The Department of Defense

DoD DEPARTMENTS/AGENCIES:

Department of the Army

Department of the Navy

Department of the Air Force

Advanced Research Projects Agency

Defense Nuclear Agency

Strategic Defense Initiative Organization

DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

FY 1992 SBIR SOLICITATION

PHASE I AWARD ABSTRACTS

DARPA, DNA, and SDIO PROJECTS

VOLUME IV

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This report presents the technical abstracts of the Phase I proposals that resulted in contract awards from the Fiscal Year 1992 Solicitations of the Department of Defense (DoD) Small Business Innovation Research (SBIR) Program. The Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA)[1], Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO) are the DoD components of the SBIR Program. Two solicitations inviting small business firms to submit proposals under this program were published in FY92. Navy, Air Force, DARPA[1], DNA, and SDIO participated in Program Solicitation 92.1 (Closing Date: 10 January 1992), and Army, Navy, and DARPA[1] participated in Program Solicitation 92.2 (Closing Date: 1 July 1992). The selection of proposals for funding was made from proposals received by the Military Services and Agencies.

FY 1992 SBIR PROGRAM

	Number of Topics		Proposals Received		Phase I Awards	
	92.1	92.2	92.1	92.2	92.1	92.2
Army	0	177	0	1841	0	260
Navy	106	82	1495	832	127	92
Air Force	181	--	2128	--	229	--
DARPA[1]	129	97	1301	911	105	77
DNA	25	--	172	--	22	--
SDIO	16	--	734	--	209	--
Total	457	356	5,830	3,584	692	429
Grand Total	813		9,414		1,121	

Of the 1,121 Phase I awards, 158 awards went to minority-owned businesses and 95 awards were to woman-owned businesses. Overall, 12 percent of the FY92 SBIR proposals were selected for funding.

In order to make information available on the technical content of the Phase I projects supported by the DoD SBIR Program, four volumes containing the abstracts and contracts for the awarded projects are published. The small business information with accompanying abstract are arranged in alphabetical order by firm name. Cross reference indices appear at the back of the volume for quick reference.

- Volume I contains Army Projects
- Volume II contains Navy Projects
- Volume III contains Air Force Projects
- Volume IV contains DARPA, DNA and SDIO Projects

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the firm whose name and address is shown.

[1] As of March 15, 1993, DARPA changed its name to Advanced Research Projects Agency (ARPA). However, DARPA is used in this publication because the FY92 topics were issued and awards were made under the DARPA name.

In 1982, Congress enacted and the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219), which created the Small Business Innovation Research (SBIR) Program to give small, high-technology firms a greater share of the federally-funded research and development contract awards.

Under the SBIR Program, each federal agency with an extramural budget for research or research and development in excess of $100 million per fiscal year must establish an SBIR Program. The program is funded by setting aside 1.25 percent of the participating agency's extramural R&R&D contracting dollars. The agencies participating in the Department of Defense SBIR Program are the Army, Navy, Air Force, Defense Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), and Strategic Defense Initiative Organization (SDIO).

The objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development.

The SBIR Program consists of three distinct phases. Under Phase I, DoD components make awards to small businesses, typically of up to one man-year of effort over a period of six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. Successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Proposals which identify a follow-on Phase III funding commitment from non-Federal sources will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period of 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and requires a comprehensive proposal outlining the intended effort in detail.

In Phase III, an innovation is brought to the marketplace by private sector investment and support. No SBIR funds may be used in Phase III. Also, under Phase III, DoD may award follow-on contracts with non-SBIR funds for products and processes meeting DoD mission needs.

Proposals received in response to a DoD solicitation are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area. Selections for Phase I are made in accordance with the following criteria:

- The scientific/technical quality of the research proposal and its relevance to the topic description, with special emphasis on its innovation and originality.
- Qualifications of the principal investigator, other key staff, and consultants, if any, and the adequacy of available or obtainable instrumentation and facilities.
- Anticipated benefits of the research to the total DoD research and development effort.
- Adequacy of the Phase I proposed effort to show progress toward demonstrating the feasibility of the concept.

The "Small Business Innovation Act of 1986" (P.L.97-443) extended the "Sunset Clause" to 1993 and increased the taxation of the extramural research and development budget to 1.25 percent. The latest SBIR re-authorization law (P.L. 102-564), signed October 28, 1992, extends the program through 2000, doubles the taxation to 2.5 percent by 1997, and increases the average Phase I and Phase II award agreements.

A & D ASSOC.
C/O KRAFT, 46 WALNUT PLACE
BRIARCLIFF MANOR, NY 10510
Phone: (212) 689-9168
Topic#: 92-023 ID#: 9210475
Office: ASTO
Contract #: DAAH0192CR307
PI: STANLEY FORMAN
Title: Functional Integral Formulation of Threat Avoidance Mission Planning
Abstract: Modern computation techniques such as parallel processing are well-suited for the solution of such problems as the simultaneous global extremization of multiple variables in a complex, nonlinear, probabilistic state space. However, the use of these techniques to solve a given problem requires that it first be formulated in these terms. Currently, threat-avoidance mission planning is approached as a dynamic programming problem, and not as a global extremization problem. Thus, in order to apply modern computing techniques to the real-time determination of evasive maneuvers for an aircraft, or for any other weapons platform, the problem must first be redefined as a global, multi-dimensional extremization problem. We will use the technique of functional integrals to reformulate the threat-avoidance mission planning problem as a global extremization problem in a multi-dimensional, probabilistic state space. The consequences of choosing different threat functions will be evaluated and we will determine the optimal form of the threat function. We will evaluate the operational utility of this approach and we will predict the optimal computation technique for its implementation. Anticipated benefits/potential applications - The problem of threat avoidance is a generic one and the results of this project can be directly applied to weapons platforms other than missiles. For example, the problem of collision avoidance of aircraft is one area where the results can be directly implemented. Also, the analysis can be inverted to determine the optimal guidance algorithm for missiles.

ACCESS DYNAMICS, INC.
1200 N. WHITE SANDS BLVD., SUITE III
ALAMOGORDO, NM 88310
Phone: (505) 437-4003
Topic#: 92-205 ID#: 9220396
Office: SSTO
Contract #: DAAH0193CR017
PI: STEPHEN COLLEY
Title: Scalable Direct Access Frame Buffer
Abstract: Current frame buffer technology is not optimized for use with general purpose processors. This proposal is for a program to develop a breadboard frame buffer which is efficiently accessed by such processors. The frame buffer is based on the VME bus and is scalable to large amounts of image memory and very fast image acquisition rates. All image data is randomly accessible at high speed. Anticipated benefits: The research will provide a practical and cost effective frame buffer which will allow cost effective general purpose processors to be used efficiently in image processing. The frame buffer will support new large format and high frame rate cameras and image sources.

ACCUWAVE CORP.
1653 19TH STREET
SANTA MONICA, CA 90404
Phone: (310) 449-5540
Topic#: 92-041 ID#: 9211247
Office: DSO
Contract #: DAAH0192CR308
PI: GEORGE RAKULJIC
Title: A 3-D Optical Memory Using Photorefractive Crystals and the Orthogonal Data Storage Technique
Abstract: Recent work in volume holography has led to the discovery of the orthogonal data storage technique. This method of holographic data recording reduces the crosstalk between channels by storing many wavelength multiplexed images in a particularly effective use of k-space. Further reduction in crosstalk is observed in holograms stored in certain photorefractive crystals using the counter-propagating geometry of orthogonal data storage because of self-induced sidelobe suppression. Permanent data storage and room temperature operation is also possible with these crystals. Thus, the purpose of the work outlined in this proposal is to identify and characterize which photorefractive crystals are best suited for use with the orthogonal data storage method in a crosstalk-free, 3D optical memory. Anticipated benefits/potential applications - Success in this research project could lead to the development of very large storage capacity, fast access 3D optical memories for use with ultra-fast computers, parallel processors, imaging equipment, and video displays. Commercial application of such devices could range from digital HDTV video recorders for the home to massive computer data storage banks for industry.

ADIABATICS, INC.
3385 COMMERCE DRIVE
COLUMBUS, IN 47201
Topic#: 92-094 ID#: 9211032
Office: MICOM
Contract #: DAAH0192CR261

Phone: (812) 372-5052 PI: PATRICK BADGLEY
Title: Novel - Low Noise, Lightweight, 30 Kw APU
Abstract: Adiabatics, Inc. is pleased to propose a research program to develop a novel "compact, minimum noise, auxiliary power unit (APU) for lightweight vehicles." The APU uses a commercial diesel engine and an advanced generator and novel cooling techniques to meet the stated requirements. The key personnel at Adiabatics and Synchrotek are well aware of the need to reduce the size and weight of APU systems for "all military vehicles" and have been involved in several programs in this area. The primary difficulty in achieving the goals of this SBIR topic are identifying an existing powerplant which has the potential to enable the development of an APU which will meet all of the stated and implied goals. The objective of this Phase I project is to demonstrate that the marriage of a state-of-the-art high performance diesel engine developed as the world's first commercially successful diesel outboard engine and an advanced concept generator can produce a family of APU's for use on lightweight vehicles which meet and exceed the government's expectations. A program has been prepared to meet this objective and deliver a brassboard demonstration unit to the government for their evaluation. Anticipated benefits/potential applications - The proposed 30 Kw and 60 Kw APU's utilizing a newly commercialized lightweight diesel engine developed as an outboard motor, and a novel lightweight 400 Hz generator result in package weights of 650 and 1050 lbs, respectively. Currently the only available APU's that meet these weights are gas turbine powered. Compared to gas turbine powered units the proposed diesel APU's have a significant cost and fuel economy advantage.

ADVANCED CERAMICS RESEARCH, INC. Topic#: 92-033 ID#: 9210692
4541 E. FORT LOWELL ROAD, SUITE 211 Office: DSO
TUCSON, AZ 85712 Contract #: DAAH0192CR309
Phone: (602) 323-6881 PI: KEVIN STUFFLE
Title: Injection Stereolithography Method for Net Shape Fabrication of Reinforced Ceramic Components
Abstract: This program will develop a new computer controlled stereolithography process for the manufacture of reinforced ceramic composite parts. Phase I will demonstrate a working system that will directly read a computer cad drawing of a simple component and then generate the actual green composite part. Phase I work will include development and fabrication of system hardware and software, development of ceramic slurry formulations, development of the slurry delivery and injection system, and development of operating parameters. Phase II of the program will include application of a laser curing system for increased resolution of fabrication. Anticipated benefits/potential applications - This program will develop a new flexible manufacturing system incorporating very low cost for small volumes, small flaw size and capability for use with a wide variety of ceramic composite systems.

ADVANCED SCIENTIFIC CONCEPTS, INC. Topic#: 92-088 ID#: 9210094
2020 ALAMEDA PADRE SERRA, SUITE 123 Office: UWO
SANTA BARBARA, CA 93103 Contract #: DAAH0192CR262
Phone: (805) 966-3331 PI: ROGER STETTNER
Title: Development of a Staring Underwater Laser Radar Receiver
Abstract: This proposal describes an innovative and proprietary multiple detector Focal Plane Assembly (FPA) designed to be used for high resolution 3 dimensional imaging (Staring) underwater laser radar. This fpa design has the following characteristics: can be used to determine the time-of-arrival of a laser pulse at each detector element in the array independent from the other detector elements in the array; depth resolution is better than 1/2 meter; very low noise and very high dynamic range, preliminary design has 12 bits dynamic range; preliminary design is for a 10 x 10 array but the number of detectors per array can definitely be increased; very compact and low power.

ADVANCED SURFACE TECHNOLOGIES, INC. Topic#: 92-065 ID#: 9210480
85 RANGEWAY ROAD, BLDG. #1 Office: LSO
NORTH BILLERICA, MA 01862 Contract #: DAAH0192CR263
Phone: (508) 663-7652 PI: IH-HOUNG LOH
Title: Electronically-controllable Filter Based on Polymer Dispersed Liquid Crystal Materials
Abstract: Electro-optic materials consisting of random dispersion of nematic liquid-crystal microdroplets embedded in an isotropic transparent polymeric media (or polymer dispersed liquid crystals (PDLC)) were developed at Advanced Surface

Technology, Inc. (AST) for use in optical and electro-optical devices. PDCL materials can be applied as a tunable optical filter which can respond to an electric field and cause a selected attenuation of optical radiation from far infrared through ultraviolet wavelengths, which can be used for fast electrical control of the visual and infrared signatures or windows of aircrafts, ships, and land vehicles. The electro-optic properties of PDLC films are dependent upon the types of materials used, the droplet morphology and the method of film construction. The desirable properties include high clarity and transmission of the film in the on and off states, low driving voltage, low power consumption, and fast switching times. In this Phase I program, we will study some of the possible PDLC fabrication techniques and how these fabrications will affect the opto-electronic properties of the PDLC materials. Anticipated benefits/potential applications - The potential commercial applications for PDLC materials are expected in the areas of large are electro-optic displays, thermal indicators, light valves, solar control windows, ir modulators, switchable windows, and high definition spatial light modulators.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 92-044 ID#: 9210980
Office: DSO
Contract #: DAAH0192CR310
PI: DAVID KURTZ

Title: In-situ X-ray Detector

Abstract: In-situ monitoring of critical film properties would greatly enhance process control of thin film coating technologies such as Chemical Vapor Deposition (CVD) and Physical Vapor Deposition (PVD). ATM, working in conjunction with pennsylvania state university, proposes to incorporate a position sensitive fiber optic x-ray scintillation detector (PSSD) for real time x-ray analysis of chemically vapor deposited metallic films. This device, developed at penn state for non-destructive testing, can be used to simultaneously measure several critical film parameters such as thickness, crystal structure, crystal perfection, preferred orientation, and residual stress. Compared to traditional x-ray detectors, the PSSD system is very compact, requires no scanning, and most importantly, has very rapid sampling time (less than 1 second). All these attributes make it ideally suited for real time analysis of thin film growth. The proposed program would first develop a method for incorporating the PSSD device into both batch and continuous CVD operations developed at ATM for DoD applications, and secondly investigate its effectiveness in a series of coating experiments. Completion of this effort will enable a Phase II effort for incorporating the PSSD x-ray monitor into CVD and PVD coating manufacturing processes for feedback process control. Anticipated benefits/potential applications - A reasonably priced in-situ x-ray monitoring device would be applicable to many active feed-back loops for intelligent control of other coating processes: melt-spray, solution-spray, electroless, electrolytic, etc. Such a device could also be used as an in-line non-destructive quality control tool.

AERO COMPOSITES
3400 SPANGLER ROAD
MEDWAY, OH 45341
Phone: (513) 849-0244
Topic#: 92-022 ID#: 9210418
Office: ASTO
Contract #: DAAH0192CR311
PI: DAVID SCULLY

Title: Small, Low Cost, Remote-controlled, Turbojet Powered Avionics Testbed/Inexpensive Turbojet Avionics Platform (ITAP)

Abstract: The ITAP requires advanced technology in fabrication and in team interaction as well. We have assembled a capable team, eager to accomplish this task. The technology for airframe construction involves advanced use of vacuum formed glass and carbon fiber reinforced epoxy skins on a Roha-cell PVC foam sandwich. This will permit the fabrication of the major airframe components in 2 halves, a top and a bottom. After assembly of the 2 halves, the airframe can then be segmented as desired. Because the process uses relatively inexpensive epoxy tooling, the airframe can be reproduced quickly and accurately. This provides interchangeability of components and consistency in "rigging" of the airframes. This allows the payload section of the fuselage to be interchangeable with multiple airframes. Also the user may customize a payload section for an unusual test configuration. Preliminary candidates for propulsion of the airframe are the Sundstrand Aerospace TJ-20/70/90 engines. Additional engines will be evaluated during the initial phases of the design iteration. The ITAP flight control avionics will include an ITAP point-of-view visual display with superimposed flight performance and heading data. An integrated autopilot will enhance safety and ease of operation with failsafe mode for engine shutdown and recovery. Anticipated benefits/potential applications - Extra payload sections can be fabricated and made available to the test avionics manufacturers for installation and bench testing of the package. The test avionics laden payload section can be quickly and easily shipped to multiple sites where airframes are already prepositioned and quickly mated for testing. ITAP operators can be trained with ballasted payload sections. The flight vehicle can be "spared" and the payload section transferred to preserve test schedules.

