier Transformation; Iron; Ultraviolet Spectroscopy; High Resolution; Ionization; Atomic Energy Levels*

**20030058878** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Measurement of Metastable Lifetimes of Highly-Charged Ions**

Smith, Steven J.; Chutjian, A.; Lozano, J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 93-95; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The present work is part of a series of measurements of metastable lifetimes of highly-charged ions (HCIs) which contribute to optical absorption, emission and energy balance in the Interstellar Medium (ISM), stellar atmospheres, etc. Measurements were carried out using the 14-GHz electron cyclotron resonance ion source (ECRIS) at the JPL HCI facility. The ECR provides useful currents of charge states such as C(sup(1-6)+), Mg(sup(1-6)+) and Fe(sup(1-17)+). In this work the HCI beam is focused into a Kingdon electrostatic ion trap for measuring lifetimes via optical decays.

Derived from text

*Electron Cyclotron Resonance; Ion Sources; Metastable State; Positive Ions; Particle Decay*

**20030058879** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

**Missing Pieces in Our Understanding of Astrochemistry: The Answers are in the Lab**

Bergin, Edwin A.; Melnick, Gary J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 109-112; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Recent SWAS results demonstrate the importance of including gas-grain interactions for interstellar chemistry. This paper highlights areas where lab astrophysics can greatly increase our understanding of astrochemistry.

Author

*Astrophysics; Interstellar Chemistry; Interstellar Matter; Abundance*

**20030058881** NASA Ames Research Center, Moffett Field, CA, USA

**Near Infrared Emission of Highly Electronically Excited CO: A Sensitive Probe to Study the Interstellar Medium??**

Gudipati, Murthy S.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 124-127; In English; See also 20030058868

Contract(s)/Grant(s): NASA-UMD-CP1131; NSF 99-10914; No Copyright; Avail: CASI; [A01](#), Hardcopy

Among the various spectroscopic features of the second most abundant molecule in the space, CO, 'the triplet - triplet transitions involving the lowest triplet state a(sup 3)II and the higher-lying a(sup 1)3 SIGMA (sup +), d(sup 3) (DELTA), e (sup 3) SIGMA (sup -) states spanning near-UV to mid-IR spectral range' have so far not been explored in astrophysical

observations. The energies of these transitions are highly sensitive to the surroundings in which CO exists, i.e. gas-phase, polar or non-polar condensed phase. It is proposed here that these triplet-triplet emission/absorption bands can be used as a sensitive probe to investigate the local environments of CO, whether in the planetary atmosphere, stellar atmosphere or interstellar medium.

Author

*Interstellar Matter; Near Infrared Radiation; Excitation; Carbon Monoxide; Astrophysics; Electron States*

**20030058882** Ohio State Univ., Columbus, OH, USA

#### **The Submillimeter-wave Rotational Spectra of Interstellar Molecules**

Herbst, Eric; DeLucia, Frank C.; Butler, R. A. H.; Winnewisser, M.; Winnewisser, G.; Fuchs, U.; Groner, P.; Sastry, K. V. L. N.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 128-130; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

We discuss past and recent progress in our long-term laboratory program concerning the submillimeter-wave rotational spectroscopy of known and likely interstellar molecules, especially those associated with regions of high-mass star formation. Our program on the use of spectroscopy to study rotationally inelastic collisions of interstellar interest is also briefly mentioned.

Author

*Interstellar Matter; Rotational Spectra; Submillimeter Waves; Molecular Spectroscopy; Spectroscopic Analysis; Organic Compounds*

**20030058887** Max-Planck-Inst. fuer Astronomie, Heidelberg, Germany

#### **Nanoparticles in Space and the Laboratory**

Henning, Th.; Mutschke, H.; Schlemmer, S.; Gerlich, D.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 175-179; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Nanoparticles provide the largest fraction of solid surface in the interstellar medium. They are therefore of great importance as catalytic sites for chemical reactions. The very small grains have unique optical and radiation properties which deviate from those of bulk materials. This paper reviews observational evidence for such particles and summarizes the necessary step to produce and characterize astronomically relevant materials in the laboratory.

Author

*Interstellar Matter; Nanoparticles; Laboratories; Astrophysics*

**20030058888** NASA Ames Research Center, Moffett Field, CA, USA

#### **The Laboratory Production of Complex Organic Molecules in Simulated Interstellar Ices**

Dworkin, J. P.; Sandford, S. A.; Bernstein, M. P.; Allamandola, L. J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 198-200; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Much of the volatiles in interstellar dense clouds exist in ices surrounding dust grains. Their low temperatures preclude most chemical reactions, but ionizing radiation can drive reactions that produce a suite of new species, many of which are complex organics. The Astrochemistry Lab at NASA Ames studies the UV radiation processing of interstellar ice analogs to better identify the resulting products and establish links between interstellar chemistry, the organics in meteorites, and the origin of life on Earth. Once identified, the spectral properties of the products can be quantified to assist with the search for these species in space. Of particular interest are findings that UV irradiation of interstellar ice analogs produces molecules of importance in current living organisms, including quinones, amphiphiles, and amino acids.

Author

*Volatile Organic Compounds; Laboratories; Astrophysics; Space Environment Simulation; Interstellar Matter; Ice*

**20030058889** NASA Johnson Space Center, Houston, TX, USA

#### **Synchrotron FTIR Examination of Interplanetary Dust Particles: An Effort to Determine the Compounds and Minerals in Interstellar and Circumstellar Dust**

Flynn, G. J.; Keller, L. P.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 201-203; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-4843; RTOP 344-31-40-07; No Copyright; Avail: CASI; [A01](#), Hardcopy

Some interplanetary dust particles (IDPs), collected by NASA from the Earth's stratosphere, are the most primitive extraterrestrial material available for laboratory analysis. Many exhibit isotopic anomalies in H, N, and O, suggesting they



contain preserved interstellar matter. We report the preliminary results of a comparison of the infrared absorption spectra of subunits of the IDPs with astronomical spectra of interstellar grains.