AERODYNE RESEARCH, INC.
45 MANNING ROAD
BILLERICA, MA 01821
Phone: (508) 663-9500
Topic#: 92-123 ID#: 9210703
Office: ASTO
Contract #: DAAH0192CR298
PI: RICHARD MIAKE-LYE
Title: Aerodynamic Contrail Prediction and Control
Abstract: The exhaust gases leaving an aircraft that is flying at altitudes in the high troposphere and lower stratosphere (30,000 to 60,000 ft) are subject to cold temperatures as they mix with the ambient air. Aerodyne Research, Inc. (ARI) has recently made significant contributions in tackling physical and technical problems related to contrail formation. Under NASA sponsorship, ARI has been studying the detailed mixing dynamics, chemistry, and condensation occurring behind aircraft to assess their importance in upper atmospheric pollution. In addition, ARI has been studying aerosols and condensation physics. This combination of expertise and background give ARI a unique perspective on the problem of contrail prediction and avoidance and also provide a strong foundation for developing strategies for effective contrail control. Predicting contrail formation allows flight plans to be modified if and when temperatures and humidity can be ascertained to be likely to produce condensation and, in a similar fashion, an aircraft in flight could be warned when it would be expected to produce a contrail. Active control of contrail formation would require such a warning, but would then require the modification of the mixing dynamics and/or condensation kinetics behind the aircraft such that water aerosols would not form in the wake behind the vehicle in their usual fashion. Effective control of contrail formation requires a detailed understanding of the physical and chemical evolution of the exhaust water vapor and condensation nuclei as they are processed in the aircraft wake. This understanding is essential for predicting when contrails form and when and how to modify their formation mechanisms. A suppression technique based on an ARI proprietary concept, combined with the aerodynamic understanding growing out of applying the ARI vortex wake model, would form the basis for a method to suppress the undesirable aspects of naturally occurring aircraft contrails. Anticipated benefits/potential applications - The significant and large scale contributions that contrails make to aircraft signatures make their suppression very important in reducing aircraft observability. Moderate to large reductions in the observability,

AEROTECH ENGINEERING & RESEARCH
424 ELDRIDGE STREET
LAWRENCE, KS 66049
Phone: (913) 865-5027
Topic#: 92-187 ID#: 9220340
Office: MICOM
Contract #: DAAH0193CR018
PI: SAEED FAROKHI
Title: System-optimized, Ultra Low-cost, High-strength Fuel Tankage for Long-range Missiles
Abstract: An ultra low-cost fuel tankage for expendable turbojet propulsion systems to be used in the Longfog missile is proposed. Design criteria and technical objectives based on mission requirements and cost-effectiveness are presented. Two candidate systems are proposed: one featuring compressor discharge bleed air for fuel tank pressurization and the other featuring a high-pressure bottle of inert gas for pressurization purposes. The mission-specific features designed into the tankage system include an external pressure vessel, internal flexible fuel bladder, slosh-minimizing-integral baffles, vibration-damping systems, structural reinforcement at critical points, inspection port and breather valve. Design factors affecting reliability, feasibility, safety, cost and total system optimization are discussed. The design and development process is a cycle of iterative optimizations based on extensive purpose-designed testing and appropriate system modification. The candidate materials for the pressure vessel include plastics and FRPs; and for the bladder include mylar, teflon and high-orthogonality composites. The candidate manufacturing processes which include injection molding, rotational molding, blow molding, hand lay up, spray-up, filament winding and thermally-activated film sealing are evaluated and discussed. Anticipated benefits: - low cost and low-weight fuel tanks for all classes of land, air and sea vehicles with enhanced safety and reliability (military & civilian) - reduced weapon system acquisition cost (federal government) - applications for space transportation and space station freedom - spin offs for food packaging industry - commercial sporting applications

AIMS, INC.
6159 EXECUTIVE BLVD.
ROCKVILLE, MD 20852
Phone: (301) 468-5542
Topic#: 92-161 ID#: 9220546
Office: DSO
Contract #: DAAH0193CR019
PI: DAVID MACENANY
Title: Wavelet And Learning Clustering Algorithms for Automatic Target Recognition
Abstract: The proposed research and development effort aims at demonstrating the following technical capabilities; (a) high performance algorithms for ATR based on two-dimensional sensor data; (b) efficient and fast software and hardware

implementations of these algorithms on low cost multiprocessor boards. These capabilities rest with the following technical principles; (a) the recently discovered properties of wavelet representations as robust multiresolution representations of one- and two-dimensional signals (e.g., radar and acoustic waveforms, images); (b) the superior properties of the learning vector quantization and self organizing feature map algorithms as learning classifiers; (c) the key idea of linking the feature extractor (preprocessor) and the classifier via feedback; (d) the availability of neural and parallel digital multi-chip boards for hardware implementations. Anticipated benefits: - compression of high resolution radar returns. - ground vehicle acoustic signature detection. - early fault and damage detection in machinery. - sensor fusion. - improved optical character recognition. - recognition of industrial objects in manufacturing.

ALABAMA CRYOGENIC ENGINEERING, INC.
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HUNTSVILLE, AL 35804
Phone: (205) 536-8629
Topic#: 92-185 ID#: 9220375
Office: MICOM
Contract #: DAAH0193CR020
PI: JOHN HENDRICKS
Title: Passive Water Removal for Compressed Air Systems
Abstract: A concept for passive removal of water from compressed air supply lines is proposed. Relying on surface tension effects to remove the water, this concept is feasible from a practical standpoint because of an inventive manufacturing approach developed by Alabama Cryogenic Engineering. The Phase I effort includes theoretical modeling and feasibility testing of critical aspects of the concept. Results obtained from these efforts will provide the basis for continuation into a Phase II program. Anticipated benefits: The concept operates without active measures, is simple to integrated into existing systems and appears commercially viable. Substantial economic benefits arising from increased productivity and reduced maintenance are expected.

ALPHATECH, INC.
50 MALL ROAD
BURLINGTON, MA 01803
Phone: (617) 273-3388
Topic#: 92-049 ID#: 9210391
Office: DSO
Contract #: DAAH0192CR300
PI: JAMES DECKERT
Title: Wavelets and Failure Prediction
Abstract: New techniques have been developed over the past 36 months that offer significant potential for on-board monitoring of mechanical systems to detect and classify incipient failures. Many are based on the wavelet transform, and its extension to the wave packets transform. All provide a means to isolate changes in signal structure in terms of scale as well as in terms of time. This effort proposes two comprehensive approaches to incipient failure detection and classification. The front-end of our proposed classifier extracts novel feature sets offered by the wavelet transform and the multiresolution time series spectral estimators. One approach uses the streams of features detected in each transform cell as an input to recently-developed and successfully applied techniques for the detection of changes in modal and spectral characteristics indicative of faults in vibrating systems. The other uses these outputs to define a feature space on which a classical neural net classifier may be trained and evaluated. Anticipated benefits/potential applications - Results of this effort will determine the extent to which wavelet transforms and multiresolution time series analysis can contribute to the early detection and classification of incipient failures in a variety of mechanical systems.

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Phone: (617) 273-3388
Topic#: 92-161 ID#: 9220295
Office: DSO
Contract #: DAAH0193CR021
PI: ROBERT WASHBURN, JR.
Title: Automatic Target Recognition Using Wavelets
Abstract: There are strong motivations for the development of new signal, image, and data processing algorithms that are well-matched to ATR problems and thus offer promise in exploiting the specific spatio-temporal characteristics that distinguish targets of interest from environmental clutter. In this proposal we describe an effort aimed at accomplishing this task by exploiting the recent advances in wavelet transforms, multiresolution signal and image analysis, and fractal image processing. In the past few years there have been major developments, motivated by the wavelet transform, in optimal multiscale image and signal processing, providing a new framework for image segmentation and feature extraction, clutter removal, and multisensor

fusion that hold the promise of substantial improvements in both performance and computational efficiency. We describe how this framework can be used for target detection, feature extraction, and clutter rejection based either on spatial or spatio-temporal features. We also describe how the wavelet transform leads naturally to the idea of a wavelet network, a nonlinear adaptive learning framework that appears to hold considerable promise for target feature extraction and classification. Anticipated benefits: Results of this effort should lead to new and effective methods for the detection and classification of spatio-temporally localized phenomena in complex environments, and for motion detection and estimation. Such methods will be of value in both military applications as well as in such civilian/commercial areas as remote environmental monitoring and biomedical imaging technologies.

ALTERNATIVE SYSTEM CONCEPTS, INC.
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PELHAM, NH 03076
Phone: (603) 635-3553
Topic#: 92-031 ID#: 9210601
Office: DSO
Contract #: DAAH0192CR348
PI: CARL KARRFALT
Title: Hardware-software Co-design Supports Integrated Engineering
Abstract: Phase I will explore novel ways to apply improved techniques using the IEEE/ DoD standard VHSIC Hardware Description Language (VHDL) to integrated engineering methods. In particular, it will enable hardware and software engineers to collaborate simultaneously during development of parallel computing systems. Some shortcomings of VHDL have been overcome by the DARPA Quest project with distributing processing, which has resulted in substantial reductions in the time required for VHDL simulation and synthesis. Distributed processing of VHDL descriptions is also being applied to Automatic Test Pattern Generation (ATPG). Research results from Quest will be investigated. A major Quest participant has proposed a hardware/software co-design methodology and seamless toolset that will be developed during Phase II. This revolutionary approach will capture the algorithms and architecture of a system in composite high-level VHDL models. The system designer will get rapid feedback on gross system performance, ranging from instruction execution rate and node loading to changes in algorithms or architecture. Proof of concept will be demonstrated during Phase I. During Phase II, the tools described in Phase I will be developed and tested on sample behavioral and structural VHDL models of a real design. Commercial suppliers of VHDL design automation tools will be identified and evaluated for potential participation in the Phase III commercial product development. Anticipated benefits/potential applications - Evaluation of the performance of high-end distributed and massively parallel computer processing systems, such as the touchstone sigma and quest projects. Decreased time for development will result from the hardware and software co-design.

AMERICAN GNC CORP.
9131 MASON AVENUE
CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 92-103 ID#: 9210431
Office: MICOM
Contract #: DAAH0192CR264
PI: C.F. LIN
Title: Rapid Robust Transfer Alignment System
Abstract: Future tactical demand rapid and robust transfer alignment for weapon delivery to meet the high-precision, high-agility, and low-observability requirements. American GNC Corporation (AGNC) proposes to develop a rapid robust transfer alignment system by exploiting optical interferometric and advanced estimation techniques. Optical interferometers are used to perform slave sensor calibration, while advanced estimation algorithms are used for alignment. This will result in a rapid, robust, precise, and reliable transfer alignment system with minimal system modifications. In Phase I, both optical interferometric and advanced estimation techniques will be applied to the transfer alignment design. In Phase II, the system will be implemented and tested in a hardware-in-the-loop environment. Anticipated benefits/potential applications - The techniques explored in the development of the transfer alignment system can be applied to navigation, measurement, alignment, and many other disciplines.

AMHERST SYSTEMS, INC.
30 WILSON ROAD
BUFFALO, NY 14221
Phone: (716) 631-0610
Topic#: 92-206 ID#: 9220772
Office: SSTO
Contract #: DAAH0193CR022
PI: CESAR BANDERA
Title: Attention in Active Vision
Abstract: An attention mechanism can influence system behavior and performance only to the extent in which system resources

are allocatable. A key visual system resource is acuity, and yet this resource is fixed in conventional uniform acuity machine vision. Features to be resolved by active vision are typically localized within the FOV. Uniform sampling within the FOV is thus inappropriate; regions with little or no relevance to the task are sampled at the same resolution as key features, occupying valuable signal bandwidth and computational resources, and increasing system latencies. Foveal active vision features imaging sensors and signal processing with graded acuity coupled with context sensitive sensor gaze control, analogous to that prevalent throughout vertebrate vision. Foveal systems operate more efficiently than uniform acuity systems because resolution is treated as a dynamically allocatable resource. Wide FOV and localized high acuity are simultaneously supported while minimizing sensor data to that which is relevant. T' e development of foveal systems is hampered by the need for attention mechanisms and gaze control which are more refined than that of uniform acuity active vision, and can rapidly allocate spatiotemporal resolution. This program will develop attention mechanisms and gaze control techniques for foveal active machine vision. The attention mechanism will integrate with all levels of the vision data path to support rapid preattentive and attentive behavioral response, and execution on hierarchical architectures. Anticipated benefits: Foveal systems offer improved vision performance, greater platform intelligence and autonomous operation, and lower system cost. Foveal systems interrogate targets with high resolution to reduce ambiguities and classification false alarm rates, while supporting a wide FOV which improves multitarget detection and tracking, and feature orders of magnitude less computational latency and hardware than uniform acuity systems with the same maximum resolution and FOV. The attention mechanisms developed under this program will serve as behavioral executives in ongoing Foveal vision projects, and accelerate the development of such systems.

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PITTSBURGH, PA 15213
Phone: (412) 421-9781
Topic#: 92-081 ID#: 9210673
Office: SSTO
Contract #: DAAH0192CR251
PI: CHRIS MAEDA
Title: Loosely-coupled Network Database for Information Retrieval
Abstract: We propose an efficient and cost-effective query processing component for an information retrieval system based on the use of networked microcomputers as a loosely-coupled network database. The query processing system will work on both local and wide area networks and can be used with any method of information retrieval. We propose to: 1. Model the expected performance of this system so that it may be compared with other IR systems; 2. Design for ease of management in addition to query processing performance, since distributed systems are in general more difficult to manage than non-distributed systems; and 3. Address the other issues that have challenged others developing distributed databases. Anticipated benefits/potential applications - This project can lead to cost-effective platforms, scalability, and fault-tolerance for ir applications that are better than mainframe implementations. The eventual technology could be applied to the healthcare and educational fields - reducing the costs of IR systems in each area.

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Topic#: 92-098 ID#: 9210896
Office: MICOM
Contract #: DAAH0192CR252
PI: SCOTT RUMBAUGH
Title: High Speed Electrodes for High Density Optical Guided Wave Devices
Abstract: High density integration of external optical waveguide modulators that may be used effectively at bandwidths in excess of 30 GHz is to be investigated. This requires launching microwave modulation energy to the modulation transmission line with minimum radiated energy, interconnecting the transmission line to coaxial cable in minimal space, increased isolation between signal lines of multiple modulators and better cavity mode suppression. The use of flip-chip mounting to achieve these objectives is proposed. Specific topics to be investigated are: the elimination of crosstalk, minimization of electrical return loss, optimization of velocity matching, tradeoffs between electrical crosstalk and dispersion in impedance matching, and designing simple and reliable interconnects. Anticipated benefits/potential applications - Optical communication systems can be made more cost effective. Increased performance of remote antenna links can be achieved at lower cost. Lightweight transmit/receive modules for phased-array antennas can be constructed. Optical interconnects between electronic subsystems and ISDN can be more readily achieved.

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Topic#: 92-044 ID#: 9210706
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PI: LAWRENCE BOURGET

Title: Fourier Transform Infrared Emission Technique for In Situ Diagnostics for Diamond Film Growth

Abstract: The aim of this project is to evaluate the use of Fourier Transform Infrared (FTIR) emission spectroscopy for characterizing the diamond thin film deposition process with in situ measurements. An FTIR spectrometer will be installed on a commercially-available diamond reactor to record the infrared radiation from a silicon substrate passing through a growing diamond film and the reactive processing gases. The project will focus on in situ measurements of film thickness and growth rate, absorption in the film due to C-H stretch, and absorption by the reactive gases. In situ measurements of these characteristics will lead to rapid diamond thin film process development for important applications, such as infrared optics, heat sinks, tool coatings, and high-quality diamond for electronic devices. Anticipated benefits/potential applications - An FTIR in situ diagnostic tool for monitoring and controlling diamond thin film processing will lead to shorter process development cycles for many diamond applications, including the production of heat sinks and tool coatings. In situ monitoring will also ensure that high quality diamond is reproducibly manufactured for production of infrared windows and other optical applications.

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Phone: (206) 674-2022
Topic#: 92-218 ID#: 9220707
Office: SSTO
Contract #:
PI: LANCE OTIS

Title: Mapping Object-structured Information Among Applications Phase I

Abstract: Applied Technical Systems, Inc. is presently performing research in the optimization of object-oriented representations among database applications. We have developed a prototype database which can be used as a "meta-database," in that it can incorporate the object structures for multiple databases and can provide a method for automatically optimizing the object structure for a specific task or user perspective. This project proposes to expand on this research work to adapt the model to a wider set of complex real-world applications that include modern object-oriented programming, database, and expert systems. Leveraging off the existing research, we propose to devise methods for analysis, customization, conversion, and optimization of any system's underlying object structure for each task and from one task set to another. In turn, the project proposes automating and integrating these methods into a database management scheme that will provide joint accessibility to each or all of these items mapped to each task or user for his particular perspective with no information loss, while assuring speedy query, speedy update, data integrity, syncronicity, and data persistence. Deliverables will be in the form of research reports, prototype software demonstrations, and recommendations for further research work. Anticipated benefits: Devising methods for analysis, customizing, converting, and optimizing the system's underlying object structure for each task and from one task set to another and in turn automating and integrating these methods into a database management scheme will improve the capability to model complex real-world situations. This could provide improved support in areas such as: industrial business management, medical research of symptoms vs. causes law enforcement criminal tracking, and defense intelligence analysis.

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PI: ANTHONY SWANIC

Title: Ruggedized Optical Fiber Optimized for Military Applications

Abstract: This proposal describes the Phase I development work for an optical fiber which has performance characteristics enhanced for military applications. Future military applications will be researched to determine the type of fiber which will be in greatest demand. Performance characteristics desired for these applications will be documented and trade off studies performed to determine the optimization levels attainable. A detailed specification for an optical fiber will then be generated and a preliminary process study performed to gauge the feasibility of manufacturing the fiber. Anticipated benefits/potential applications - Military systems incorporating optical fiber would no longer be dependant upon commercial fiber designs which are optimized for Telco applications and are often considered proprietary. Standardization could be achieved, costs lowered, and optical fiber performance & reliability improved.

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Topic#: 92-176 ID#: 9220558
Office: ESTO
Contract #: DAAH0193CR0[illegible]
PI: ERNEST BLOOD
Title: Next Generation Position/orientation Tracking Device
Abstract: The objective is to design and fabricate a proof-of-concept model of a novel six degrees-of-freedom tracking device for measuring the position and orientation of a head or hand in an augmented reality environment. The feasibility model to be built in Phase I will demonstrate greatly reduced sensitivity to nearby metal objects, less sensitivity to environmental noise, a higher measurement rate, less data lag, and fewer electronic components than existing magnetic and electromagnetic tracking products. Following a system configuration analysis to optimize range, accuracy, form factor and sampling rate, hardware and software will be integrated into a breadboard system. Proof of concept will be established by testing this breadboard system in a laboratory environment. The new tracker's capability to operate in hostile, metallic environments, e.g., cockpits of tactical vehicles, cockpit simulators, hospital operating rooms, and in "on-the-job" augmented reality training environments will foster new military and commercial applications. New applications include precise catheter and endoscope localization during surgery, three-dimensional human organ imaging using ultrasonic scanners, quantitative measurements of limb movement during physical therapy of patients with metallic joint implants or external braces, and precise pointing to overlay computer-generated, head-mounted display information during vehicle repair. Anticipated benefits: Low cost six degrees-of-freedom tracking device that is small, lightweight, rugged and capable of operating in all operational environments without degradation of its highly accurate, high speed outputs. Commercial applications include real time head and hand tracking in augmented reality systems: telerobotics, teleconferencing, flight simulation, entertainment, medical imaging, rehabilitation, engineering and interactive educational systems.