Author

*Interplanetary Dust; Interstellar Chemistry; Chemical Analysis; Isotopes; Infrared Spectra; Absorption Spectra*

**20030058890** Leiden Univ., Netherlands

**Production of Organic Matter While Simulating the Interstellar Dust Environment**

Schutte, W. A.; Caro, G. M. Munoz; Meierhenrich, U. J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 217-219; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

We review the recent detections of amino acids following the recreation of the conditions on interstellar grains in the laboratory.

Author

*Organic Materials; Cosmic Dust; Space Environment Simulation*

**20030058892** Syracuse Univ., NY, USA

**Investigations of the Formation of Molecular Hydrogen on Dust Grain Analogues**

Vidali, Gianfranco; Roser, Joseph E.; Manico, Giulio; Pirronello, Valerio; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 224-228; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-6822; NAG5-9093; IM-21043088; No Copyright; Avail: CASI; [A01](#), Hardcopy

In the last four years we have been working to investigate the formation of molecular hydrogen on surfaces of materials of astrophysical interest, such as silicates, carbonaceous particles and ices, and in conditions approximating the ones present in a variety of astrophysical environments. Our experimental studies - the first of their kind and complemented with computer simulations and theoretical analyses - have given not only hydrogen recombination rates under different ISM conditions, but they have also offered new insights into this fundamental astrophysical problem. Here we summarize our experimental methods and most significant results.

Author

*Hydrogen Recombinations; Computerized Simulation; Cosmic Dust; Particles; Space Environment Simulation*

**20030058893** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Laboratory Studies of the X-ray Emission Produced by the Interaction of Solar Wind Heavy Ions with Comets**

Beiersdorfer, P.; Chen, H.; May, M.; Thorn, D.; Boyce, K. R.; Brown, G. V.; Kelley, R. L.; Porter, F. S.; Stahle, C. K.; Szymkowiak, A. E., et al.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 235-237; In English; See also 20030058868

Contract(s)/Grant(s): NASA Order W-19938; W-7405-Eng-48; No Copyright; Avail: CASI; [A01](#), Hardcopy

The process of X-ray emission following charge exchange between solar wind heavy ions and cometary gases is studied in the laboratory. The emission is recorded with the spare ASTRO-E 6x6 microcalorimeter array. The microcalorimeter affords a resolution of better than 10 eV in the range of X-ray energies of interest and thus individual emission lines can be resolved. Our present measurements focus on the most abundant K-shell heavy ions found in the solar wind. In particular, we measure the K-shell emission of bare C, N, O, and Ne, and their hydrogenlike counter parts interacting with such gases as CO<sub>2</sub>, N<sub>2</sub>, and CH<sub>4</sub>. Several results are noted that had not been considered in the early cometary X-ray models.

Author

*Comets; Heavy Ions; Solar Wind; X Ray Astronomy; Interplanetary Gas*

**20030058895** Lawrence Livermore National Lab., Livermore, CA, USA

**Submillimeter Spectra of Low Temperature Gases and Mixtures**

Wishnow, E. H.; Gush, H. P.; Halpern, M.; Ozier, I.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 260-263; In English; See also 20030058868

Contract(s)/Grant(s): W-7405-eng-48; No Copyright; Avail: CASI; [A01](#), Hardcopy

Submillimeter absorption spectra of nitrogen, nitrogen-argon mixtures, and methane have been measured using temperatures and pressures near to those found in the atmospheres of Titan and Saturn. The experiments show the spectral signature of dimers which will likely appear in far-infrared spectra of Titan that will be obtained by the Composite Infrared Spectrometer (CIS) onboard the Cassini spacecraft. The recent CIRS spectrum of Jupiter shows far-infrared spectral lines of methane and the corresponding lines are observed in the laboratory. We are extending this work to lower frequencies using

a new differential Michelson interferometer that operates over the frequency region 3-30 1/cm..

Author

*Absorption Spectra; Line Spectra; Spectral Signatures; Michelson Interferometers; Planetary Atmospheres; Dimers*

**20030058896** Colorado Univ., Boulder, CO, USA

**The Hubble Space Telescope and Laboratory Astrophysics**

Snow, Theodore P.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 267-270; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Users of the Hubble Space Telescope, particularly the spectrographs, have relied heavily on laboratory measurements in analyzing their data. Conversely, the HST has provided data to constrain or derive basic atomic and molecular parameters, thus supporting and supplementing laboratory astrophysics. This paper provides an overview of the interaction between the HST and laboratory astrophysics, and summarizes some areas where further lab data are needed in support of HST research.

Author

*Hubble Space Telescope; Spectrographs; Astrophysics*

**20030058897** Georgia State Univ., Atlanta, GA, USA

**Interchannel Coupling in the Photoionization of Atoms and Ions in the X-Ray Range**

Manson, Steven T.; Chakraborty, Himadri S.; Deshmukh, Pranawa C.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 70-72; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

To understand how this interchannel coupling, so important in neutral atoms, applies to positive ions, a research program has been initiated to deal with this question, i.e., a program to quantify the effects of interchannel coupling in ionic photoionization, thereby assessing existing photoionization data bases in the x-ray region. To accomplish this task, we have employed the Relativistic Random-Phase-Approximation (RRPA) methodology which includes significant aspects of electron-electron correlation, including interchannel coupling. The RRPA methodology has been found to produce excellent agreement with experiment for neutral Ne at photon energies in the 1 keV range.

Derived from text

*Photoionization; Astronomical Models; Ionization Cross Sections; Electron Scattering; Photon-Electron Interaction; Coulomb Collisions; Coupling*

**20030058902** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Laboratory Study of the Diagnostic Utility of the 3C/3D Line Ratio in Fe XVII**

Brown, G. V.; Beiersdorfer, P.; Chen, H.; Chen, M., II; Reed, K. J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 35-37; In English; See also 20030058868

Contract(s)/Grant(s): NASA Order S-03958-G; W-7405-Eng-48; No Copyright; Avail: CASI; [A01](#), Hardcopy

Fe XVII X-ray emission is present in a multitude of sources, such as the corona of the Sun, Capella, and Procyon. Two of the strongest lines observed in these spectra are the resonance and intercombination lines located at 15.01 and 15.26 Å, respectively. As part of the laboratory astrophysics program at the electron beam ion traps EBIT-I & EBIT-II located at the Lawrence Livermore National Laboratory we have measured this line ratio for the case where the relative abundance of Fe XVI to Fe XVII is approx. 1. Our results show that an Fe XVI innershell satellite line coincides with the intercombination line and can significantly reduce the relative intensity, R, of the resonance to intercombination line. The fact that the apparent relative intensity of the resonance and intercombination line in Fe XVII is sensitive to the strength of an Fe XVI innershell satellite, and therefore, the relative abundance of Fe XVI to Fe XVII, makes the line ratio a diagnostic of temperature, and explains the anomalously low ratios observed in the solar and stellar coronae.

Author

*X Ray Astronomy; Iron; Atomic Spectra; Atomic Energy Levels; Astronomical Spectroscopy; X Ray Spectra; Emission Spectra*

**20030058903** NASA Goddard Space Flight Center, Greenbelt, MD, USA

**Laboratory Astrophysics at the LLNL Electron Beam Ion Traps: EBIT-I and EBIT-II**

Brown, G. V.; Boyce, K. R.; Kelley, R. L.; Porter, F. S.; Stahle, C. K.; Szymkowiak, A. E.; Tillotson, W.; Beiersdorfer, P.; Chen, H.; May, M. J., et al.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 38-41; In English; See also 20030058868

Contract(s)/Grant(s): NASA Order S-03958-G; W-7405-eng-48; No Copyright; Avail: CASI; [A01](#), Hardcopy

In order to provide a complete, accurate set of atomic data for interpreting spectra provided by missions such as

XMM-Newton, the Chandra X-Ray Observatory, and Astro-E2, we have harnessed the Lawrence Livermore National Laboratory's electron beam ion traps EBIT-I, EBIT-II, and Super-EBIT for laboratory astrophysics. In support of this work we have developed a number of unique techniques, including the ability to experimentally simulate a Maxwellian distribution of electron energies and measuring low-energy charge exchange cross sections using the magnetic trapping mode. We have also built and operated a full suite of spectrometers spanning the 1-7000 Angstrom wavelength band, the most recent being a spectrometer based on a spare Astro-E (6 x 6) microcalorimeter array. Results of our efforts include a complete list of wavelengths of the Fe L-shell transitions, measurements of absolute and relative cross sections for direct impact, dielectronic, and resonance excitation, and measurements of low energy charge transfer reactions. A brief overview of the LLNL ebit facility, its capabilities, and some results will be discussed.

Author

*Atomic Spectra; Charge Exchange; Electron Energy; Ion Traps (Instrumentation); Research Facilities; Ion Beams; Traps*

**20030058904** NASA, Washington, DC, USA

**NASA's Laboratory Astrophysics Workshop: Opening Remarks**

Hasan, Hashima; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 15-16; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The Astronomy and Physics Division at NASA Headquarters has an active and vibrant program in Laboratory Astrophysics. The objective of the program is to provide the spectroscopic data required by observers to analyze data from NASA space astronomy missions. The program also supports theoretical investigations to provide those spectroscopic parameters that cannot be obtained in the laboratory; simulate space environment to understand formation of certain molecules, dust grains and ices; and production of critically compiled databases of spectroscopic parameters. NASA annually solicits proposals, and utilizes the peer review process to select meritorious investigations for funding. As the mission of NASA evolves, new missions are launched, and old ones are terminated, the Laboratory Astrophysics program needs to evolve accordingly. Consequently, it is advantageous for NASA and the astronomical community to periodically conduct a dialog to assess the status of the program. This Workshop provides a forum for producers and users of laboratory data to get together and understand each others needs and limitations. A multi-wavelength approach enables a cross fertilization of ideas across wavelength bands.

Author

*Astrophysics; Laboratories; NASA Programs; Astronomical Spectroscopy; Space Missions; Astronomy*

**20030058910** Columbia Univ., New York, NY, USA

**Ion Storage Ring Measurements of Low Temperature Dielectronic Recombination Rate Coefficients for Modeling X-Ray Photoionized Cosmic Plasmas**

Savin, D. W.; Gwinner, G.; Schwalm, D.; Wolf, A.; Mueller, A.; Schippers, S.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 83-84; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Low temperature dielectronic recombination (DR) is the dominant recombination mechanism for most ions in X-ray photoionized cosmic plasmas. Reliably modeling and interpreting spectra from these plasmas requires accurate low temperature DR rate Coefficients. Of particular importance are the DR rate coefficients for the iron L-shell ions (Fe XVII-Fe XXIV). These ions are predicted to play an important role in determining the thermal structure and line emission of X-ray photoionized plasmas, which form in the media surrounding accretion powered sources such as X-ray binaries (XRBS), active galactic nuclei (AGN), and cataclysmic variables (Savin et al., 2000). The need for reliable DR data of iron L-shell ions has become particularly urgent after the launches of Chandra and XMM-Newton. These satellites are now providing high-resolution X-ray spectra from a wide range of X-ray photoionized sources. Interpreting the spectra from these sources requires reliable DR rate coefficients. However, at the temperatures relevant, for X-ray photoionized plasmas, existing theoretical DR rate coefficients can differ from one another by factors of two to orders of magnitudes.

Author

*Cosmic Plasma; Electron-Ion Recombination; Low Temperature; Photoionization; Recombination Coefficient; Storage Rings (Particle Accelerators); X Ray Sources*

**20030058912** Georgia Univ., Athens, GA, USA

**Charge Transfer Calculations and Database for Astrophysics**

Wang, J. G.; Stancil, P. C.; Rakovic, M.; Schultz, D. R.; Zygelman, B.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 101-103; In English; See also 20030058868

Contract(s)/Grant(s): DE-AC05-00OR-22725; NAG5-9088; No Copyright; Avail: CASI; [A01](#), Hardcopy

A variety of theoretical approaches, having different but overlapping energy ranges of applicability, are applied to investigate charge transfer processes for collisions of atomic ions with atoms and molecules. The methods include quantum molecular-orbital close-coupling, classical trajectory Monte Carlo, and continuum distorted wave methods. Recent collision systems studied include  $S(+4) + H$ ,  $S(+4) + He$ ,  $N(+7) + He$ ,  $H_2O$ ,  $CO$ , and  $CO_2$ ,  $O(+q)(q = 1 - 8) + H$ ,  $H_2$ , and  $S(+q)(q = 1 - 16) + H_2$ . The database effort is concentrating on astrophysically important reactions of atomic ions  $X(+q)(X=H-Zn, q=1-4$ , and selected higher charges) with  $H$ ,  $He$ , various metal atoms,  $H_2$ , and other selected molecular targets. Existing data, much of it produced by us, has been compiled and critically evaluated. Data for many reactions missing in the literature are estimated using the multichannel Landau-Zener approximation. Fits to cross sections and rate coefficients using standard functions are provided as well as tabulations of the raw data. The database is available on the World Wide Web at [cfadc.phy.ornl.gov/astro/ps/data](http://cfadc.phy.ornl.gov/astro/ps/data).