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Contract #: DAAH0193CR037
PI: JAESOEK RYU
Title: High Selectivity Composite Membranes Utilizing Fullereness
Abstract: A novel gas separation method is proposed based on composite membrane utilizing newly discovered fullerenes. This new membrane will allow gas separation over a wide range of temperatures with extreme selectivity, and at higher flux than presently can be achieved. The new membrane material is innovative. It incorporates the key feature of a well-defined fullerence pore structure, the thermomechanical stability of a porous ceramic support, and an extremely selective thin metal layer. In Phase I, we will demonstrate the feasibility of fabricating doped fullerence thin films on commercially available ceramic membranes. We will demonstrate that these composite membranes will exhibit a higher permselectivity than can be presently achieved with commercial inorganic membranes. The physical and chemical stability of the prepared composite membranes at elevated temperatures will also be investigated. In Phase II, we will determine the selectivity of the composite membranes using various gas mixtures of interest, and determine the effects of contaminants on membrane performance. Also we will optimize the composition and fabrication procedures for doped fullerence layers, and composite membrane configuration to achieve both high selectivity and high rates of permeation. We also will prepare a conceptual design and execute a preliminary economic analysis.Anticipated benefits: The successful completion of this program will result in the development of highly efficient inorganic membrane technology. It will benefit the chemical process industry and U.S. Department of Defence by providing necessary technology for economical separation of gases, such as producing hydrogen from gas mixtures over a wide range of temperatures.

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Contract #: DAAH0193CR038
PI: HASSAN ALAM
Title: Integration of Information from Heterogenous Sources
Abstract: Much information is published and stored on national networks in the form of electronic documents. Current indexing technology does not effectively extract the contents of these documents. As a result, people cannot easily find source documents they need. We plan to develop a system which will extract key information from documents and index it precisely with

minimum data loss, while allowing users to continue submitting documents in the format and structure of their choice. Our method will support multiple formats, allowing for customization and evolution over time. In Phase I we will demonstrate this technique by analyzing and extracting data from complex two-dimensional tables. In Phase II we will extend this approach to heterogeneous collections of documents. Anticipated benefits: We believe this approach will make documents more accessible on computer networks. Contents of electronic documents will be precisely indexed, and network users will be able to generate precise queries to locate information. In addition, this technique will improve information-input capability of general information retrieval systems. Today these systems face similar problems in indexing and integrating heterogeneous document input.

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Topic#: 92-108 ID#: 9210748
Office: MICOM
Contract #: DAAH0192CR255
PI: MEG NOAH

Title: Fractal-based MMW and IR Synthetic Scene Generation

Abstract: The proposed research will investigate efficient fractal-based techniques for generating wide area SAR imagery of natural clutter to support weapons system testing. The computer graphics field has demonstrated the use of fractals for rapidly creating visually realistic background scenes. For weapon system testing, however, synthetic data must also provide a quantitative representation of the scene -- particularly the clutter structure which can impact the performance of automatic target recognition and detection algorithms. Traditional fractal-based techniques cannot support this requirement in SAR imagery. Atlantic Aerospace proposes to overcome limitations of common fractal techniques for SAR scene generation by 1) using higher-order fractals and 2) analyzing real data to determine synthesis parameters. Several methods for extracting (low- and high-order) fractal descriptors from real SAR imagery and generating synthetic imagery from these descriptors will be investigated. A synthetic scene will be generated and compared to real data from the MIT/LL 35 GHz ADTS SAR system. Scene fidelity will be evaluated by comparing measured statistical and polarimetric properties, relating to ATR algorithm performance, between the real and synthetic data. The Phase I effort will result in candidate image-generation techniques and sample synthetic imagery demonstrating these techniques. Anticipated benefits/potential applications - The Phase I research will verify the feasibility of fractal-based techniques for synthesizing SAR background imagery. Synthetic images are useful for digital and hardware-in-the-loop simulations used in the evaluation of MMW and IR weapon systems. Phase I will lay the ground work for further development and extensive evaluation in Phase II including synthesis of other sensor imagery and the design of an interactive multi-spectral scene generation workstation.

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Topic#: 92-182 ID#: 9220619
Office: MICOM
Contract #: DAAH0193CR040
PI: WARREN WRIGHT

Title: Quasi-optical Injection Locking Techniques

Abstract: In a quasi-optical oscillator array the output of a large number of oscillators are combined coherently with good efficiency to produce high powers at millimeter-ware frequencies. By placing the array in a fabry-perot resonator, high quality factors can be achieved. To further improve the stability of the output signal, an external locking signal can be used. The locking signal prevents the array's operating frequency from drifting and jumping modes, and also reduces the phase noise. The injection locked signal can also be used to fm modulate the array's output. We propose to investigate schemes for fundamental and sub-harmonic injection locking of quasi-optical arrays. Two distinct quasi-optical schemes for efficient coupling of the signal into the array will be explored. An alternative scheme in which the locking signal is fed directly onto the wafer using an integrated diode multiplier will also be examined. Preliminary tests of this scheme will be performed with a 10 GHz array that has already been built. The key figure of merit is the bandwidth over which injection locking is obtained for a given power. In parallel with this effort, a modelling program to study oscillator interactions will be created. Anticipated benefits: Recent demonstrations of quasi-optical power combining have generated interest in the applicability of these arrays to communication and radar systems. These arrays are small and light-weight and can be fabricated monolithically at relatively low cost.

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Topic#: 92-183 ID#: 9220891
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PI: WARREN WRIGHT
Title: Quasi-optical Power Combiner Modelling
Abstract: Quasi-optical oscillator arrays provide a means of combining the output of a large number of devices to overcome the limited power handling capabilities of individual millimeter wave solid-state devices. Because of the high-frequency of operation and the complexity of the non-linear interactions, the accurate analysis of these systems presents many challenges. Modeling requires advanced electromagnetic simulation for the radiating and bias structures as well as non-linear analysis of the individual active devices and oscillator ensemble. We propose to investigate existing linear and non-linear approaches for analyzing arrays of oscillators in a quasi-optical resonator. Our goal is to develop a general approach for designing quasi-optical arrays. The key system parameters that will be calculated are the total output power, antenna pattern, stability, dc to RF efficiency, and combining efficiency, for a given array topography and active device. Where possible this approach will build upon existing electromagnetic simulators and non-linear cad tools. Anticipated benefits: Because these arrays are planar they could be fabricated monolithically at relatively low cost for high volume applications. At millimeter wavelengths they would be small and lightweight. Furthermore, these quasi-optical arrays can also be steered and pulsed, thereby opening the door to a wide range of communication and radar applications at millimeter wavelengths.

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Contract #: DAAH0193CR041
PI: JOHN MCHUGH
Title: Demonstrably Correct Compilation (DCC)
Abstract: A technique for obtaining trustworthy compilation based on a compilation checker (similar to a proof checker) is proposed. The transformations used in a compiler will be formally specified and verified using interpreter equivalence methods. The compiler will be instrumented to produce a trace of the transformations applied in the compilation of a given program. The compilation checker will validate the trace using the verified transformations abstracted from the compiler. This approach separated the hard problem of finding the translation from the easier problem of ensuring that the translation has been correctly done. Formal specification and verification of the compilation checker using hand proof techniques is within the current state of the art. With appropriate formally based reverse engineering techniques, the approach should be extendable to cover existing commercial quality compilers for real languages such as C and Ada. Anticipated benefits: The proposed work has numerous potential applications both within the government and in the civilian sector. Government applications ranging from computer security and communications to avionics for military aircraft could benefit from trustworthy compilation as could civilian applications ranging from automobiles to commercial avionics to medical devices to household appliances where compilation errors have a potential for causing injury or death.

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Contract #: DAAH0193CR042
PI: DAVID CHEN
Title: Laser Patterning of Color Filters for Liquid Crystal Displays
Abstract: Color filter fabrication is one of the most expensive steps in the manufacture of color LCD displays. Color filter formation is usually accomplished by a photolithographic process which requires a number of steps. The yield is low and labor and material costs are relatively high. In addition, the environmental impact of the chemicals required for existing processes is not desirable. We propose to use innovative laser patterning and curing processes to make color filters to reduce the number of manufacturing steps, reduce production costs and minimize environmental concerns. In Phase I, we will evaluate two techniques: (1) laser ablation of color filter materials to obtain clear cuts with different geometries and (2) laser curing of the color filter materials at a controlled temperature. Commercially available color filter materials will be evaluated using these techniques. The processes proposed can reduce the cost of color filter production while maintaining or improving color resolution. Anticipated benefits: Large flat panel LCD displays switched by thin film transistors are expected to achieve a market size paralleling IC production. These large displays have application in laptop computers, dedicated work processors

and flat screen and projection television systems.

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Contract #: DAAH0192CR272
PI: ALEXANDER KOTT
Title: Integration of Feature-based and Knowledge-based Design Paradigms for Predictive Advice Capability
Abstract: A number of commercially-available CAD systems allow the designer to represent a design artifact as a collection of form features. However, their ability to represent domain-specific features and design knowledge is rather limited. The knowledge-based design systems, on the other hand, offer knowledge representation facilities, suitable, in particular, for implementing automatic predictions of manufacturability. However, they lack the full power of CAD systems, including form features facilities. This document presents a work plan to investigate an approach to an integrated tool, which includes a knowledge-based design component and a feature-oriented CAD component. Integration of the two technologies is expected to enable a qualitatively new stage in design and manufacturing methodologies, characterized by feature-based design process, explicit capture of design intent, and use of multiple predictive knowledge bases early in the design process. The feasibility of the approach will be demonstrated by evaluating a prototype against a small but demanding design examples. Anticipated benefits/potential applications - An integrated design tool will bring benefits both in industry (improved productivity, cost and quality of designs) and in government (automatic inspection of product compliance with specifications and regulations). "Plug-in" knowledge bases, covering design codes and standards, and government specifications and regulations, will be distributed and automatically utilized by multiple users of the tool.

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Contract #: DAAH0192CR269
PI: JOHN LANCASTER
Title: Probabilistic Optimization Software for Concurrent Engineering
Abstract: A breakthrough in engineering optimization methodology has been achieved, based on technology developed in the DARPA Initiative in Concurrent Engineering (DICS) program. The methodology is based on a completely rigorous integration of uncertainty and randomness in engineering optimization problems. This integration of uncertainty and randomness solves the critical technical problem of concurrent engineering: achieving closure between partially defined product and process (including manufacturing and support) specifications including constraint management. The solution is delivered in such a way that random variability in manufacturing and support processes can be introduced on an equal footing with uncertainty in specifications. As an additional benefit of the methodology, systematic procedures can be derived for finding optimal product and process specifications that are robust in the face of requirements and operational uncertainties. The proposed work will realize the benefits of this methodology by integrating these optimization techniques with decomposition methods for solving large engineering optimization problems. Computer software packages will be developed to implement the enhanced methodology. Advanced computer programming technologies will be employed that will make it possible to demonstrate the integration of the concurrent engineering optimization software with advanced technology product and process models. Anticipated benefits/potential commercial applications - the development and demonstration of this breakthrough concurrent engineering optimization capability will allow DoD program managers and product producers to apply downstream considerations (choices among device options-manager level/manufacturing considerations-producer level) to product concepts before all product design decisions are available.

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Contract #: DAAH0192CR271
PI: YU-WEN CHANG
Title: Hypersonic Missile Seeker Sensor
Abstract: A high angular resolution focal plane array technique at 94 GHz is used for small aperture missile for semiactive homing. The high angular resolution is minimized by the clutter and multipath problem. The semiactive homing illuminator

design is also included and ranging through datalink is proposed. Anticipated benefits/potential commercial applications of the research or development: demonstration of the new focal plane array concept at millimeter wave for a wide range of applications.

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Contract #: DAAH0193CR043
PI: A. KELLY

Title: Field Emitter Array Cathode Electron "bulb" for Electrostatic Atomization and Dispersal

Abstract: By coupling an electron transparent thin film window to an electron gun it is now possible to make free standing electron sources (bulbs) that operate at modest voltages (<30 kV). These sources of free electrons have been demonstrated to be capable of sustained operation at electron beam currents of order 0.1 ma in air, and can be used to charge inject both liquids and aerosols for electrostatic atomization and dispersal. The windows are sufficiently robust to be used for diesel and gas turbine nozzles and other demanding atomizer applications. Since the windows have to be kept at or near ground potential, the need to maintain the conventional thermonic cathode at elevated potential represents the major impediment restricting the applicability of these "bulbs". The use of a field emitter array, as the gun cathode, not only eliminates the need for an isolated HV filament supply, but provides inherent robustness that permits application to the physically most demanding applications. The proposed program will demonstrated that field emitter arrays can be used to produce compact, rugged, and inexpensive electron bulbs that will be capable of providing atomization and dispersal of all fluids from fuels and liquid metals to aerosols. Anticipated benefits: The availability of field emitter cathode electron "bulbs" will permit the development of compact, rugged, and inexpensive electrostatic atomizers, and the full exploitation of charged sprays unique characteristics. This technology will enable development of: powder coating guns, liquid paint sprayers, metal sprayers, direct polymerization coating guns, spray driers, high flow rate engine nozzles, oil burner and agricultural sprayers, and x-ray sources.

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Contract #: DAAH0193CR044
PI: HAIXING ZHENG

Title: Low-cost, Weather-resistant Photochromic Thin Films by the Sol-gel Process

Abstract: Silver halid containing glasses are the most satisfactory photochromic materials which possess (a) a large transmittance change from 20-30% to 80-90% with and without direct solar illumination; (b) fast darkening and bleaching; (c) free optical fatigue; (d) good chemical durability. However, fabrication of large area of silver halide photochromic glasses suffers from relatively high cost. In this work, two approaches based on the sol-gel process will be carried out to fabricate large area of silver halide photochromic glass coatings on the field equipment. The cost of fabrication will be estimated and expected to be low while producibility is expected to be high since the sol-gel process has been applied to commercially fabricate various large area coatings on glasses. In this project, we will do systematic investigations on the processing to optimize the properties and lower cost. Anticipated benefits: The success of this proposed work will introduce an alternative approach to make the photochromic articles at low cost. The photochromic coatings are applied not only on field equipment but more importantly on glass window panes. The latter application will be beneficial for energy conservation.

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Contract #: DAAH0192CR340
PI: RICHARD ALTES

Title: Neural Network Maximum A Posteriori Angle Demodulation for Spread Spectrum Communications and FM Receivers

Abstract: New results indicate that a VLSI hopfield neural network can be configured to quickly solve the nonlinear integral equation describing optimum, Maximum A Posteriori (MAP) phase demodulation. Performance of this device should be significantly superior to the widely used but suboptimum phase locked loop demodulator, which only processes half the relevant data samples. Application of the neural network demodulator to spread spectrum communication, which is increasingly used in military and commercial communication links, and to standard frequency demodulation is considered. MAP phase estimation can partially compensate for time varying channel perturbations and nonstationary interference effects so as to reduce decoding

errors for spread spectrum communications. For FM reception, replacement of a phase locked loop demodulator by a hopfield map demodulator should reduce mean-squared error between demodulated and transmitted signals, and should lead to more graceful degradation of performance than the sudden signal drop-out presently experienced in mobile FM radio receivers. The proposed Phase I effort involves computer simulations and analysis to demonstrate the expected improvements. Anticipated benefits/potential applications - Utilization of spread spectrum techniques by DoD and others is increasing because of robustness to interference and fading. Improvement of such techniques has high market potential for satellite and multiple access communications, e.g., cellular telephones. Other applications of VLSI neural network MAP angle demodulation include FM radio receivers for home and car.

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Topic#: 92-101 ID#: 9210335
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Contract #: DAAH0192CR256
PI: TODD JOHNSON

Title: Infrared Signal Combining Techniques for Multi-color Projector Applications
Abstract: Assessment of multi-spectral weapon systems requires generation of multi-spectral scenes. These scenes are generated by different sources which are then combined. Beam combination of scenes with a field of view of few degrees involves large and costly beam combiners, moreover, available materials for beam combiners are limited in their spectral range. Phase I of this project provides conceptual design and laboratory demonstration of signal combination technique which will operate from the UV to the far IR spectrum, allowing for a true multi-spectral scene to be generated. This technique will yield a cost effective beam combination for projectors with fields of view larger than the field of view of the units under test. Anticipated benefits/potential applications - This project will enable wide field of view and multi-spectral scene generations in an economical method, with large flexibility in beam combination ratio and insensitivity to angle of incidence.

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Topic#: 92-104 ID#: 9211286
Office: MICOM
Contract #: DAAH0192CR276
PI: PRUCHYA PIUMSOMBOON

Title: Integration of Expert System for Process Planning and Feature Based Designs
Abstract: Artificial intelligence/expert system techniques have demonstrated the ability to address complex reasoning tasks required for process planning. Feature-based design theory and preliminary efforts have shown the potential of providing a fundamental model for capture and manipulation of design knowledge. However, the two technologies have not been sufficiently integrated to allow design features to automatically influence process planning considerations. This proposal describes research effort to identify and evaluate innovative artificial intelligence/expert system techniques which integrate feature-based design and process planning technologies. The thrust of this Phase I project will then be to research state-of-the-art in all the components needed for the integration of expert systems, process planning and feature-based designs. It will also develop the architecture of a proof-of-concept system. This research effort represents the technical baseline for a full scale development of an intelligent feature-based process planning system. Anticipated benefits/potential applications - This research project attacks the lack of appropriate process planning tools during the early stages of product development. Consequently, any industry engaged in concept engineering can benefit from this project regardless of industry segment or company size.