Author

*Data Bases; Charge Exchange; Ion Atom Interactions*

**20030058914** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Laboratory Measurements of Solar-Wind/Comet X-Ray Emission and Charge Exchange Cross Sections**

Chutjian, A.; Cadez, I.; Greenwood, J. B.; Mawhorter, R. J.; Smith, S. J.; Lozano, J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 117-119; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The detection of X-rays from comets such as Hyakutake, Hale-Bopp, d Arrest, and Linear as they approach the Sun has been unexpected and exciting. This phenomenon, moreover, should be quite general, occurring wherever a fast solar or stellar wind interacts with neutrals in a comet, a planetary atmosphere, or a circumstellar cloud. The process is,  $O(+8) + H_2O \rightarrow O(+7^*) + H_2O(+)$ , where the excited  $O(+7^*)$  ions are the source of the X-ray emissions. Detailed modeling has been carried out of X-ray emissions in charge-transfer collisions of heavy solar-wind Highly Charged Ions (HCIs) and interstellar/interplanetary neutral clouds. In the interplanetary medium the solar wind ions, including protons, can charge exchange with interstellar  $H$  and  $He$ . This can give rise to a soft X-ray background that could be correlated with the long-term enhancements seen in the low-energy X-ray spectrum of ROSAT. Approximately 40% of the soft X-ray background detected by Exosat, ROSAT, Chandra, etc. is due to Charge Exchange (CXE): our whole heliosphere is glowing in the soft X-ray due to CXE.

Author

*Charge Exchange; Cometary Atmospheres; Solar Wind; X Ray Spectra; Ion Emission; Cross Sections*

**20030058917** NASA Ames Research Center, Moffett Field, CA, USA

**Infrared Spectroscopy of Matrix-Isolated Polycyclic Aromatic Nitrogen Heterocycles (PANHs)**

Mattioda, A. L.; Hudgins, D. M.; Bauschlicher, C. W.; Allamandola, L. J.; Biemesderfer, C. D.; Rosi, M.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 135-137; In English; See also 20030058868  
Contract(s)/Grant(s): 188-44-57-01; 399-20-01-05; No Copyright; Avail: CASI; [A01](#), Hardcopy

The mid-infrared spectra of the nitrogen-containing heterocyclic polycyclic aromatic compounds 1-azabenz[a]-anthracene; 2-azabenz[a]anthracene; 1-azachrysene; 2-azachrysene; 4-azachrysene; 2-azapyrene, and 7,8 benzoquinoline in their neutral and cation forms were investigated. The spectra of these species isolated in an argon matrix have been measured. Band frequencies and intensities were tabulated and these data compared with spectra computed using density functional theory at the B3LYP level. The overall agreement between experiment and theory is quite good, in keeping with earlier results on homonuclear polycyclic aromatic hydrocarbons. The differences between the spectral properties of nitrogen bearing aromatics and non-substituted, neutral polycyclic aromatic hydrocarbons will be discussed.

Author

*Heterocyclic Compounds; Infrared Spectroscopy; Polycyclic Aromatic Hydrocarbons; Nitrogen Compounds*

**20030058919** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, USA

**Laboratory Astrophysics Needs of the Herschel Space Observatory**

Pearson, J. C.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 141-144; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The science teams of the Herschel Space Observatory have identified a number of areas where laboratory study is required for proper interpretation of Herschel observational data. The most critical is the collection and compilation of laboratory data on spectral line frequencies, transition probabilities and energy levels for the known astrophysical atomic and molecular species in 670 to 57 micron wavelength range of Herschel. The second most critical need is the compilation of collisional

excitation cross sections for the species known to dominate the energy balance in the ISM and the temperature dependent chemical reaction rates. On the theoretical front, chemical and radiative transfer models need to be prepared in advance to assess calibration and identify instrument anomalies. In the next few years there will be a need to incorporate spectroscopists and theoretical chemists into teams of astronomers so that the spectroscopic surveys planned can be properly calibrated and rapidly interpreted once the data becomes available. The science teams have also noted that the enormous prospects for molecular discovery will be greatly handicapped by the nearly complete lack of spectroscopic data for anything not already well known in the ISM. As a minimum, molecular species predicted to exist by chemical models should be subjected to detailed laboratory study to ensure conclusive detections. This has the greatest impact on any astrobiology program that might be proposed for Herschel. Without a significant amount of laboratory work in the very near future Herschel will not be prepared for many planned observations, much less addressing the open questions in molecular astrophysics.

Author

*Spectroscopy; Astrophysics; Atmospheric Chemistry; Astronomical Observatories*

**20030058920** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

**UV photoabsorption cross sections of CO, N<sub>2</sub>, and SO<sub>2</sub> for studies of the ISM and planetary atmospheres**

Smith, Peter L.; Rufus, J.; Yoshino, K.; Parkinson, W. H.; Stark, Glenn; Pickering, Juliet C.; Thorne, A. P.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 158-161; In English; See also 20030058868

Contract(s)/Grant(s): NAG5-4348; NAG5-9059; No Copyright; Avail: CASI; [A01](#), Hardcopy

We report high-resolution laboratory measurements of photoabsorption cross sections of CO, N<sub>2</sub>, and SO<sub>2</sub> in the wavelength range 80 to 320 nm. The motivation is to provide the quantitative data that are needed to analyze observations of absorption by, and to model photochemical processes in, the interstellar medium and a number of planetary atmospheres. Because of the high resolution of the spectrometers used, we can minimize distortion of the spectrum that occurs when instrument widths are greater than the widths of spectral features being measured. In many cases, we can determine oscillator strengths of individual rotational lines - a unique feature of our work.