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Topic#: 92-019 ID#: 9210036
Office: ASTO
Contract #: DAAH0192CR273
PI: STEPHEN PLANETA

Title: Modulation and Coding Design to Provide Two Orders of Magnitude Improvements in Meteor Burst Communication
Abstract: CNR has developed HF communications terminals with CNR's unique protocols and code combining techniques for optimizing information transfer over stressed, time-varying channel conditions in accordance with available channel capacity, anti-jam and LPI constraints. CNR surenet terminals support error-free traffic in both point-to-point and network operations and are capable of interfacing to 2-88 MHz RF transceivers as well as uhf satellite and wireline media. The effort proposed here extends the existing technology into the VHF band using the meteor burst transmission mechanisms applied via an array

processing strategy to realize orders of magnitude improvements in performance over conventional single channel systems and at the same time provide maximum LPI protection in conjunction with low power operation. An array of high speed code combiner processors using multiple waveforms spread over multiple frequency bands to transmit probeless packets combined with the use of multiple directive antennas pointed toward areas of high meteor density provide the basis for significant performance improvement similar to the approach used by parallel processors for increasing computer power. Detailed specifications and performance predictions will be prepared that describe both an on-the-air demonstration configuration using off-the shelf discrete components as well as a future integrated meteor burst communications system. Anticipated benefits/potential applications - This new technology is directly applicable to both fixed and mobile tactical and emergency communications systems used by military, government and commercial entities. Applications include expansion of existing multiple media based communications suites to use VHF band as well as provision of rapid network establishment capability for remote field station connectivity using a secure private broadcast media.

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Topic#: 92-149 ID#: 9220081
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Contract #: DAAH0193CR045
PI: ED ANDERT

Title: Parallel Software Visualization and Automated Partitioning

Abstract: In search of computational advances, methods and software for easing the task of developing efficient programs for scalable parallel computers are needed. A much higher level of computer assistance is required, particularly in parallelization and optimization. Effective parallel programming tools need to ease the burden of partitioning a problem onto parallel processors, provide a portable representation basis for algorithms, and produce efficient executable parallel programs. Current approaches to parallel languages which produce non-portable programs, automatic extraction of parallelism from sequential code which produces limited speedup due to missing data access knowledge, and extending sequential languages with data partitioning specification which still requires manual parallel partitioning. The proposed visualization and automated partitioning approach targets the three goals of easing the parallelization burden, portability, and production of efficient parallel code. It utilizes the current state-of-the-art sequential languages with parallel data structures to capture the problem dimensions that have the potential to be mapped onto scalable parallel topologies. This is augmented by an innovative parallel problem visualization environment and automated partitioning tool to streamline the parallel software development process and produce efficient programs for different parallel computer architectures and scalable topologies. Anticipated benefits: The successful completion of this effort will meet a need of national importance for the efficient use and improved programmability of high performance computers. Potential users include many government agencies, universities, and businesses with scalable and large-scale experiment computing needs in areas such as biomedical analysis, geological analysis, and physics modeling.

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Topic#: 92-156 ID#: 9220137
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Contract #: DAAH0193CR046
PI: JAMES BARRY

Title: Collaboration Technology for Concurrent Engineering

Abstract: Concurrent Engineering (CE) provides the means for shortening product development schedules, reducing acquisition cost, and improving product quality by enabling simultaneous, integrated, and parallel efforts on research, design, development, manufacturing, and other support processes. The proposed project will demonstrate the feasibility of innovative collaboration technology for electronic management of design data. The software will be based on information server and hypertext. Knowledge-based software will provide intelligent, semi-automated management of the data. The system architecture will support multi-user and multifunction access to the design database as well as semi-automated constraint/design consistency review. The software will adhere to open standards for user interfacing and networking. In Phase I, we will show the feasibility of our software approach by developing a detailed software design and architecture, and performing proof-of-concept prototyping. The full software development and testing program will take place during Phase II. Anticipated benefits: The proposed software will provide improved means for intelligent, automated management of design information by DoD contractors and commercial firms. Resulting application of CE will result in faster and less expensive product development programs.

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Topic#: 92-031 ID#: 9210041
Office: DSO
Contract #: DAAH0192CR343
PI: SANKAR VIRDHAGRISWARAN
Title: Proposal for Collaborative Concurrent Engineering Tool
Abstract: Companies that are implementing simultaneous engineering of products face several problems lack of tools that support collaboration; lack of support for high-bandwidth communication media to increase the collaboration between marketing and development; and lack of tools that support integration of cross functional and cross domain tools in a team context. To address these problems we at Crystaliz Inc. propose to build a conceptual software prototype that: supports a graphical user interface with remote viewing and annotation facility allowing immediate mode collaboration; has interactive photo-realistic rendering capability to support high bandwidth communication; is used to create non manifold solid models that could be easily converted to finite element meshes; would allow designers to create objects with solid, orientation and positional information that could be used by dynamic and kinematic simulation packages; supports native representation of PDES/STEP format so that object data could be exported to dissimilar tools. The objective of this proposal is to develop a proof-of-concept prototype that demonstrates viability of this concept. The work consists of developing three layers of software. The first layer consists of integrating a non-manifold solid modeler from Carnegie Melon University called Noodles with interactive renderman. The second layer consists of developing an object schema used to represent geometric, positional and orientation information. This schema will be compatible with PDES/STEP. The final layer is the direct manipulation user interface that support collaboration and provides an annotation facility. Anticipated benefits/potential applications - This effort will seed the development of a new generation CAD tool that can be used by product teams to reduce the time to market. In addition, expression and resolution of cross-functional constraints increases the quality of the designed product. We believe that the market is for such a tool $110 million in 1991 growing at a rate of 20%.

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Topic#: 92-156 ID#: 9220067
Office: DSO
Contract #: DAAH0193CR098
PI: LOUIS ALFELD
Title: Concurrent Engineer (CE)
Abstract: The proposal describes a method for developing a dynamic simulation model of the management decision-making process that supports the concurrent engineering process. The model can capture the complex tradeoff pressures that inevitably arise among schedule, budget and engineering quality. The feedback structure that underlies the dynamic behavior of engineering management system contains interlinked decision functions. Combinations of system pressures can push these decision functions toward ineffective responses, resulting in model faithfully reproduces the concurrent engineering management environment, it allows managers to create and test any number of "what-if" scenarios designed to explore the consequences of alternative decision choices. Anticipated benefits: Simulation technology promises three significant benefits. By increasing the effectiveness of management decision-making DARPA will (1) reduce the cost of concurrent engineering programs, (2) increase the quality of engineering performance and (3) improve communication among managers competing for engineering resources. Many engineering companies will desire a dynamic simulation model to assist in managing the tradeoffs that arise during complex design projects.

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Phone: (619) 576-1261
Topic#: 92-088 ID#: 9210675
Office: UWO
Contract #: DAAH0192CR268
PI: MARK OLSSON
Title: Underwater Imaging for Small Object Locating and Identification
Abstract: Objects on the seafloor can be located and identified by means of an underwater optical imaging system. Current systems are performance-limited by the absorption and scattering of light in seawater -- problems inherent to underwater imaging. Present systems rely solely on light source-to-imager separation to minimize back scatter; we propose a better approach -- using a narrow stripe of light to illuminate a swath of the seafloor, which is imaged with either electronic still cameras or conventional CCD video cameras. The novel aspect of this approach is the use of very small diameter flash tubes coupled with an advanced reflector design to offer a previously unachievable degree of beam edge control and luminous intensity.

This approach offers an immediate, significant, and cost-effective increase in underwater imaging system performance. The light stripe approach is inherently more reliable and useable in actual working conditions than competing technologies. Range-gated and volume scanning systems are complex, expensive, and pose significant design an manufacturing problems. Phase I will entail analysis and design of the light sour reflector and imager, providing a basis for Phase II, the demonstration of a working prototype system. Anticipated benefits/potential applications - A general improvement of strobe lighting technology will result from the increased beam edge control. Deepsea Power & Light recognizes commercial potential in two versions of the light stripe imaging system, a high performance version utilizing electronic still cameras and fiber optic cable, and a lower cost version utilizing conventional CCD cameras and coaxial cable.

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Topic#: 92-141
Office: CSTO
Contract #: DAAH0193CR100
PI: MARK YAGER

ID#: 9220028

Title: Novel Internet Services for Text, Audio, and Image Search and Retrieval

Abstract: Imagine an internet service that rapidly retrieves every lecture and conference of a particular person based on a speech sample. Imagine an internet service that quickly retrieves all infrared and satellite images of a city based on an aerial photograph. Also, imagine searching gigabytes of unstructured text in seconds on a 386-based microcomputer. Develosoft Corporation proposes to incorporate a new computational paradigm for the rapid searching of text, audio, and image data. The paradigm, called a correlithm, has been successfully demonstrated on text searching (topical retrieval), audio analysis (voice recognition), and image pattern recognition (radiographic inspection), and image pattern recognition (radiographic inspection) SBIRs. Correlithms utilize a fraction of the computational power needed by conventional solutions on expensive hardware. For example, radiographic images were automatically analyzed on a 386-based microcomputer in equivalent computational time as on an n-cubed machine utilizing alternative methods. The proposed services for text, audio, and image search and retrieval will be incorporated within Wide Area Information Service (WAIS) interfaces and protocols. Moreover, correlithms will be demonstrated to significantly reduce WAIS computational demands and index overhead for text search. Anticipated benefits: The intended users for the text, audio, and image search and retrieval internet services are scientists and researchers in the academic, government and commercial sectors. The users will collaborate more effectively with one another, facilitating technological transfer, military research, and national economic competitiveness.

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Topic#: 92-057
Office: ESTO
Contract #: DAAH0192CP341
PI: MICHAEL FELDMAN

ID#: 9210934

Title: Hybrid Diffractive/refractive Relay System for Head Mounted Displays

Abstract: An optical relay used to image text, graphics, and video in a Head Mounted Display (HMD) system is proposed. Computer generated holograms will be employed in conjunction with conventional-refractive optics in order to reduce the weight and size of the system while enhancing its performance. Both Liquid Crystal Displays (LCD) and Deformable Mirror Devices (DMD) illuminated by a low power laser diode or led will be considered as a source. Commercial optical software in conjunction with in-house software will be used to analyze and optimize the system's performance. Anticipated benefits/potential applications - HMD's can provide graphics, text, and video information while not confining the user to a terminal. This leaves the users hands free. They would be useful to aircraft technicians working in tight quarters and need access to technical information. This would also be good for pilots and astronauts. HMD's also have applications which range form that of an inventory taking tool to Virtual-Reality (VR) simulator.

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Topic#: 92-057
Office: ESTO
Contract #: DAAH0192CR275
PI: MARK HANDSCHY

ID#: 9210578

Title: Miniature Full-color Display

Abstract: The miniaturization of full-color, high-resolution information displays is a problem that will be difficult to solve by

extension of existing display technologies. We propose here a solution that utilizes a combination of existing commercially-driven technologies to yield displays that overcome fundamental limitations of more orthodox technologies. The first objective of the Phase I effort includes the design and fabrication of a 64 x 64 miniature display prototype with grey scale and colors ranging between at least two primaries. The second objective is the completion of a design study for a head- or helmet-mounted VGA-resolution display with full color, for development during Phase II. The proposed technology can be naturally extended to high-definition miniature displays and ultra-resolution flat panels. Anticipated benefits/potential applications - Successful completion would yield the first full-color display of size and power consumption suitable for head and helmet mounting. It can be used as a head-up display of symbol and sensor data, or for the display of continuous-scene imagery in training and simulation applications. Its moderate cost makes it well suited for commercial application as a display of stereo imagery for virtual reality.

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Topic#: 92-078
Office: SSTO
Contract #: DAAH0192CR339
PI: JED ROBERTS

ID#: 9210947

Title: Dictation System for Tactical Environments

Abstract: This is a proposal for the development of a large vocabulary speech-to-text dictation system that could be used in tactical environments. The system will allow users to create text and generate reports without using a keyboard. The user will not have to go through a lengthy enrollment procedure. The system will allow the use of new words and will perform under varied acoustic conditions. In addition, the system will be portable to facilitate report generation in the field. The main effort in Phase I of the development will consist of developing the prototype and testing its effectiveness in realistic simulations. Anticipated benefits/potential applications - Speech-to-text dictation capability for tactical reporting for applications such as resource and management reports, field observations, cataloguing, cartography, equipment maintenance reports, and other time-critical, eyes-busy, hands-busy environments. Large vocabulary recognition with no or limited enrollment required; capability to add new words to the system.

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Topic#: 92-216
Office: SSTO
Contract #:
PI: JANET BAKER

ID#: 9220882

Title: *Semi-automated Speech Transcription Systems*

Abstract: Dragon Systems will explore the transcription process, survey some available data and materials, and analyze potential transcription aids incorporating large vocabulary continuous automatic speech recognition. Dragon Systems will also acquire some selected data and perform some relevant recognition experiments using broadcast material. Anticipated benefits: Transcription of recorded speech has wide applications throughout the federal government, both military and civilian agencies. In addition to being valuable for intelligence applications, it is useful in any office setting. Captioning of television broadcasts is an application for the hearing impaired that is supported by several government agencies.

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Topic#: 92-188
Office: MICOM
Contract #:
PI: ROBERT HOCHMAN

ID#: 9220871

Title: Flexible Circuit Reliability Enhancements Using Pulsed Magnetic Treatments

Abstract: Flexible circuits, used as system interconnects, can suffer reliability problems due to repeated flexing. These circuits which are designed to bend can break the conductor traces transmitting signals between circuits. This proposal will investigate whether this low cycle fatigue problem can be minimized by pulsed magnetic treatments. Pulsed magnetic treatments have been shown by positron annihilation spectroscopy (PAS) to change the metallurgical defect concentration and stress relieve metals like copper and nickel. This technique has the potential to decrease the defect density at low temperatures. The typical flexible circuit is not a candidate for thermal annealing since annealing temperatures will degrade the dielectric. Our approach in this proposed effort is to perform partial fatigue tests of realistic electronic constructions through the use of flexible ductility testers,

perform various amounts of pulsed magnetic treatments and determine the efficacy of the treatments to extend fatigue life. A second goal of the Phase I contract will be to determine the cost effectiveness of the treatment and whether the increased lifetime for each circuit is justified over simply replacing it at periodic intervals. Anticipated benefits: Extended fatigue life through exposure to pulsed magnetic treatment will translate into lower overall system cost for military and commercial electronic hardware since the need for replacement will decrease.

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Topic#: 92-179 ID#: 9220811
Office: LSO
Contract #: DAAH0193CR103
PI: CHRIS ANDERSON

Title: Diagnostic Instrumentation for Behind-armor Debris Using High-speed Laser Photodetection

Abstract: Dynetics proposes a novel high-speed photonic diagnostic tool for characterizing the behind-armor effects of chemical-energy warheads and armor-defeat phenomena. By subdividing the behind-armor volume into regions that are continuously monitored with laser beams and photodetectors, passing particles are detected since they modulate the photodetector outputs. Post-processing of the digitized, multiple-detector outputs then extracts information about the size, spatial position, and time of arrival of each particle. Since detector data are digitized and stored over time, particle movements are tracked from beam to beam, thereby allowing the velocity and direction of travel to be determined. By performing data analysis for all particles, a wealth of information is available to the warhead designer for assessing lethality. Dynetics' proposed approach provides the advantage of tracking the entire particle field over the total event duration unlike existing approaches such as high-speed photography, laser doppler measurement, and x-ray analysis. During this Phase I effort, dynetics' objectives would be to design, build, and demonstrate a small-scale version of the diagnostic instrument. This research would then provide the requisite background needed to develop a complete test system in Phase II. Anticipated benefits: anticipated benefits of the research include development of an enhanced diagnostic tool for designing chemical-energy warheads and development of a high-speed in-flight particle analysis system that could be useful for both government and commercial projectile analysis.

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Topic#: 92-026 ID#: 9210364
Office: DSO
Contract #: DAAH0192CR274
PI: JAMES KLEIN

Title: High Dielectric Endohedral Fullerene Films

Abstract: Although the structure and properties of C60 buckminsterfullerene are intriguing, the most technologically useful behavior will be derived from endohedral and interstitial metal fullerene complexes. The development of high dielectric strength capacitors based on thin films of endohedral fullerene complexes (fullerenes-with-metals-inside, e.g., M@C60) is proposed. The films will exhibit high polarizations due to the creation of large dipole moments within each fullerene cage. The face-centered cubic thin films of M@C60 will exhibit high saturization polarizations due to the anion-cation separation allowed by the large interior volume of the fullerene cage. Such films should be isotropic, readily deposited, and compatible with conventional semiconductor materials such as Si and GaAs. Furthermore, there exists the possibility that endohedral fullerenes intercalated with interstitial (exohedral) alkali ions (e.g., K(M@C60)) will exhibit ferroelectric properties. A characterization of electronic, optical, and electro-optical properties is proposed to provide a design basis for thin film capacitor devices. Phase II would seek to optimize dielectric properties of endohedral and endohedral-interstitial fullerene complexes, fabrication of dielectric devices, and development of single-step deposition protocols. Anticipated benefits/potential applications - 1) capacitors for integrated circuits on Si and GaAs; 2) large area dielectric coatings deposited at low temperature; 3) bistable hardened memory applications; 4) switchable nonlinear optical effects.

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Topic#: 92-172 ID#: 9220083
Office: ESTO
Contract #: DAAH0193CR104
PI: V. RAMAN

Title: High Performance CMOS Digital Integrated Circuits Using Si1-xgex PMOSFETs

Abstract: We propose to develop ultra fast LSI/VLSI CMOS circuits using Si1-xGex channel PMOS and Si channel NMOS

devices integrated on the same chip suitable for strategic defense systems. Since the mobility of the PMOS SiGe channel devices at least by 50% the CMOS circuits will have higher packing density (due to smaller PMOS cells) and higher speed. We will identify a suitable process compatible with existing CMOS technology with minimal modifications. The gate dielectric (silicon dioxide) layer will be thermally grown using a silicon cap layer grown on this SiGe acting as the channel layer for the PMOS devices. The channel SiGe layer will be undoped and the valence band discontinuity will result in a modulation doping contributing to free holes confined in the channel. We will optimize the channel layer, cap layer and buffer layer thicknesses along with the doping concentrations for acceptable PMOS threshold voltage. In Phase I, we will delineate the fabrication process and design the device structure. We will also design several basic cells suing this exciting mixed CMOS technology for variety of digital and signal processing circuits and optimize the design using process, device and circuit simulations. Anticipated benefits: High speed data processors, high density CMOS digital circuits and fast VLSI systems.

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Topic#: 92-105 ID#: 9210502
Office: MICOM
Contract #: DAAH0192CR270
PI: CRIT COOK
Title: MMW Combat Identification Device

Abstract: The millimeter wave combat identification device is a passive (non-emitting) beacon which is a low-cost, combat rugged device for the positive identification of friendly ground vehicles, in tight quartered, obscure battlefield engagements and conditions. The passive IFF beacon is autonomous, except for the manual/tamper deactivation feature. Other than activation, the unit requires no crew attendance for full operation. It is omni-directional, able to respond to interrogation from horizon to zenith, and at all azimuth angles simultaneously. Since the beacon does not actively transmit a signal, it cannot be used by enemy forces for the identification or targeting of friendly vehicles. The beacon system would allow identification of friend or foe at extended stand-off ranges, actually exceeding ground vehicle enemy target acquisition by the host targeting systems. The beacons will not be conductive to counterfeiting, increase the signature, or disclose the location or identity of the host vehicles to hostile forces. It will, however, positively identify a friendly vehicle from identical surrounding hostile vehicles. Additionally, the system would utilize existing millimeter targeting and surveillance equipment in the active interrogation function for detection/discrimination. Anticipated benefits/potential commercial applications - these passive beacons, not requiring expensive transmit/receive electronics, are inexpensive alternatives to the typical tx/rx transmit devices. The most economical facet of the system is the potential use of existent millimeter targeting/surveillance equipment. This low cost would be conducive for mass production of these units.

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Topic#: 92-072 ID#: 9210486
Office: MTO
Contract #: DAAH0192CR280
PI: GARY TOMPA
Title: Development of Novel Wide Bandgap Blue Light Emitting Diodes

Abstract: The epitaxial growth of high quality wide bandgap II-VI heterostructures will be investigated. The recent demonstration of blue lasers in ZnSe based materials has reinvigorated interest in the II-VI wide bandgap materials as light emitters. It is envisioned that these materials will rapidly replace the much less efficient SiC based blue leds. We presently have a funded materials effort in ZnSe based blue light emitters. In this effort, we propose to develop a more novel but potentially more efficient II-VI material system. This will be accomplished using an ultrahigh vacuum epitaxial growth system combined with the development of an advanced elemental vapor transport technique operating in the 10-3 - 10-6 torr range. The technique is called Elemental Vapor Transport Epitaxy (EVTE). The technique is a hybrid offering the advantages of both MOCVD and MBE with none of the disadvantages. In Phase I, the growth and materials characteristics of MNSE, CDMNSE and MNSSE structures needed for light emitting diodes would be determined. In Phase II, doping techniques would be established and functional devices would be fabricated and characterized. Also in Phase II, additional II-VI/III-V heteroepitaxy structures could be investigated. Anticipated benefits/potential applications - Successful materials development of MNSE, CDMNSE and MNSSE heterostructures is essential for the development of devices such as blue light emitting diodes. The development of a hybrid, high-yield technique capable of addressing II-VI, III-V and group IV materials within one growth system will significantly advance the development of these compound semiconductors.

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Topic#: 92-010 ID#: 9210265
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Contract #: DAAH0192CR281
PI: I. MCINTYRE
Title: High Power, Frequency Agile Blue Laser
Abstract: New developments in optical materials offer the potential of widely tunable, efficient sources operating in the blue-green regime for submarine laser communication. The proposed laser system involves the exploitation of two recent developments; the Cr3+:LiSrAlF6 material and high power visible laser diodes. The advantages of Cr3+:LiSrAlF6 are that it can be pumped by diode lasers directly and that the absorption spectrum is very broad. On the other hand, Ti:Al2O3, the current material of choice for blue-green laser systems, is handicapped by its short upper state lifetime, and also with the narrow absorption spectrum of its Nd:YAG pump laser. Consequently, the Cr3+:LiSrAlF6 laser system offers the potential of being several times more energy efficient than Ti:Al2O3 and can be configured in a much more simple, and therefore more reliable, system. Energy Compression Research (ECR) proposes an injection seeded, high power laser system, which is tunable at high rates (in excess of several 10s of KHz) using special techniques. The laser will be based on the use of diode laser pumped Cr3+:LiSrAlF6, using the laser diode technology developed by McDonnell Douglas Co., with whom there exists a collaborative development program. Anticipated benefits/potential applications - A high power efficient, simple tunable blue-green laser for use in submarine laser communication. Laser system could also be used in the near IR for military applications such as CM, and in scientific applications for tunable short pulse production, spectroscopy etc.

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Topic#: 92-121 ID#: 9210986
Office: NMRO
Contract #: DAAH0192CR327
PI: ZOLTAN DER
Title: Genetic Algorithm (GA) Machine Learning of Seismic Waveform Characteristics
Abstract: The SBIR Phase I project proposed consists of testing the application of Genetics-Based Machine Learning methods (GBML) to two problems; seismic waveform characteristics in the context of seismic discrimination and in identification of seismic arrivals. Other applications of these methods may also be explored in the proposed work. In the application to discrimination, the following data sets will be used: regional array data for earthquakes and quarry blasts in the Scandinavian regions, IRIS data recorded in the USSR and selected data sets used previously to deduce discriminates. The performance of these techniques will be evaluated by various data partitioning and resampling methods. The objective of this research is to make use of the extensive parametric data generated by the IMS. By generating new rules from the data by the machine learning algorithms and including them in the system the cognitive capabilities of the IMS can be continuously upgraded. Anticipated benefits/potential applications - The automatic discrimination schemes to be tested and developed under this project can be incorporated into the IMS and upgraded continuously as new data becomes available. This would lead to the anticipated benefit of continuous improvement of discrimination capability of IMS. The algorithms can also be used in numerous other applications in seismology and other fields.

ENTROPIC RESEARCH LABORATORY, INC.
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Topic#: 92-082 ID#: 9210842
Office: SSTO
Contract #: DAAH0192CR282
PI: JOHN SHORE
Title: Information-theoretic Robust Speech Parameterization
Abstract: Like human recognition performance, computer recognition performance degrades inevitably in the presence of interference and distortion. There are two basic approaches to minimizing the degradation: (1) seek new acoustic features that yield performance that is less sensitive to signal corruption; (2) try to "see through" the corruption and to the "true" values of the information-bearing features. We suggest an approach applying information theory to estimate the underlying acoustic features. The proposed work will extend previous results in which Minimum Relative-Entropy (MRE) techniques were used to provide robust estimation of LPC parameters in the presence of helicopter noise. Analogous MRE techniques will be used to develop robust estimators for other "traditional" acoustic features (e.g., cepstral coefficients and line spectrum frequencies). Furthermore, we will build on recent results that have provided an information-theoretic description of the cochlear representation of speech. Certain cochlear models have been shown to have a certain degree of intrinsic noise-immunity. We

hope to obtain additional noise-immunity using the MRE approach. Anticipated benefits/potential applications - There is strong empirical evidence that out approach will lead to improved recognition performance. Further, the work will help to extend a general theory that should be useful beyond the estimation of the acoustic proposed for study in this project. On-going applications are likely through several avenues: via Entropic's new role as a technology-transfer agent for the DARPA Speech and Language Systems (SLS) program; another is through Entropic's commercial signal processing software packages ESPS and waves+.

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Topic#: 92-159 ID#: 9220110
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Contract #:
PI: GREGORY MATVIYENKO
Title: Wavelet Based Methods for Partial Differential Equations
Abstract: We propose to develop fast wavelet and adapted wave form methods for the solution of non-linear hyperbolic and elliptic partial differential equations. A generic example employed will be the PDES that arise in modeling and simulation of micro device fabrication. Current simulations of the various steps of microchip building involve large scale computations time. Wavelet and multiresolution tools are expected to be capable of accelerating some of these computations. We propose to adapt these methods to the fast computation of the optical profiles to be used as boundary conditions for the various PDES involved in the photo lithography process. These include computational solutions of nonlinear Maxwell equations as well as reaction diffusion systems of equations. We expect that they will be handled more efficiently by appropriate wavelet tools. We have currently formed a team of the top experts in the USA in these related areas, in collaboration with top industrial research institutions including IBM, AMD and others. The methods to be developed are expected to assist US industry and DoD labs. In particular the specific PDES considered will aid in the fabrication of 256 Mb DRAM technology. Anticipated benefits: Fast algorithmic methodologies will enable us to reduce substantially the development time for micro device fabrication, by allowing the manufacturer to interactively adjust his process to enhance Line Shape (LS) and Critical Dimension (CD) control of micro fabrications. More generally, the wavelet based numerical tools developed for this purpose will have a broad range of applicability for large scale computation in partial differential equations and simulations of similar industrial processes of interest to DoD.

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Contract #: DAAH0192CR284
PI: MICHAEL TUCKER
Title: Adaptive Wavelet Parameterization of Speech Signals
Abstract: Fastman proposes to utilize the Adaptive Wavelet Transform (AWT) to decompose speech signals into their integral, information-bearing components for use as a preprocessor for pattern recognizers. For a given signal, fast-man's adaptive wavelet transform selects the basis which produces the most concentrated representation of the signal in which most of the information in a signal is "compressed" into a few basis elements allowing the important information to be readily extracted. In this proposal we demonstrate the ability of the AWT to isolate the information bearing elements of speech signals by showing that most of the information in complex speech signals can be compressed into 1/100th the number of original coefficients. We believe that our approach will maximize speech recognition and talker identification scores while minimizing the effects of noise and channel distortions. In Phase I we will: 1) produce an analytical study and simulation which compares the AWT to currently-used techniques and demonstrates its advantages over those techniques, 2) determine the robustness of the decomposition produced by the AWT in the presence of noise and channel distortions and 3) develop pattern recognition methods which use the information-bearing speech components extracted by the AWT to improve speech recognition algorithms. Anticipated benefits/potential applications - The adaptive wavelet transform can provide the basis for new data compression and processing algorithms for: voice mail, text-to-voice, voice annotated records, voice recognition, voice printing, video conferencing and others.

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Topic#: 92-045 ID#: 9210581
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Contract #: DAAH0192CR305
PI: KENT MURPHY

Title: Optical Fiber Sensor-based Smart Materials and Structures

Abstract: Smart materials offer exciting opportunities for the implementation of adaptive structures. Smart materials are a new class of materials, which contain their own internal sensor, actuator and signal processing elements. These structurally and functionally integrated elements give the material the capability to detect changes in its environment, change its structural, electromagnetic and/or chemical characteristics, and autonomously respond to external stimuli. Because optical fiber sensor technology is further along in development than integrated, microscale, high-authority actuators, Fiber and Sensor Technologies (F&S) proposes to begin with the implementation of optical fiber sensor-based materials and structures, and to develop functionally integrated smart material systems from that base. In Phase I, F&S and consultants in the Fiber & Electro-Optics Research Center (FEORC) at Virginia Tech propose to advance optical fiber sensor elements which can be upscaled for the material analysis and control of large military structures, and to incorporate large scale multiplexing, and signal processing capabilities within the sensors themselves. Based upon that work, Phase II would investigate methods to implement parallel actuator elements, and to close the control system loop using embedded signal processing electronics. F&S and FEORC researchers are acknowledged innovators in the field of smart materials and structures. Anticipated benefits/potential applications - The results of the proposed Phase I research program may be important to the health monitoring and structural control of existing and new military and commercial aerospace, hydrospace and civil structures. The optical fiber sensors proposed would be applicable in particular to large scale structures.

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Topic#: 92-045 ID#: 9210571
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Contract #: DAAH0192CR302
PI: SHIRLEY DARRAH

Title: Development of Smart Material Structures with Piezoelectric Composites

Abstract: Fiber Materials, Inc. (FMI) proposes a program to develop a new class of smart materials which have the capability of sensing environmental change and responding to it in a desired manner. Piezoelectric sensors and actuators will be coupled electrically to form the smart material structure. A new type of composite material containing piezoelectric tubes will be developed for high actuation with low voltages. The program will be conducted by FMI in collaboration with Prof. Eric Cross and Dr. Qiming Zhang of the Materials Research Laboratory at Pennsylvania State University. The Phase I program builds on the previous experience and success of FMI and MRL with related materials. It will result in a demonstration of the effectiveness of the new composite material and of the sensor/PZT tube combination. Calculations of transfer functions for PZT/resin combinations will also be initiated. Anticipated benefits/potential applications - The proposed smart material structure will have numerous applications in government and industry. It can be used in flow pattern modification to reduce flow resistance and eliminate flow noise, in large area vibration isolation, in improving the contact between irregular surfaces and to reduce the friction of motion between two surfaces.

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Topic#: 92-157 ID#: 9220749
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Contract #:
PI: PAUL CHAYKA

Title: Creep Resistant Yttrium Aluminum Garnet (YAG) Fibers

Abstract: The primary objective of the proposed effort is to demonstrate a bench scale process capable of producing continuous, fine diameter, polycrystalline YAG (yttrium aluminum garnet) fiber. Several published reports have documented the outstanding creep resistance of polycrystalline YAG at 1500-1600°C. The proposed effort will involve the use of a novel YAG precursor polymer which is suitable for fiber spinning. The chemistry behind this precursor was developed by Babcock & Wilcox Co. Fiber Materials, Inc. will develop spinning and sintering techniques with the objective of demonstrating continuous polycrystalline YAG filaments, with diameters < 15 microns. Characterization will include morphology of green and sintered fibers, crystal phase analyses and testing of tensile strength. Anticipated benefits: The fibers targeted by this proposal are badly needed in many DoD, DoE, and civilian applications requiring composite materials for high temperature, high stress

environments. The fibers will permit energy savings, higher aircraft speeds and reduced emissions via higher operating temperatures for aircraft stationary turbine engines and automobile engines. Such a fiber will enhance the industrial competitiveness of the nation that develops it.

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Phone: (703) 425-5111
Topic#: 92-032 ID#: 9210952
Office: DSO
Contract #: DAAH0192CR283
PI: FREDERICK MAKO
Title: High Energy Electron Beam Processing
Abstract: High energy electron beam (1 to 12 MeV) material processing offers a few important advantages over existing processing methods. Energetic electrons enable processing in air without the need to locate the processed sample in vacuum. The higher energy electrons allow for treatment of thicker samples which could only be treated with inefficient gamma or x-ray sources. Higher energy electrons can also treat materials in their original packages which is more cost effective. Repetitively pulsed electron sources may enable production of materials with highly improved properties. Repetitively pulsed electron sources also have the potential for higher average power which enhances the throughput of the processing plant. Control of pulse shape and high energy allows for better process control. The Phase I research work will generate models for high energy electron deposition profiles. The Phase I research is also devoted to modelling of thermal deposition and radiation chemistry. A review of processing methods will be carried out and electron beam processing will be compared to other processing methods. A few processing cases which are optimized for high energy electron beam processing will be selected and demonstration experiments will be designed to prove the effectiveness and feasibility of this technology. Anticipated benefits/potential applications - Advance the state of the art of electron beam processing. Enable processing operation in air or even underwater and increase productivity of processing and types of pieces that can be processed. Increased productivity for radiation induced processing.

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Phone: (617) 890-3200
Topic#: 92-025 ID#: 9210551
Office: DSO
Contract #: DAAH0192CR306
PI: CHARLES CAREY
Title: HTSC Compact High Frequency Antenna Arrays
Abstract: The application of HTSC materials to realize small stand alone broad band antenna elements to provide highly mobile low observable HF arrays is proposed. Superconducting feeds based on already demonstrated HTSC coaxial delay lines. The slow wave (by a factor of up to 1/1000 the speed of light) properties of these transmission lines are used to implement a lossless, channelized matching network with a length under 8 in. in a 2 in. diam. cylindrical volume. An optimally broad band antenna consisting of a split top loaded dipole will be developed, built and tested with the HTSC matching network. The antenna will be made out of copper and the tests in Phase I will be used to verify the optimal bandwidth design as well as to determine whether the antenna as well as the matching network must be superconducting. This innovative research will lead to the early insertion of new highly mobile HF array capability not possible with normal metal conductors. Anticipated benefits/potential applications - The proposed research will explore the heretofore neglected applications of HTSC components for the HF (3 to 30 MHz) region of the spectrum. The components (filters, delay lines, tuning and matching elements) developed under this effort will greatly enhance the performance and reduce the size of military and commercial communications systems.