Author

*Ultraviolet Absorption; Photoabsorption; Cross Sections; Planetary Atmospheres; Interstellar Matter; Interstellar Chemistry*

**20030058921** Florida Univ., Gainesville, FL, USA

**Dehydrogenated Neutral PAH Radicals as Carriers of the DIBs? Spectroscopy of the Fluorene-like C<sub>13</sub>H<sub>9</sub> Radical**

Vala, Martin; Szczepanski, Jan; Banisaukas, John; Hirata, So; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 162-164; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Polycyclic aromatic hydrocarbons (PAHs), in their neutral, ionized, hydrogenated and dehydrogenated forms, have been proposed as possible carriers of the diffuse interstellar absorption bands (DIBs) and the unidentified infrared emission (UIR) bands. In this work, we suggest that a dehydrogenated PAH could be responsible for one of the DIBs. It is general knowledge that neutral PAHs, upon ionization, shift their optical absorption bands to lower energy. We point out here that certain neutral PAHs may also shift their electronic transitions to the red when dehydrogenated. In particular, we show that when fluorene (C<sub>13</sub>H<sub>10</sub>) loses one hydrogen, its optical absorption shifts to the red and appears in the vicinity of a strong DIB band.

Author

*Polycyclic Aromatic Hydrocarbons; Diffuse Interstellar Bands; Dehydrogenation*

**20030058922** NASA Marshall Space Flight Center, Huntsville, AL, USA

**Laboratory Studies of the Optical Properties and Condensation Processes of Cosmic Dust Grains**

Abbas, M. M.; Craven, P. D.; Spann, J. F.; Tankosic, D.; LeClair, A.; West, E.; Sheldon, R.; Witherow, W. K.; Gallagher, D. L.; Adrian, M. L., et al.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 180-184; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

A laboratory facility for conducting a variety of experiments on single isolated dust particles of astrophysical interest levitated in an electrostatics balance has been developed at NASA/Marshall Space Flight Center. The objective of the research is to employ this experimental technique for studies of the physical and optical properties of individual cosmic dust grains of 0.1-100 micron size in controlled pressure/temperature environments simulating astrophysical conditions. The physical and optical properties of the analogs of interstellar and interplanetary dust grains of known composition and size distribution will be investigated by this facility. In particular, we will carry out three classes of experiments to study the micro-physics of cosmic dust grains. (1) Charge characteristics of micron size single dust grains to determine the photoelectric efficiencies, yields, and equilibrium potentials when exposed to UV radiation. (2) Infrared optical properties of dust particles

(extinction coefficients and scattering phase functions) in the 1-30 micron region using infrared diode lasers and measuring the scattered radiation. (3) Condensation experiments to investigate the condensation of volatile gases on colder nucleated particles in dense interstellar clouds and lower planetary atmospheres. The condensation experiments will involve levitated nucleus dust grains of known composition and initial mass (or m/q ratio), cooled to a temperature and pressure (or scaled pressure) simulating the astrophysical conditions, and injection of a volatile gas at a higher temperature from a controlled port. The increase in the mass due to condensation on the particle will be monitored as a function of the dust particle temperature and the partial pressure of the injected volatile gas. The measured data will permit determination of the sticking coefficients of volatile gases and growth rates of dust particles of astrophysical interest. Some preliminary results based on measurements of photoelectric emission and radiation pressure on single isolated 0.2 to 6.6 micron size silica particles exposed to UV radiation at 120-200 nm and green laser light at 532 nm are presented.

Author

*Cosmic Dust; Laboratories; Particles; Physical Properties; Optical Properties; Condensing; Space Environment Simulation; Size Distribution*

**20030058925** Nottingham Univ., UK

### **Laboratory Surface Science: The Key to the Gas-Grain Interaction**

Collings, M. P.; Dever, J. W.; Fraser, H. J.; McCoustra, M. R. S.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 192-197; In English; See also 20030058868; No Copyright; Avail: CASI; [A02](#), Hardcopy

It is widely recognized by the astronomical community that understanding the chemical processing of molecular gas clouds is the key to understanding aspects of the physics of star formation, and possibly to understanding the origin of life itself. Central to this is the recognition that physical and chemical processes occurring at the surfaces of interstellar grains are crucially important. Grains provide surfaces upon which a variety of reactions occur, and allow condensation of ices which, when irradiated by photons and cosmic rays, are chemical nanofactories in which more complex molecules are synthesized. The basis of this chemistry is the adsorption and desorption of atoms and molecules from the grains themselves, under both reactive and non-reactive conditions. As a field of research, surface science has existed for some forty years, since the development of vacuum technology sufficient to achieve ultrahigh vacuum (UHV) conditions. One of the main forces driving the field has been the study of heterogeneous catalysis for industrially important reactions. In such research, a reductionist approach is required - an extremely complex system is simplified to a level where parameters can be controlled and varied individually. The behavior of the complex system is then understood through a knowledge of the behavior of the system's many components. In some respects, interstellar ices are not dissimilar systems to those involved in heterogeneous catalysis. They are complex mixtures with a composition and structure that is variable and not yet fully characterized. The chemistry that occurs within such ices and on its surface, while perhaps not strictly heterogeneous catalysis, can most readily be studied by reducing the ice matrix to a controlled and simplified system. The conditions of low temperature and pressure in the ISM make interstellar ice analogues ideally suited for study in a cryogenic UHV apparatus using existing surface science techniques. Indeed, the value of surface science to the study of these aspects of astrophysics has been recognized. Of forty eight articles in a recent volume the journal *Surface Science*, which was dedicated to a review of the future directions of the field, three dealt with astrophysical applications. It is well known from laboratory studies that water ice can exist in a number of phases under conditions of low temperature and pressure. Water adsorbed at temperatures prevalent in most molecular clouds (less than 30K) will form a high density amorphous phase, which has a highly porous structure. When this phase is heated, a transition to less porous, low density amorphous phase, I(sub hda), occurs gradually over the 32 approx. 80K temperature range. Water ice adsorbed in this temperature range will also show a graduated mixture of the two phases. At higher temperatures, the I(sub lda) phase crystallizes to a cubic structure, I(sub c) which, under conditions applied in our laboratory, occurs near to 140K.