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Topic#: 92-045 ID#: 9210940
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Contract #: DAAH0192CR301
PI: LAWRENCE DOMASH
Title: Automatic Holographic Controlled Reflectivity/Emissivity of Spacecraft and Terrestrial Vehicles
Abstract: The ability to continuously change the thermal reflectivity/emissivity of external spacecraft surfaces automatically through intensity-induced refractive index changes in a nonlinear optical liquid within a holographic film with no moving parts would have considerable performance, reliability and cost impact on future DoD, nasa and commercial spacecraft and terrestrial vehicles. Having the entire external spacecraft or vehicle surface part of an active thermal management system will enable far

more precise platforms for thermal sensitive systems as well as giving these systems chameleon ability to change their thermal signature when interrogated. Automatic thermal management on the vehicle skin will reduce the need (cost/weight) for internal HVAC systems and will improve the environment (reliability/service life) for electronic systems. The proposed Phase I program will design, fabricate and demonstrate a broadband variable hologram in a rugged, thin polymer film that will control surface reflectivity/emissivity over a wide dynamic range. Our goal is to achieve 99% reflectivity with the hologram turned full-on, a dynamic range of at least 80% with a time constant of at least one second to reach the 90% point in either direction. In Phase II we will address the producibility issues of the tunable holographic film with our commercial partner, Polaroid. We will fabricate a model vehicle with a controllable reflectivity emissivity external skin and test this model in a solar simulation test chamber with the help of our aerospace partner, Lockheed. Anticipated benefits/potential applications - In addition to the potential of revolutionizing the thermal management design of spacecraft, earthbound vehicles and habitats, tunable holograms will have many applications in emerging laser based technologies including optical switches, beam dividers, optical neural networks, laser protection and a variety of optical computing systems. The automotive and architectural applications alone make tunable holograms an exciting commercial opportunity.

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Topic#: 92-061 ID#: 9211080
Office: ESTO
Contract #: DAAH0192CR285
PI: K. JAYARAJ

Title: Low-cost, Thermally Efficient 3-D Packaging

Abstract: Foster-Miller proposes to develop a low cost, low thermal impedance, modular packaging technology to meet the DoD's requirements for a rugged, 3-D package. It is based on the ultrahigh density, low cost multichip packaging (MCP) technology Foster-Miller is currently developing for DARPA. Individual multichip units will be stacked, assembled and interconnected to achieve excellent thermal, mechanical and electrical performance in a 3-D package. In the multichip unit, highly impermeable, low dielectric constant (ϵ = 2.6) Liquid Crystalline Polymers (LCP) provide hermeticity, chip-to-chip interconnections, and area i/os for module-to-module connections. In the baseline approach, z-interconnects are provided by well-developed printed wiring board fabrication techniques. If repairability is desired, a variety of options exist to provide z-connections at the edges including button boards, elastomeric connections and z-tape. This technology is applicable to both silicon and GaAs ICs, and will be useful up to several GHz. In Phase I, Foster-Miller will team up with Ensystems to evaluate current MCP and z-connection technologies and select a 3-D approach which incorporates these innovative features, and perform a cost-benefit comparison with other 3-D approaches. In Phase II we will provide a thorough electrical, thermal and mechanical reliability characterization of this technology, and implement it in a DoD electronic system. Demonstration of a highly reliable, low-cost 3-D package will establish a firm basis for a commercially supported Phase III program. Anticipated benefits/potential applications - DARPA's high performance communications and computing initiative will be the primary beneficiary of this development. DoD will benefit from the ability to incorporate a complete computer system in a smart munition. In the commercial sector, applications will be in large high performance computer systems, built-in signal processors for process control sensors, automotive electronics, and a wide range of civilian avionics systems.

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Topic#: 92-177 ID#: 9220338
Office: ESTO
Contract #:
PI: W. SCHROEDER

Title: Novel Computer Interface Using Eye Tracking

Abstract: The ideal computer interface should be usable: without "flat space," accessible from any posture; hands-free and hands-free portable; in any illumination or darkness, in any noise conditions, including those requiring hearing protection; with complete silence, if necessary; as a 3D virtual reality display an eyetracker interacting with a head-mounted display meets all these requirements. Information obtained by tracking the eye can be used by the computer as a pointing device (like a mouse). If both eyes are tracked and a display provided for each eye, pointing can be extended into the third dimension. Program development is planned to incorporate display technologies which will become available in the next 24 months. Phase I will specify and Phase II build and test a prototype of the device, which will make computer functionality available to support field, maintenance, and emergency work as well as extended usage for the everyday computer user. Applications for this technology beyond military and law enforcement include hands-free control, computer interfaces, and clinical tools for ophthalmologists

and neurologists. The results of this program will have value to eye tracking technology in any case, and may prove an important factor in HMD design as well. Anticipated benefits: Many applications (military, law enforcement, emergency crews, etc.) need a truly portable computer link. Where panel and flat space are restricted, or where protective clothing limits manual dexterity, such as in naval or space equipment operation and maintenance, advanced computer technology is inaccessible, since tactile data entry is impossible, or the flat space for a keyboard and screen is "somewhere else." If the device works out to be relatively efficient and low cost, users in less restricted applications will be found.

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Topic#: 92-184
Office: MICOM
Contract #:
PI: BRUCE GAMBLE
ID#: 9220358

Title: Electric Field Up/down Sensor

Abstract: Guidance sensors are an enabling technology for RPVs, UAVs as well as guided and autonomously guided munitions. Gyros have traditionally been used for these applications but tend to be complex and expensive. The atmospheric electric field is vertically oriented and sensors based on measuring the electric field gradient have been used in the past for guidance of aircraft. The Foster-Miller EFUDS (electric field up/down sensor) is an electric field roll angle sensor based on a cylindrical field mill which is extremely simple and has good sensitivity. The measurement for a more general definition of orientation. Missiles can become highly charged due to the impaction of atmospheric particles and due to the charging action of the missile exhaust. The proposed system provides atmospheric electric field measurement capabilities to determine the roll angle in the presence of significant vehicle charging. Under the proposed program the impact of atmospheric variation in electric field will be reviewed with respect to system requirements. A cylindrical electric field sensor will be designed and significant features demonstrated in Phase I by towing the sensor behind an aircraft equipped and instrumented for such measurements. A preliminary design of an electric field sensor for guidance will be developed and key features will be verified in testing. Anticipated benefits: The successful design of a cylindrical electric field sensor will find application for a number of military and commercial uses requiring automatic control. In particular it offers a simple and cost effective means of guidance for RPVS, guided and autonomously guided munitions. The electric field sensors also can be used to measure lightening strike potential which is critical for air vehicle electronics protection and route planning.

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Topic#: 92-221
Office: UWO
Contract #:
PI: ARNIS MANGOLDS
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Title: Lemmings - A Swarming Approach to Shallow Water Mine Field Clearance

Abstract: A method is proposed which uses a swarm of inexpensive, limited intelligence expendable vehicles to discover and neutralize man made devices such as mines and obstacles. The vehicles referred to as lemmings achieve a high rate of mission confidence using off the shelf components and some unique detection and control systems. The lemming swarm is shown to require only 2 percent of the delivery volume and weight of 100 percent optimized distributed explosives. The swarming approach is inherently reliable due to the high level of redundancy. A pseudo-random search pattern has been developed which is position independent, thereby freeing the system of the single greatest control constraint of automous systems. An aggressive search mode minimizes the units required and simulations have shown consistently greater than 90 percent discovery and neutralization rates using threat densities and tactically useful lane widths. A unique detection system is also described which distinguishes man-made from natural objects. The system takes advantage of the unique environment and operating principle of the lemming swarm. Proof of concept laboratory tests confirm detections is achievable without the need for extreme sophistication required by most systems. Neutralization is by detonation by a dedicated charge of 3 to 4 lbs of comp C4 contained within the vehicle. Detonation occurs at a present time interval. Other cargos such as beacons are optional. The overall lemming system architecture, simple design, and aggressive search pattern results in a countermeasure design which is as effective and of the same cost order as the threat mines. Anticipated benefits: The lemming sampling approach has a variety of applications whenever search and exploration is required. Similarly the feeler detection system is shown to be extremely sensitive and effective, and has a wide variety of potential applications wherever close proximity sensors are used. The Phase I effort will define, by test, the operational limits of all of the critical subsystems of the lemming swarm.

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Topic#: 92-224
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PI: MARK DRUY

ID#: 9220469

Title: Neural Networks Determine Degree of Cure in High Rate Composite Fabrication Processes

Abstract: Foster-Miller, Inc., proposes to develop a neural network classification of infrared spectral information to determine degree of cure for the fiber placement of thermosets. The proposed Phase I program will advance the state-of-the-art in sensor based intelligent control by combining Foster-Miller's fiber optic FTIR process sensing with neural network classification technology from our subcontractor neurodyne. The neural network will be trained to identify critical features in the infrared spectra of the resin and to calculate resin state properties. In Phase I we will begin training the neural network using our existing database of spectral information. Integration of the neural network hardware/software with a "look-down" resin state sensor would be performed in Phase II. This sensor/control system would then be combined with Foster-Miller's proven ultrasonically heated tape layer to demonstrate high speed placement of either thermoset or thermoplastic composites. The system and software would be sufficiently flexible to work with any other heating devices having similar characteristics (laser, microwave, hot gas) with minimal retraining. Anticipated benefits: Composite materials are attractive for many applications because of their high specific strength and stiffness, resistance to corrosion, low observable characteristics, etc. However, the labor intensive nature of manufacturing has inhibited widespread application of these materials. The advanced submarine technology and the composite armored vehicle programs will benefit from innovative process automation methods to ensure cost-effective manufacture of high-quality polymeric matrix composite structures.

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Topic#: 92-165
Office: DSO
Contract #: DAAH0193CR050
PI: JOHN KOSEK

ID#: 9220227

Title: Electrochemically Activated Fullerenes as Accelerants for Conductive Diamond Film Deposition

Abstract: Fullerness, particularly C70, have been shown to significantly enhance the nucleation rate for deposition of non-conductive diamond films on silicon. Researchers have deposited the C70 layer with an ion cluster beam deposition process and activated the layer with a microwave plasma method. Enhanced nucleation offers the potential for enhanced growth of superior ultrathin diamond coatings with a fine-grain structure, which are of interest for many applications requiring exceptional mechanical properties and chemical inertness. Recently, development by Giner, Inc. With boron-doped conductive diamond films has expanded the number of potential applications of diamond-film technology. We propose to investigate an alternative economic, scalable method for depositing a thin C70 layer by a solution-casting techniques, followed by electrochemical activation of the C70. We will investigate this novel deposition and activation method for enhancing the growth of conductive diamond films on select conductive substrates. During Phase I, we will investigate the nature of the chemical structure of the electrochemically activated C70 layers and correlate the morphology to the properties of the conductive diamond layer. Formation of superior, pore-free ultrathin conductive diamond films will be demonstrated through measurement of surface and mechanical properties and corrosion resistance. Following testing, any changes in film properties will be determined. Anticipated benefits: Fullerene-based, conductive diamond films are expected to find applications in many electrolytic cells, electrodes, and as bipolar plates for low-temperature (80-200°C) fuel cell systems. Potentially important industrial applications include aluminum production, fuel cells, batteries and plating industries. Military and commercial applications for diamond films include lenses for infrared detectors and wear-resistant coatings for tools.

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Topic#: 92-092
Office: MICOM
Contract #: DAAH0192CR304
PI: THOMAS CHEN

ID#: 9211075

Title: Common Intelligent Tutoring System Architecture Application to a Family of Weapon Systems

Abstract: Global Information Systems Technology, Inc. proposes to develop an Intelligent Tutoring System (ITS) architecture that is flexible, modularly structured to allow for future evolution, and which can be used in a family of tactical weapon systems in embedded training operations. In particular, we propose using an existing ITS for weapon system training, the Intelligent Embedded Operator Assistant (IEOA), developed in part by global for the U.S. Army Missile Command under the direction

of Dr. Willard M. Holmes, as a baseline for continued development and research. The IEOA will be enhanced and extended in a number of ways, including the addition of a new operator position. Student users can then be either operator type (e.g., tactical or radar operator), and the ITS will model the missing team member. The missing team member will be modeled either as an expert when the student is a novice, or as a novice (using another student's faulty or incomplete student model) when the student is advanced. Anticipated benefits/potential applications - The Intelligent Tutoring System (ITS) developed during Phase I and II will be generic and widely applicable to high performance, weapon system skill-maintenance domains. The architecture is well suited to air defense systems, which could be updated to include embedded training systems of this type, and new systems could be designed to integrate such an ITS. The ITS architecture is general enough to model other types of domains which require the operator to apply strategic rules to a dynamically changing environment. Some of the applications include manned and unmanned space operations training, remote robot manipulation, and air traffic control.

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Topic#: 92-134 ID#: 9220018
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Contract #: DAAH0193CR049
PI: CHARLES MOREFIELD
Title: Low-cost Airborne Data Systems
Abstract: The goal of this proposal is to provide a prototype system architecture for a broadcast data service that can provide real-time situation awareness information to a wide cross-section of airborne users. We will also carry out an actual flight demonstration of a low cost system for the air segment of the architecture. The technical risk associated with the flight demonstration is low since it will involve integration of commercial off-the-shelf hardware and an existing data transmission service. The FAA air traffic control system maintains a large database consisting of the radar positions of aircraft within us airspace. The database is currently constructed using transponder data from ground-based radars, and is shared across the conus air traffic control network. This information can be made available to airborne users on a cheap and timely basis, providing commercial, general-aviation, and military aircraft with onboard pseudo-radar displays for local air traffic. The system can also provide compressed weather images for display in the aircraft, as well as text message traffic. This proposal concerns the technical means of accomplishing these goals in a low-cost manner. Anticipated benefits: The major contribution of this work is to the civilian air safety. Onboard situation awareness systems are not currently part of civilian air traffic control. The integration of low-cost broadcast data networks with other technologies described in the study will make this possible for the first time.

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Topic#: 92-158 ID#: 9220846
Office: DSO
Contract #:
PI: JOSEPH HALLORAN
Title: Surface Strengthening of Advanced Structural Ceramics
Abstract: Two techniques for producing ceramic laminate composite materials have demonstrated improved strength, reliability and fracture toughness. The two techniques include inducing surface compressive stresses and reinforcing them with transformation toughened materials or materials reinforced with second phase particles, whiskers or fibers. Another surface modification techniques utilizes thermoelastically tailored reinforced laminates that combine both increased toughening and surface compressive stresses into a ceramic composite structure. Laminate design techniques were also used to incorporate crack arresting layers near the surface to prevent surface flaws from growing to critical size. A major advantage of laminated-composite processing is that it provides the engineering flexibility to use innumerable material and property combinations that would be impossible with traditional methods involving thermal or chemical tempering. This concept also allows the use of non-equilibrium compositions for greater degree of stress profile variation. Maximizing the stress gradient by the introduction of a high-expansion material in the interior of the composite is impossible by conventional chemical tempering but is feasible by lamination. Anticipated benefits: Laminated ceramic composite designs can be used in a variety of structural applications but the thermoelastically tailored gradient designs have great potential for armor systems. Applying compressive layers on both the front and back face of ceramic armor can be achieved by laminated designs. Other military and commercial applications that can make effective use of laminated ceramic composite designs include high temperature engine components and cutting tool inserts. For these applications both gradient tailoring and crack arresting layer designs are appropriate.

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Topic#: 92-012 ID#: 9210783
Office: ASTO
Contract #: DAAH0192CR236
PI: MICHAEL CROWE

Title: Interactive Flight Vehicle/ground Simulator Network for Close-in-combat Evaluation

Abstract: There are challenges in linking high-performance airborne vehicle(s), such as the DARPA X-31, with manned and/or unmanned ground-based air vehicle simulators to replicate Close-in-Combat (CIC) conditions and improve tactics evaluation. We discuss these challenges and the simulation concepts that can quantify the utility of emerging technologies and qualify their tactical significance. We describe the driving requirements for developing and implementing an appropriate simulation network environment; a multidimensional adversary simulation network that is an intelligently interactive, real-time manned and unmanned adversary simulation capable of supporting systems requirements evaluation efforts. Discussed are the various ways in which such a simulation technology can be leveraged to support emerging technologies such as the DARPA X-31 EFM demonstrator, and other emerging technologies. Development of a simulation network environment can serve as the conduit for linking advanced technology and simulation and can provide for the improved exploration of the valid definition of operational and tactical utility to be provided by a technology. Using an interactive flight vehicle/ground simulator network, the government is offered the opportunity to scrub requirements and evaluate emerging technologies and tactics, through an unmanned balanced-fidelity adversary representation and a manned flight simulator or airborne air vehicle. Anticipated benefits/potential applications - Results of this research will provide the technical foundation for establishing requirements for a prototype, low cost air combat simulation network utilizing two-way RF data-link and other advanced interface technologies. This system will be useful for the development and evaluation of future technologies to support advanced air combat. This research will lead to a revolutionary realization of advanced simulation and interface technologies.

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Topic#: 92-132 ID#: 9220478
Office: ASTO
Contract #:
PI: JOHN WEBSTER

Title: Low Cost, Non-destructive Inspection of Aircraft Composite Parts

Abstract: Composite materials have failure modes unlike metals and alloys, suffering from delamination, debonding and cracking as well as deterioration from ambient exposure. In addition to failure in service, these materials also suffer from defects in manufacturing similar to those which occur under field stresses. Techniques which are employed for in-plant NDE are not suitable in the field, and in most cases require skilled interpretation of the data. A system which exploits the change in vibration characteristics, that is modal response, of composites when they have internal defects has the potential of providing a low cost, low skill NDE methodology which could be used in either a factory environment or in the field, on small or large structures. Relying on induced vibration by impigment of sonic or laser impulse, and the remote measurement of the amplitude of surface waves by means of doppler laser techniques, such a system could provide on site evaluation and also data storage for comparison of damage propagation in time. A rugged, compact system is envisioned, suitable for adverse field conditions where inspection after a battle mission is desired. The components of the technology has been demonstrated; integration into a demonstrable unit is the aim of the project. Anticipated benefits: A system which can store defect data and monitor defect would make NDE of aircraft more reliable. Being automatic in operation operator skill and interpretation of data is greatly reduced. Military and commercial aircraft would benefit from the ability to more frequently test parts considered more susceptible to defect formation and growth. The system could be applied to a wide range of other structures requiring periodic certification.