Author

*Molecular Clouds; Interstellar Gas; Adsorption; Desorption; Ultrahigh Vacuum; Catalysis; Ice; Chemical Reactions*

**20030058926** NASA Goddard Space Flight Center, Greenbelt, MD, USA

### **Nature of the Organic Signature in Dust from the Interstellar Medium: Laboratory Analog Studies**

Freund, M. M.; Freund, F. T.; Staple, A.; Scoville, J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 204-207; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

We measured the infrared (IR) nu(sub CH) absorption bands around 3.4 microns (2800 - 3000 cm(sup -1)) in large laboratory-grown magnesium oxide (MgO) and natural olivine single crystals that crystallized from CO/CO2/H2O saturated melts. These bands are very similar to those from many astronomical sources, such as from dust in the diffuse interstellar medium (ISM), from the outflow of evolved stars, etc., and they are characteristic of aliphatic -CH2- and -CH3 entities. In

our laboratory single crystals the VCH bands arise from C-H entities that were introduced by a solid solution process, and that are imbedded in the mineral matrix in form of polyatomic C(sub n) entities with C atoms bonded to O and to H. Heating breaks the C-H bonds, causing hydrogen to disperse in the mineral matrix. C-H bonds are re-established rapidly during annealing. We propose that dust grains probably contain the same type of internal C(sub n)-H entities in solid matrix rather than an external organic layer covering the grain surfaces. Thermodynamical arguments show that the concentration of organics in solid solution in small grains can be comparable to that found in astronomical environments.

Author

*Cosmic Dust; Absorption Spectra; Infrared Absorption; Infrared Spectra; Signatures; Magnesium Oxides; Olivine; Single Crystals; Crystallization*

**20030058927** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Synthesis of HCN and HNC in Ion-Irradiated N<sub>2</sub>-Rich Ices**

Moore, M. H.; Hudson, R. L.; Ferrante, R. F.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 208-212; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Near-IR observations reveal that N<sub>2</sub>-rich ice containing small amounts of CH<sub>4</sub>, and CO, is abundant on the surfaces of Triton, a moon of Neptune, and Pluto. N<sub>2</sub>-rich ices may also exist, in interstellar environments. To investigate the radiation chemistry of such ices we performed a systematic IR study of ion-irradiated N<sub>2</sub>-rich mixtures containing CH<sub>4</sub> and CO. Irradiation of N<sub>2</sub> + CH<sub>4</sub> mixtures at 12 K, showed that HCN, HNC, diazomethane, and NH<sub>3</sub> were produced. We also found that UV photolysis of these ices produced detectable HCN and HNC. Intrinsic band strengths, A(HCN) and A(HNC), were measured and used to calculate yields of HCN and HNC. Similar results were obtained on irradiation of N<sub>2</sub> + CH<sub>4</sub> + CO ices at 12 K, with the main difference being the formation of HNCO. In all cases we observed changes on warming. For example, when the temperature of irradiated N<sub>2</sub> + CH<sub>4</sub> + CO was raised from 12 to 30 K, HCN, HNC, and HNCO reacted with NH<sub>3</sub>, and OCN-, CN-, N<sub>3</sub>-, and NH<sub>4</sub><sup>+</sup> were produced. These ions, appearing at 30 K, are expected to form and survive on the surfaces of Triton, Pluto, and interstellar grains. Our results have astrobiological implications since some of these radiation products are involved in the syntheses of biomolecules such as amino acids and peptides.

Author

*Hydrocyanic Acid; Ammonia; Methane; Carbon Dioxide; Ice; Nitrogen; Interstellar Matter; Ion Irradiation*

**20030058928** NASA Goddard Space Flight Center, Greenbelt, MD, USA

#### **Condensation Processes in Astrophysical Environments**

Nuth, Joseph A., III; Rietmeijer, Frans J. M.; Hill, Hugh G. M.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 213-216; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Astrophysical systems present an intriguing set of challenges for laboratory chemists. Chemistry occurs in regions considered an excellent vacuum by laboratory standards and at temperatures that would vaporize laboratory equipment. Outflows around Asymptotic Giant Branch (AGB) stars have timescales ranging from seconds to weeks depending on the distance of the region of interest from the star and, on the way significant changes in the state variables are defined. The atmospheres in normal stars may only change significantly on several billion-year timescales. Most laboratory experiments carried out to understand astrophysical processes are not done at conditions that perfectly match the natural suite of state variables or timescales appropriate for natural conditions. Experimenters must make use of simple analog experiments that place limits on the behavior of natural systems, often extrapolating to lower-pressure and/or higher-temperature environments. Nevertheless, we argue that well-conceived experiments will often provide insights into astrophysical processes that are impossible to obtain through models or observations. This is especially true for complex chemical phenomena such as the formation and metamorphism of refractory grains under a range of astrophysical conditions. Data obtained in our laboratory has been surprising in numerous ways, ranging from the composition of the condensates to the thermal evolution of their spectral properties. None of this information could have been predicted from first principals and would not have been credible even if it had.