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Topic#: 92-071 ID#: 9210209
Office: MTO
Contract #: DAAH0192CR237
PI: ELGIN EISSLER

Title: Growth of Bulk II-VI Crystals for Visible Light Emitters

Abstract: High quality zinc telluride (ZnTe) and zinc selenide (ZnSe) substrates are required for the current development of blue and green light emitting devices fabricated by Molecular Beam Epitaxy (MBE) and Organic Metallic Vapor Phase Epitaxy (OMVPE) processes. A suitable bulk growth technique will not only have the potential to produce large, high purity, low dislocation, heavily doped substrates, but will also have potential to evolve into a low cost substrate production process. This

project will investigate and improve the high pressure vertical bridgman bulk growth technique for substrate production. An undoped ZnSe monocrystal previously grown with this technique will be characterized as a benchmark. Heavy doping will be used to provide lattice strengthening resulting in low dislocation p-type ZnTe and n-type ZnSe. Chemical Vapor Deposited (CVD) ZnSe and vertically solidified zinc and tellurium will be used as starting materials after purity analysis. Finished crystals will be characterized by x-ray topography for defect structure, and by hall measurements for purity and conductivity. Phase II feasibility will be indicated by high conductivity doped single crystals with reduced dislocation defects when compared to undoped crystals. Anticipated benefits/potential applications - High quality substrates of these materials will aid the development of blue and green light emitting devices fabricated by MBE and OMVPE processes. This bulk growth technique could evolve into a cost effective substrate production process.

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Topic#: 92-090 ID#: 9210827
Office: MICOM
Contract #: DAAH0192CR238
PI: HAROLD HUMPAL
Title: Small Air-driven Power Modules
Abstract: The public domain literature contains very little information on small (under 1 kW) air-turbine-driven power systems. The principal investigator and proposing firm have experience in this area that is spread over many years, including a recent SBIR Phase I project. Data presented in this proposal shows that specifications for the 8.4 watt unit can be met using apparatus and technology currently possessed by the proposing firm. There are, however, several aspects of the existing system that can and will be improved prior to building and delivering a working prototype unit to DARPA. These include improving the impulse turbine efficiency, increasing the alternator power density by using new high energy density permanent magnets and the design of a more compact power conditioner/regulator. Implementing these improvements will, simultaneously, permit us to meet the specifications for the 56 watt unit. Phase I will deliver one working prototype and several designs for other power modules. DARPA may select the design criteria which they wish to emphasize and then, in Phase II, optimized versions of these designs, selected for increased efficiency and lower production costs, will be built during Phase II. Anticipated benefits/potential commercial applications - this project will result in a new approach to the design of efficient, rugged, compact power modules. The high power density alternator that is developed here should find wide application in small, portable, emergency power supplies that span the power range from 5 watts to over 30 kW.

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Topic#: 92-038 ID#: 9210408
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Contract #: DAAH0192CR239
PI: ROBERT KOSUT
Title: Control of Industrial Processes Via Convex Optimization
Abstract: The Phase I technical objectives are: (1) to further develop the convex optimization approach to controller design for process control applications, (2) investigate features and functionality of new graphical CACE tools that are appropriate for the process control industry, and a manufacturing system of interest to DoD which can serve as a target application. The basic approach to (1) involves directly designing a good closed-loop response, as opposed to designing an open-loop controller that yields a good closed-loop response. A wide variety of important constraints on system performance can be formulated as convex constraints on the response of the closed-loop system, e.g., peak RMS, step response bounds, frequency domain (singular value) bounds, settling time, and percent overshoot. The advantage of this approach will not be realized unless the interface between the designer and the controller analysis and synthesis program (2) is convenient and natural. We propose that the interface should be entirely graphical: the designer will select and drag the specifications (e.g., frequency response or step response bounds); the controller design code will compute a controller that satisfies the specifications (or relax the specifications if they are infeasible). Anticipated benefits/potential applications - The proposed approach to process control design will have potential use at many government material processing labs. The potential commercial application is both in aiding process engineers with controller design as well as developing a new CACE tool market in the process control industry.

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Topic#: 92-004 ID#: 9210008
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Contract #: DAAH0192CR240
PI: JEFFREY SHELLAN
Title: Remote Sensing for Climate Research and Tactical Surveillance
Abstract: Governments worldwide have recently concluded that they face an issue unprecedented in the history of science and technology - anthropogenic modifications to the biosphere which could, potentially, have a trillion dollar impact on the world economy. The purpose of the proposed work is to design a small satellite which will be capable of making the key measurements needed to investigate these climate changes. Since many of the instruments needed for climate measurements have much in common with the increasing need for tactical surveillance, the sensor suite will also be designed to satisfy the surveillance mission. The key tasks which will be completed during the proposed program will include, 1) determination of the key requirements for the dual mission satellite, 2) analysis and design of the payload instruments and support hardware (cameras, filters, FPAS, telescope, scanner, WFOV radiometer, instrument calibration, and data management), 3) identification of launch vehicles, and 4) cost and schedule estimate. JBST plans to make extensive use of previous work conducted by NASA for EOS, as well as groups with experience with lightsat instruments and support hardware used in surveillance and climate monitoring. These groups include LLNL, LANL, DARPA, NASA Goddard, TRW, DSI, Sandia, and JBST. Anticipated benefits/potential applications - Near term, low cost satellites are urgently needed to investigate anthropogenic climatic changes, which could have an enormous impact on the world economy. If those satellites could also be designed for tactical surveillance, the DoD savings would be significant. The remote sensing data would also be beneficial to commercial interests such as businesses involved in agriculture, fisheries, forestry, mineral extraction, mapping, media, insurance, real estate, and waste management.

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Phone: (203) 786-5130
Topic#: 92-040 ID#: 9210513
Office: DSO
Contract #: DAAH0192CR241
PI: BRET HALPERN
Title: High Intensity Ti and Mg Jet Vapor Sources for Deposition of Microlaminate Composite Materials
Abstract: Composite materials composed of alternating, submicron layers of disparate materials, such as ceramics and metals, have enhanced mechanical properties when compared with conventional materials. The challenge is to economically manufacture such materials at high rate and low cost in the form of "near net shape" components with local properties "tailored" for the intended structural application. We propose to develop high rate Ti and Mg metal vapor sources for use in our innovative, patented Jet Vapor Deposition (JVD) process for microlaminate composite material fabrication. JVD has already been used successfully to deposit high quality Al/Al2O3 microlaminate materials at high rate. The goal of this Phase I effort is to extend the JVD process to high rate deposition of the structurally important Ti and Mg materials systems. A further goal is to enhance the jet source deposition rates to as high as 1 cm3 per minute for higher throughput and lower cost manufacture of microlaminate composite materials. Anticipated benefits/potential applications - Phase I success will add to the foundation for low cost manufacture of high quality, advanced microlaminate structural composites in the form of "near net shape" components with both bulk and surface properties tailored for use in advanced aerospace, automotive, and biomedical applications.

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Phone: (908) 647-6890
Topic#: 92-175 ID#: 9220103
Office: ESTO
Contract #: DAAH0193CR048
PI: JOHN BROWN
Title: Innovative Color Filter Materials
Abstract: The color filters currently used to convert black-and-white LCD displays to color displays severely limit the brightness of the displays because available color filter materials (dyes and glasses) are inherently rather broadband. Consequently, if they are dense enough to limit the transmitted light to a reasonably narrow band for color purity, they also cut down on the brightness of the transmitted light. What is needed is a family of dyes with steep cutoffs at the edges of their passbands; in other words, unusually narrow passbands. Few, if any, dyes of commerce offer narrow passbands; but the porphyrin and phthalocyanine dyes offer unusually narrow absorption bands, and the absorptions of a series of narrowband absorbers can be "stacked" to five a filter with a bright, steep-sided passband anywhere in the spectrum. Some porphyrin and phthalocyanine dyes are available, but not

enough of them to fill the spectrum. This proposal offers to develop syntheses for additional dyes with narrow absorption bands spaced throughout the visible spectrum and to demonstrate the enhanced display brightness that they can provide. Anticipated benefits: These new dyes will enable the manufacture of color filters with high light transmission and high color purity for use in both military and civilian lcd displays. The technology can also be used in the manufacture of improved photographic color films and in the manufacture of greatly improved inexpensive sunglasses.

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Topic#: 92-209 ID#: 9220907
Office: SSTO
Contract #: DAAH0193CR051
PI: PERAKATH BENJAMIN

Title: Virtual Factories as a Mechanism for Continuous Business Re-engineering

Abstract: The primary goal of this project is to develop and demonstrate a simulation/factory control capability to (1) simulate products, processes, and factory configurations at multiple levels of abstraction, (2) provide fine grained analysis of product and process designs, and (3) provide a model driven factory control architecture so that the models executed in the simulation studies can be directly used as the factory control logic. The results will provide an enterprise-wide evolution support environment to facilitate CALS & CE technology transfer to DoD agencies and contractors. The strategy is to investigate the use of a Continuous Business Re-engineering (CIBR) concept as an effective means for change management. The tasks include development of: (1) manufacturing process ontologies, (2) a constraint-linked network of business process models, (3) inter-model constraint representations, (4) representations for the constraint-linked network of business process models, (5) a proof of concept prototype qualitative reasoner for organizational change impact prediction, and (6) an architecture to implement the CIBR concept. Phase I results will provide the basis for a more detailed characterization of organizational change impacts, and the development of quantitative tools such as simulation modeling support. Anticipated benefits: Since continuous and pervasive change will be the prominent characteristics of the coming information age, the development of sophisticated technology to manage change will likely distinguish success from organizational failure. The concepts and methods that will emerge at the end of this Phase I effort will provide the foundation for new technology to effectively manage change. Moreover, the development and use of the constrained process network paradigm as an enabler of organizational change is a significant scientific contribution.

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Topic#: 92-072 ID#: 9210954
Office: MTO
Contract #: DAAH0192CR242
PI: S. OFFSEY

Title: Feasibility of Efficient Blue Light Emitting Diodes

Abstract: There is a need for higher efficiency blue LEDs for uses such as discrete lamps and especially multi-color LED displays. When compared to green and red LEDs, which have efficiencies as high as 10%, blue LEDs are presently less than 0.1% efficient. Therefore, it is necessary to increase their efficiency to make them compatible with the drive electronics presently used for red and green LEDs. In Phase I, we will address the feasibility of improving the radiant efficiency of blue LED material. In Phase II, we will develop proof of concept blue LEDs for use in multi-color displays. Commercialization will be carried out in Phase III. Anticipated benefits/potential applications - This work will result in blue LED material for brighter, more efficient discrete LED lamps and multi-color LED displays. The increased luminescence efficiency will also be directly applicable to blue lasers made from the same material.

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Topic#: 92-041 ID#: 9210775
Office: DSO
Contract #: DAAH0192CR243
PI: RYSZARD BURZYNSKI

Title: Novel Photorefractive Media for Optical Memory Storage Using Multicomponent Inorganic-organic Composites

Abstract: There is a convincing need for novel and reliable memory storage devices to be used in rapidly advancing optical computer technology. The novel optical storage devices must have the attributes of high density data storage and retrieval with high speeds to be compatible with ultra-fast optical computers. Materials which can be used for this type of erasable high

density memory devices are photorefractive materials exhibiting a reversible refractive index change under a low power laser beam illumination. Information recording in the volume of a photorefractive material potentially offers a storage density of 10(12) bits cm-3. The proposed Phase I research utilizes sol-gel technique to fabricate processable photorefractive material made of novel inorganic gas/organic polymer composite. The flexibility of sol-gel processing of the materials allows to vary constituents of the proposed composite to achieve high photorefractive sensitivity and diffraction efficiency, and low dark current conductivity. The processing ease of the proposed materials enables route to inexpensive, reconfigurable and high density optical memory storage devices. Anticipated benefits/potential applications - The proposed approach to fabricate inorganic/organic photorefractive materials will be an effective and versatile technique for producing efficient, high speed, and high density optical memory devices. Applications include optical computing and high definition video display.

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Topic#: 92-162 ID#: 9220004
Office: DSO
Contract #: DAAH0193CR008
PI: JEFFREY KMETEC

Title: Coupling of Quasi-Continuous Wave (Quasi-CW) Diode

Abstract: Quasi-continuous wave diode lasers (arrays) are the most powerful and least expensive form of light obtainable from semiconductors. Unfortunately the output beam spatial properties are poor, and the highly rectangular, relatively incoherent radiation pattern is difficult to use. In contrast, the uniform, circular output emission of an optical fiber is a very useful form of radiation. If diode arrays could be efficiently coupled into an optical fiber, they would gain a much wider acceptance. This proposal addresses a new idea which is capable of coupling one or more quasi-CW arrays to a single fiber with very high specific brightness. This technique is potentially simple, robust and highly efficient. The theoretical brightness through the fiber can be virtually as bright as the diode emitter stripe itself. We anticipate this coupling will allow a 5-array stack to produce 350 w (200 microsecond pulse) of light through a single 900 micron fiber, with a numerical aperture of .18. Anticipated benefits: This technique provides an optimal solution for the coupling problem and will expand the utility of quasi-CW arrays. Applications include solid state laser end-pumping for high energy, high beam quality diode-pumped systems, in addition to precision machining, laser ranging, and flash infrared illumination.

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Topic#: 92-033 ID#: 9210505
Office: DSO
Contract #: DAAH0192CR244
PI: CURTIS GRIFFIN

Title: Flexible Manufacturing of Advanced Structural Ceramics Using Laminated Object Manufacturing Techniques

Abstract: Fabricating ceramic prototypes or manufacturing low volume quantities of ceramic parts is a costly, time-consuming, and inflexible process. These restrictions limit the use or even the consideration of ceramics in some applications. A variety of techniques have been developed to produce paper- and polymer-based parts directly from a computer-aided drawing without any hard tooling, dies, or molds. Lone Peak Engineering and Helisys see an opportunity to develop a flexible manufacturing process for advanced structural ceramics using one of these techniques, Laminated Object Manufacturing (LOM). Using the LOM process, ceramic parts call be produced in a matter of days compared to the months sometimes required by conventional methods. This process will be flexible and suitable for a wide variety of ceramic materials in virtually any configuration. The LOM process will vastly expand the range of applications being considered for ceramic materials. This Phase I project will demonstrate that LOM can be used to manufacture high density, advanced ceramics. In Phase II, an LOM system specifically for ceramics will be designed and constructed. Using this system, a component of interest to DoD will be produced. The flexibility and cost- and time-savings of the LOM process will also be demonstrated in Phase II. The proposed project will be a joint effort between Lone Peak Engineering, Inc., who has a strong ceramics background, and Helisys, Inc., who has pioneered the development of the LOM process for non-ceramic materials. Anticipated benefits/potential applications - Once fully developed, the LOM process will provide a cost-effective, rapid method to produce advanced ceramic components for both military and nonmilitary applications. The LOM process can also be used to rapidly prototype ceramic components for new applications or in new designs.

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Topic#: 92-026 ID#: 9210950
Office: DSO
Contract #: DAAH0192CR245
PI: OLIVER MURPHY
Title: Applications of Fullerenes: Catalyst Supports for Aqueous Fuel Cells
Abstract: Fuel cells operating in aqueous electrolytes (below 200°C, depending on the chosen electrolyte technology) normally operate on hydrogen fuel and oxygen (or air) as the oxidant. High-performance fuel cell electrodes require high catalyst surface areas, good electronic conductivities and broad reaction zones, defined by the contact area between the catalyst, the gas phase reactant and the electrolyte. For electrodes of this type, a stable, low-density, electronically conducting catalyst support is required. High surface area carbon blacks are usually used, with areas between 250 and 450 M(2)G(-1). Such carbon blacks support rather stable platinum crystallites with surface areas of about 100 M(2)G(-1) in a 10 wt % loading prepared by colloidal methods. They are used in all situations where carbon blacks are stable. However, all carbon materials are lacking in stability to a greater or lesser degree for fuel cell applications requiring the highest performance. An improvement in properties is required. The essentially aromatic fullerenes with no dangling bonds and rather inert surfaces may have the appropriate stability in aqueous solutions. They have high surface areas (800 M(2)G(-1) for the outside surface of C(60)) and should have greater stability than common graphite edge planes. No experimental data on them has been reported in aqueous media. The purpose of this proposal is to examine the basic electrochemistry of fullerenes in aqueous media, investigate their oxidation/corrosion behavior and determine their electrode potential regions of stability for fuel cell applications. If successful, fullerenes can bring about a great improvement in aqueous fuel cell performances by permitting operation under more extreme conditions. Anticipated benefits/potential applications - Replacement of easily degraded carbon blacks and/or graphite powders in existing fuel cell electrode structures with fullerene materials will give enhanced stability to, and improved performance from, a new generation of fuel cell electrodes. Technology arising from this project will give rise to oxidation resisting, chemically and electrochemically stable, high-performance noble metal-catalyzed electrodes suitable for use in aqueous fuel cells.