Author

*Asymptotic Giant Branch Stars; Stellar Activity; Stellar Atmospheres; Astrophysics*

**20030058929** NASA Ames Research Center, Moffett Field, CA, USA

#### **A Solar System Perspective on Laboratory Astrophysics**

Cruikshank, Dale P.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 231-234; In English; See also 20030058868

Contract(s)/Grant(s): RTOP 344-32-20-01-21; No Copyright; Avail: CASI; [A01](#), Hardcopy

Planetary science deals with a wide variety of natural materials in a wide variety of environments. These materials include metals, minerals, ices, gases, plasmas, and organic chemicals. In addition, the newly defined discipline of astrobiology introduces biological materials to planetary science. The environments range from the interiors of planets with megapascal pressures to planetary magnetospheres, encompassing planetary mantles, surfaces, atmospheres, and ionospheres. The interplanetary environment includes magnetic and electrical fields, plasma, and dust. In order to understand planetary processes over these vast ranges, the properties of materials must be known, and most of the necessary information comes from the laboratory. Observations of the bodies and materials in the Solar System are accomplished over the full range of the electromagnetic spectrum by remote sensing from Earth or spacecraft. Comets exemplify this; molecular and atomic identifications are made from the hard ultraviolet to radio wavelengths, while X-rays are emitted as comets interact with the solar wind. Gamma rays from the surfaces of the Moon and asteroids are diagnostic of the mineral and ice content of those bodies; eventually, gamma rays will also be observed by probes to comets. A number of planetary materials are available in the laboratory for extensive study: rocks from the Moon, Mars, several asteroids, as well as dust from comets (and perhaps the Kuiper Belt) are closely studied at every level, including atomic (isotopic). Even pre-solar interstellar grains isolated from meteorites are scrutinized for composition and crystalline structure. Beyond the materials themselves, various agents and processes have altered them over the 4.6-Gy age of the Solar System. Solar radiation, solar wind particles, trapped magnetospheric particles, cosmic rays, and micrometeoroid impacts have produced chemical, physical, and morphological changes in the atmospheres and on the surfaces of all planetary bodies. These processes are not well understood, so studies in a laboratory setting are especially needed.

Author

*Planetary Geology; Astrophysics; Solar System*

**20030058932** Georgia Univ., Athens, GA, USA

**Molecular Line and Continuum Opacities for Modeling of Extrasolar Giant Planet and Cool Stellar Atmospheres**

Weck, P. F.; Schweitzer, A.; Stancil, P. C.; Hauschildt, P. H.; Kirby, K.; Yamaguchi, Y.; Allen, W. D.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 165-167; In English; See also 20030058868

Contract(s)/Grant(s): JPL-961582; NAG5-8425; NAG5-9222; NAG5-10551; NSF AST-97-20704; NSF AST-00-86246; No Copyright; Avail: CASI; A01, Hardcopy

The molecular line and continuum opacities are investigated in the atmospheres of cool stars and Extrasolar Giant Planets (EGPs). Using a combination of ab initio and experimentally derived potential curves and dipole transition moments, accurate data have been calculated for rovibrationally-resolved oscillator strengths and photodissociation cross sections in the B' (sup 2)Sigma+ (left arrow) X (sup 2)Sigma+ and A (sup 2)Pi (left arrow) X (sup 2)Sigma+ band systems in MgH. We also report our progress on the study of the electronic structure of LiCl and FeH.

Author

*Cool Stars; Extrasolar Planets; Astronomical Models; Stellar Atmospheres; Molecular Spectra; Line Spectra*

**20030058936** NASA Ames Research Center, Moffett Field, CA, USA

**Infrared Emission From Interstellar PAHs, New Probes of the Interstellar Medium**

Hudgins, D. M.; Allamandola, L. J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 131-134; In English; See also 20030058868; No Copyright; Avail: CASI; A01, Hardcopy

Tremendous strides have been made in the understanding of interstellar material over the past twenty years thanks to significant, parallel developments in two closely related areas: observational IR astronomy and laboratory astrophysics. Twenty years ago the composition of interstellar dust was largely unknown and the notion of abundant, gas phase, polycyclic aromatic hydrocarbons (PAHs) anywhere in the interstellar medium (ISM) considered impossible. Today the dust composition of the diffuse and dense ISM is reasonably well constrained and the spectroscopic case for interstellar PAHs, impossibly large molecules by early interstellar chemistry standards, is very strong. PAH spectral features are now being used as new probes of the ISM. PAH ionization states reflect the ionization balance of the medium while PAH size and structure reflect the energetic and chemical history of the medium. Aromatic carbon-rich materials ranging in size from PAHs and PAH nanoclusters, to sub-micron and micron-sized dust grains represent an important component of the ISM. These species: (1) dominate the heating and cooling of interstellar clouds via energetic photoelectron ejection and infrared (IR) emission; (2) moderate the ionization balance in photodissociation regions and molecular clouds; (3) moderate the composition of the gas phase and play an important role in determining the chemistry of the ISM; (4) contribute to the interstellar extinction in the near IR, visible, and UV spectral regions; and (5) convert UV, visible, and near-IR radiation to mid- and far-IR radiation in



the ISM and, as such, are responsible for the well known, widespread family of mid-IR emission features with major components near 3.3, 6.2, 7.7, 8.6, and 11.3 microns.

Derived from text

*Astrophysics; Interstellar Chemistry; Interstellar Matter; Polycyclic Aromatic Hydrocarbons; Infrared Astronomy; Emission Spectra*

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### 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*.

**20030057795** Lawrence Livermore National Lab., Livermore, CA

#### **Planetary Interiors: Experimental Constraints**

Nellis, W. J.; Jul. 06, 2001; 22 pp.; In English

Report No.(s): DE2003-15003021; UCRL-JC-144592; No Copyright; Avail: Department of Energy Information Bridge

The most important material to study with respect to giant planets is hydrogen because it has by far the greatest cosmological abundance. The most important pressures and temperatures for hydrogen experiments are pressures of 50 GPa to 1 TPa and temperatures of 1,000 to 30,000 K. This is the region in which fluid hydrogen undergoes a transition from a molecular insulator to a monatomic metal. The purpose of this section is to review the current experimental situation for hydrogen at high pressures and to describe the nature of observed metallic fluid hydrogen. Implications for Jupiter and Saturn will be discussed. Similar statements could be made about giant hydrogen planets now being discovered in other solar systems.

NTIS

*Hydrogen; Jupiter (Planet); Saturn (Planet); Planetary Evolution; Planetary Composition; Planetary Geology*

**20030058900** Columbia Univ., New York, NY, USA

#### **X-ray Spectroscopy and Atomic Data**

Behar, Ehud; Kahn, Steven M.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 23-27; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

The Laboratory Astrophysics program employing the Lawrence Livermore National Laboratory (LLNL) Electron Beam Ion Trap (EBIT) has been providing useful atomic data in support of the X-ray missions Chandra and XMM-Newton. Major achievements have been made for Fe-L ions in hot, collisional plasma, relevant to stellar coronae, supernova remnants, elliptical galaxies, and galaxy clusters. Measurements for L-shell ions of other cosmically important elements are also required, some of which are in the LLNL EBIT pipeline. On the other hand, data for inner-shell excited lines relevant to photoionized plasmas near accretion sources are largely lacking. Even the wavelengths of these lines are only poorly known, which severely limits their use for diagnostics, despite the great potential.

Author

*X Ray Spectroscopy; Electron Beams; Ion Traps (Instrumentation); X Ray Astrophysics Facility; Xmm-Newton Telescope; High Temperature Plasmas; Collisional Plasmas; Ferric Ions*

**20030058933** Alabama Univ., Birmingham, AL, USA

#### **MALDI TOF MS: An Exobiology Surface-Science Approach for Europa**

Gerakines, Perry A.; Wdowiak, Thomas J.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 249-252; In English; See also 20030058868; Original contains black and white illustrations; No Copyright; Avail: CASI; [A01](#), Hardcopy

If Europa is to be of primary exobiological interest, namely as a habitat for extant life, it is obvious that: (i) a hydrosphere must prevail beneath the cryosphere for a long time, (ii) internal energy sources must be present in a sufficient state of activity, and (iii) a reasonable technical means must be available for assessing if indeed life does exist in the hypothesized hydrosphere. This discussion focuses on technological issues, because the compounding evidence about Europa indicates that the first two are highly likely to be true. We present a consideration of time-of-flight mass spectroscopy (TOF MS) conducted in-situ on the cryosphere surface of Europa during a landed robotic mission. We assert that this is a reasonable technical means not only for exploring the composition of the cryosphere itself, but also for locating any biomolecular indicators of extant life brought to the surface through cryosphere activity. We also describe a MALDI (MAtRix Laser Desorption and Ionization) TOF MS

system that we are constructing as a proof-of-concept prototype for conducting TOF MS measurements on Europa.

Author

*Europa; Mass Spectroscopy; Time Of Flight Spectrometers; Cryospheres; Exobiology*

**20030058935** NASA Ames Research Center, Moffett Field, CA, USA

**Cryogenic Reflectance Spectroscopy in Support of Planetary Missions**

Dalton, J. B.; Proceedings of the NASA Laboratory Astrophysics Workshop; November 2002, pp. 241-244; In English; See also 20030058868; No Copyright; Avail: CASI; [A01](#), Hardcopy

Present understanding of planetary composition is based primarily on remotely-sensed data, and in particular upon ultraviolet, visible, and infrared spectroscopy. Spectra acquired by telescopic and spacecraft instruments are compared to laboratory measurements of pure materials in order to identify surface components based on characteristic absorption features. Cryogenic spectral measurements are necessary for the study of worlds beyond the Earth's orbit. While some materials exhibit only small spectral changes as a function of temperature, many others are strongly temperature-dependent. For example, hydrated salts exhibit different spectral behavior under conditions appropriate to Europa than at terrestrial temperatures. The icy satellites of the outer solar system contain significant quantities of volatile ices which do not even exist at standard temperature and pressure (STP). A comprehensive spectral database of ices and minerals covering a wide temperature range will have applications ranging from the study of comets and Kuiper Belt objects to outer planet satellites and the polar regions of Mars. Efforts are presently underway at NASA-Ames to develop capabilities which will contribute to such a database. As spacecraft instruments feature increasing spatial and spectral resolution, appropriate laboratory reference spectra become increasingly critical to accurate interpretation of the spacecraft data.

Author

*Cryogenic Temperature; Reflectance; Astronomical Spectroscopy; Spectrum Analysis; Temperature Dependence*

**20030058944** Lawrence Livermore National Lab., Livermore, CA

**Spectral Astrometry Mission for Planets Detection**

Erskine, D. J.; Edelman, J.; Aug. 09, 2002; 18 pp.; In English

Report No.(s): DE2003-15002780; UCRL-JC-147003; No Copyright; Avail: Department of Energy Information Bridge

The Spectral Astrometry Mission is a space-mission concept that uses simultaneous, multiplestar differential astrometry to measure exo-solar planet masses. The goal of SAM is to measure the reflex motions of hundreds of nearby (approximately 50 pc) F, G and K stars, relative to adjacent stars, with a resolution of 2.5 micro-arcsec. SAM is a new application of Spectral Interferometry (SI), also called Externally Dispersed Interferometry (EDI), that can simultaneously measure the angular difference between the target and multiple reference stars. SI has demonstrated the ability to measure a  $\lambda/20,000$  white-light fringe shift with only  $\lambda/3$  baseline control. SAM's structural stability and compensation requirements are therefore dramatically reduced compared to existing long-arm balanced-arm interferometric astrometry methods. We describe the SAM's mission concept, long-baseline SI astrometry method, and technical challenges to achieving the mission.

NTIS

*Planets; Astrometry; Planetary Systems; Stellar Mass*

**20030059017** Hawaii Univ., Honolulu, HI, USA

**Outer Solar System Nomenclature**

Owen, Tobias C.; Grant, John, Technical Monitor; [2003]; 2 pp.; In English

Contract(s)/Grant(s): NAG5-6829; No Copyright; Avail: CASI; [A01](#), Hardcopy

This grant has supported work by T. Owen and B. A. Smith on planetary and satellite nomenclature, carried out under the general auspices of the International Astronomical Union (IAU). The IAU maintains a Working Group on Planetary and Satellite Nomenclature (WGPSN) whose current chair is Prof. Kaare Aksnes of the Rosseland Institute for Theoretical Astrophysics in Oslo, Norway. Both Owen and Smith are members of the WGPSN; Owen as chair of the Outer Solar System Task Group, and Smith as chair of the Mars Task Group. The major activity during the last grant period (2002) was the approval of several new names for features on Mars by Smith's group and features on Jovian satellites plus new names for satellites of Jupiter, Saturn and Uranus by Owen's group. Much of this work was accomplished by e-mail exchanges, but the new nomenclature was formally discussed and approved at a meeting of the WGPSN held in conjunction with the Division for Planetary Sciences meeting in Birmingham, Alabama in October 2002.

Author

*Nomenclatures; Jupiter Satellites; Planets; Natural Satellites*

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