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Topic#: 92-186 ID#: 9220154
Office: MICOM
Contract #: DAAH0193CR009
PI: BRYAN SEEGERS
Title: Design and Fabrication of an Ultra Low Cost Turboprop for RPV/UAV Applications
Abstract: M-Dot, Inc. proposes to design, fabricate and test a propeller drive gearbox, turbine and governor system for attachment to a low cost expendable turbojet engine. The system will be designed for application on the Sunstrand TJ-90 engine and will utilize existing and proven technologies. The system will consist of the following: 1. Drive turbine, nozzle and nozzle inlet duct configured to be attached directly to the turbine exit duct of a Sunstrand TJ-90 turbojet engine. 2. Gearbox with oil mist lubrication and speed sensor. 3. Bifurcated exhaust duct with heat shield. 4. Electronic speed governing system. 5. Fixed pitch propeller the Phase I program would accomplish the following: 1. Design and construction of a reduction gearbox with lubrication system and speed sensor. 2. Design and construction of an axial flow drive turbine and associated ducting. 3. Design and construction of an electronic fuel control. 4. Specification and procurement of a fixed pitch propeller. 5. Performance testing of the above systems on a Sunstrand TJ-90 or turbocharger based gas turbine power plant. Anticipated benefits: A small low cost turboprop engine would provide increased performance for UAV/RPVS presently powered by piston engines. Additionally, safety of operation and operational commonality would be improved due to use of jet fuel instead of gasoline.

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Topic#: 92-109 ID#: 9211300
Office: MICOM
Contract #: DAAH0192CR246
PI: JERRY POLLON
Title: Multiple Beamwidth MMW Antenna
Abstract: Malibu Research has developed techniques for extremely rapid scan of W-band and KA-band beams (> 500°/s) known as an edge-eagle scanner. This antenna operates on the principle of voice-coil modulation of one wall of an edge-slotted WR-10 or WR-28 waveguide. It has inherent to its operation the ability to obtain a widely varying non-linear aperture phase and thus the ability to generate up to a 30:1 variable beamwidth. Under the proposed SBIR Phase I program, a detailed analysis of such

a design will be performed. An experimental demonstration of at least 10:1 beamwidth variation utilizing an existing 4" w-band antenna will be performed with 1ms to 2ms beamwidth switching time. As a part of the proposed Phase I program, Malibu Research also proposes to evaluate the feasibility of using a second Malibu Research antenna technique known as FLAPS, for generation of a variable beamwidth. This technique uses a unique electromagnetic structure having the capability of scattering feed-incident RF energy in specific patterns. This has been used to generate switchable pencil and CSC2 patterns from the same antenna. By means of a similar design it should be possible to generate an electronic variable beamwidth antenna. The FLAPS technique, described in this proposal, is particularly applicable at w-band. Anticipated benefits: Low-cost, electronically variable beamwidth antenna for commercial aviation and commercial automobile collision avoidance radars.

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Topic#: 92-095 ID#: 9211264
Office: MICOM
Contract #: DAAH0192CR247
PI: RANDALL O'CONNOR

Title: Earth Penetrating Radar

Abstract: This proposal addresses the design of a low frequency airborne earth penetrating radar which will detect buried objects and earth cavities (as contrasted to imaging them). It uses low directivity loop-dipole antennas, ground clutter cancellation through frequency diversity and possibly lobe switching. It might also detect radar camouflage. We also propose .01 scale model experiments to search for submerged objects from the air over a tray of salt solution. An appendix where we develop the equations needed for the scale model also shows that the ground conductivity is critical in determining the frequency at which such a system can operate. Ranges of earth conductivity from the literature are given, but we also propose a search for better data and the design of experiments to collect such data from the air in regions of military interest. A notable feature of the proposal is its emphasis on the basic limitations of earth penetrating radars. A two volume final report is offered. One volume will be devoted to these basic limitations, tradeoffs and sensitivity analysis. It will be self contained, in readable form, intended as a reference and starting point for further work and management decisions in this subject area. Anticipated benefits/potential applications - Locating near surface underground features such as springs, ruins and old streambeds. Archaeologic features such as stone structures also represent differences in conductivity and might be located by such a device. It is also conceivable that, with progress in electronics, the concept could be implemented in hand held devices such as those now used to find lost coins, ring and other conducting objects in sand beaches.

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Topic#: 92-139 ID#: 9220510
Office: CSTO
Contract #: DAAH0193CR013
PI: PATRICK DEAN RUSK

Title: A Command Editor Tool for Nextstep and X-windows Systems

Abstract. Marble Associates, Inc., proposes to develop a command editor to run under Nextstep, Motif, and Open Windows. This tool will allow users to customize the menus and command-key equivalents used within applications to suit their individual needs and to construct palettes of frequently used commands. It will integrate seamlessly with various development environments, enabling developers to add this functionality to their applications with minimal effort. It thereby promotes two important graphical user interface goals: ease of development and user customization. The command editor will be a set of interface classes that can be added to applications with little extra programming. In particular, the Nextstep version - to be delivered at the end of Phase I - will integrate seamlessly with interface builder as a set of objective-C classes with palettes and inspectors. The Motif and Open Windows versions will similarly integrate with programming tools available on those environments. With the command editor, users will be able to add, remove, or rearrange application menus to suit their needs. Furthermore, they will be able to assign any number of command-key equivalents to any commands within a program, regardless of whether the commands appear in menus. Finally, users can group frequently used commands into palettes for easy on-click access. Anticipated benefits: Both users and developers will immediately benefit from Marble's command editor tool. Users will benefit by being able to reconfigure the command structures of their programs to make them easier to learn and more efficient to use. Developers will benefit by being able to add this functionality to their applications with very little programmatic effort.

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Contract #: DAAH0192CR297
PI: AUGUST RIHACZEK

Title: Innovative Detection and Tracking Techniques for Missile Seekers Engaging Low Flying and Hovering Aircraft in Clutter

Abstract: Two of the outstanding problems in radar are the detection of hovering helicopters and the detection of cruise missiles flying nearly perpendicular to the radar line of sight. The problem is essentially the same in both cases: the returns are weak (except for the flashes from the rotating blade, which occur too infrequently for reliable detection), and they appear within the ground clutter spectrum, which means that they cannot be enhanced by doppler filtering. The proposed solution is based on a new type of radar signal processing that was developed at mark resources for identifying airborne targets. Basically, with this new signal processing it is possible to extract very detailed information from the returns that can be used to discriminate between legitimate targets and clutter. The viability of the concept will be demonstrated during Phase I by processing real data. Anticipated benefits/potential applications - The primary benefit will be that the detection of hovering helicopters and low-flying cruise missiles will be accomplished purely by radar, which should prove to be much more reliable than the fusion of data from several sensors.

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Topic#: 92-030 ID#: 9211149
Office: DSO
Contract #: DAAH0192CR277
PI: LORI LEASKEY

Title: Compressive Surface Strengthening of Whisker Reinforced Composites

Abstract: The development of whisker reinforced structural ceramics with superior mechanical properties has been limited by strength controlling flaws which are often present on the surface. The presence of a compressive surface layer is known to be effective in preventing growth of these flaws. However, techniques which have heretofore been utilized have been ineffective in that the improvement in mechanical properties is not maintained to high temperatures and the processing employed is prone to introducing additional flaws. The technique proposed here has neither of these disadvantages and results in improvements in both strength and fracture toughness to at least 1400°C. This process involves the controlled oxidation of Al(2)O(3)-ZrO(2)-SiC(w) composites to produce a compressive surface layer on a sample of any size or shape. Pressureless sintering of these composites will be investigated so that fabrication of high strength complex shape structural ceramics will be possible. Anticipated benefits/potential applications - The development of a process to enhance the properties of ceramic composites and increase their reliability will result in the widespread use of ceramics and composites. Applications for these superior property composites will include armors, heat engine components, and load bearing structure parts for aerospace applications.

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Topic#: 92-030 ID#: 9211295
Office: DSO
Contract #: DAAH0192CR257
PI: JAN-FONG JUE

Title: Novel, MoSi2-based Composites with Surface Compressive Stresses

Abstract: Flaw sensitivity limits applications of ceramics in several structural applications. Majority of failures originate from surface flaws introduced during service. Enhanced resistance to contact-induced damage should significantly increase application of ceramics. Three layer composites consisting of surface compressive zones described in this proposal exhibit extremely high resistance to contact damage. Even after indenting with a vicker's indenter under 1000 n (225 lbs.) load, the strength is retained to greater than 600 mpa (100 KSi). In the preliminary work, this was achieved in Al(2)O(3)-ZrO(2) by forming layered structures with outer layers containing unstabilized zirconia and alumina. The technique is not limited to oxides. It is proposed that MoSi(2)-based three layer composites with SiC and mullite as outer layers is proposed. Strengths in excess of 2 gpa with excellent damage resistance is anticipated. The effect of surface compressive stresses will be to enhance the reliability of structural ceramics. Anticipated benefits/potential applications - The development of structural ceramics with excellent resistance to contact-induced damage, which is the main shortcoming of ceramics, and strength retention to 1400°C will be the principal benefit. These ceramics will have applications as wear parts, valve seats, armor plates, cutting tools, diesel engine parts and ceramic turbines.

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Topic#: 92-191 ID#: 9220290
Office: MICOM
Contract #: DAAH0193CR014
PI: ANTHONY CAIAZZO

Title: Development of an Integrated Design and Automated Fiber Placement System

Abstract: The opportunity is to develop an innovative design system for composite parts with complex shapes which integrates advanced materials modeling techniques, structural optimization and automated software for manufacturing process development. The proposed program will explore the development of the technologies which integrate composite materials design methods with robotics manipulator code for controlling fiber placement paths on a shell structure of complex shape. Fiber placement is a technique which can produce composite parts of complex shape and reinforcement architecture while maintaining fiber volumes, stiffness and strengths which are achieved in simple filament wound geometries. The approach is to use physically based analytical materials models for continuous fiber composites and structural mechanics methods to establish fiber architectures which meet design goals for a thermoplastic matrix composite shell structure with protruding finds. The Phase I development effort will focus on a specific part design and transforming the structural design requirements into fiber paths which can be followed by a robotics manipulator. A small scale demonstration article will be fabricated. Anticipated benefits: To make a major impact on defense a commercial markets, advanced composites must become most cost competitive. Integration of materials analysis, structural design and manufacturing systems will lead to reliable cost effective applications of composites for structural applications.

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Topic#: 92-061 ID#: 9210941
Office: ESTO
Contract #: DAAH0192CR325
PI: JUSTIN BOLGER

Title: High Interconnect Density Substrate for 3-D Packaging

Abstract: Merix proposes a new method to make 3-D multilayer copper on kapton substrates, which can provide a very high density of interconnections between closely packed chips. The new substrate can be used to mount chips in a 2-d array, as in MCM's, or in a 3-D stacked chip array. Connections between chips, or chip stacks, and substrates can be made by solder, by tab or by wire bonding. The new substrates will be made by adhesive bonding 7 or more circuit films to each other and to a copper support structure. Each circuit film has a 0.8 mil thick copper circuit pattern formed on a 1 mil thick kapton support film. Circuit line widths can be as small as 2 mils on 4 mil pitch. This construction permits the same number of interconnections as with conventional multilayer substrates, but has major advantages in head transfer, cost, manufacturability, reliability, ruggedness and signal quality. Anticipated benefits/potential commercial applications: this process will lower the cost of faster, multichip modules.

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Topic#: 92-130 ID#: 9220684
Office: ASTO
Contract #:
PI: JAMES LARSEN

Title: Multi-Media Network-Layer Protocols to Support Meteor Burst (MB) and Other Communication Media

Abstract: Under an existing IR&D program Meteor Communications Corporation (MCC) demonstrated that US Standard 2400 bps LPC-10 vocoded voice could be sent in near real time using a high performance meteor scatter system. This proposal investigates techniques to simultaneously improve the quality, recognizability, and intelligibility of the received voice and at the same time reduce number of bits per second required to send voice. We will investigate replacing the existing standard vocoder with experimental vocoders developed by the government. New modem techniques designed for enhancing performance of the vocoder will be investigated. These new vocoder technologies capable of operating at bit rates as low as 800 bps could allow high quality vocoded voice to be used on ordinary meteor scatter communications links. New link level protocols will be investigated to reduce delays. A novel adaptive protocol will be designed to reduce or increase the vocoder transmission rate to match enhancements or reductions in system capacity. An experiment will be conducted using the existing high performance link consisting of adaptive data rate protocol modem, high power amplifiers, and a multiple receiver phased array antenna system. Anticipated benefits: Incorporation of meteor scatter communication into conventional packet data communication infrastructure. Intelligent use of all available communication assets.

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Topic#: 92-055 ID#: 9211214
Office: ESTO
Contract #: DAAH0192CR278
PI: WENDELL PETERSEN

Title: Advanced High Power InP Millimeter-Wave Devices and Circuits

Abstract: Short gate length GaAs based MESFETs and modulation-doped FETs (MODFETs, or HEMTs) have demonstrated respectable gain and low noise figure at frequencies as high as 94 GHz; however they can not provide high power with high associated efficiency. InP based lattice matched modulation doped FETs, on the other hand, possess a combination of properties including high thermal conductivity, high saturated electron velocity, and potential high breakdown voltage which will allow truly spectacular performance for millimeter-wave power applications. Preliminary measurements of one micron gate test devices incorporating this materials structure have already demonstrated a transconductance of 410 ms/mm and a current density of 500 ma/mm. A related InP based heterostructure has also demonstrated a gate-source breakdown voltage of -12 volts. Microwave Monolithics Incorporated and its subcontractor, the University of California at San Diego, therefore propose to further develop this materials and device technology and apply it to the design and fabrication of millimeter-wave power circuits. A suitable test structure will be designed, fabricated, and characterized during program Phase I. Measured performance of this device will then guide the design and fabrication of a TBD high power millimeter-wave test device/circuit (such as a 60 GHz high efficiency power amplifier) in program Phase II. Anticipated benefits/potential applications - The primary applications of the proposed high efficiency millimeter-wave power devices and circuits are expected to be in the areas of inter-satellite links and millimeter-wave imaging systems, which are equally important for military and commercial communications and resource monitoring/surveillance requirements. Secure short range communications systems will also benefit from these components.

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Office: LSO
Contract #: DAAH0192CR279
PI: D. KOZAKOFF

Title: Sensors For Airborne Detection And Discrimination Of Buried Land Mines

Abstract: The availability of airborne sensors capable of detecting buried and surface minefields from altitudes of 100 feet, or higher, would be a significant asset to U.S. Defense forces. This system would not only improve the effectiveness of our forces, but also reduce man and material losses which are of particular importance in the future down-scaled Army. The posed solution to this problem is to utilize novel Ground Penetrating Radar (GPR) with suitable signal processing and target discrimination algorithms. MWT proposes to exploit artificial intelligence techniques to sort through and evaluate the large amount of data, and graphically present the results to the operator. We believe this can be accomplished within the state-of-the-art, and at low cost. The selected waveform is FMCW, and the quasi-monostatic antenna array can either be mounted on the aircraft for forward or side looking scan Field-of-View (FOV). A case of particular interest to be studied is the side looking fixed beam which utilizes aircraft forward motion to scan the battlefield. This case has no doppler component due to aircraft motion, and simplifies the signal processing process. Polarization and complex natural resonances are viewed as strong discrimination candidates for mine detection against background clutter. Generation of a 2-D field map and application of grey scale mapping is another possible discrimination tool to be researched. Anticipated benefits/potential applications - MWT is sensitive to the growing need of an advanced sensory instrument which will accurately detect and locate underground pipes and gas leaks within underground piping systems. This instrument would find major applications within the gas or petroleum industry. Other requirements are emerging within the utilities industry to accurately locate and classify cables and other buried assets.

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Topic#: 92-029 ID#: 9210163
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Contract #: DAAH0192CR258
PI: J. HENLEY

Title: Secure Communications Systems Based on Encoding of Chaotic Carriers

Abstract: Scaled probabilistic methods of nonlinear signal processing have been shown to be capable of separating known nonlinear signals from noise at very poor signal to noise ratios. Second, these methods can restore the nonlinear signal, even if it has been distorted in some ways, such as by suppressing certain frequency bands. These methods also restore the nonlinear time domain signal itself and not only the geometric properties such as the attractor structure. As a result, scaled probabilistic

methods may prove key to the development of covert communications methods that take advantage of the noise-like broad band nature of chaotic nonlinear signals to hide their presence. This Phase I SBIR project will demonstrate the feasibility of using nonlinear signals as carriers of information, even under adverse noise conditions, by the application of the scaled probabilistic methods. Anticipated benefits/potential applications - The results of this research will demonstrate new methods of providing secure and covert communications. Military and intelligence applications include use in the battlefield, underwater communications with remotely controlled vehicle and demolition teams and covert intelligence communications. It could also be used to identify friend or foe. Commercial applications include all communications over public airwaves where privacy is desired, such as banking and communications to negotiating teams.

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Topic#: 92-202 ID#: 9220759
Office: NMRO
Contract #: DAAH0193CR066
PI: MARK FISK
Title: Development of a Statistical Framework for Evaluating the Identification of Seismic Events
Abstract: The primary objective of the DARPA nuclear monitoring program is to monitor small or clandestine underground nuclear tests. This requires that we are able to detect, locate and identify decoupled 1 kt explosions (equivalent to magnitude 2.5). Regional identification of small seismic events is a complex problem that has not been solved, although a number of promising methods have been developed. To monitor nuclear proliferation effectively, both scientifically and politically, it is crucial to have a statistical framework that (1) carefully treats the random fluctuations in seismic signals, including correlations among the features used as discriminants; (2) is able to quantify classification probabilities, including false alarm rates; (3) is capable of identifying nuclear explosions in regions for which relevant nuclear explosion training data do not exist; and (4) provides a rigorous framework in which to report and justify the results. In this proposal, we discuss many of the important issues that must be addressed, and a plan to combine promising statistical methods and region-specific knowledge. We propose to develop a multivariate statistical package to meet these objectives, and to implement it as a subsystem of the IMS. Anticipated benefits: This effort will provide a critical review of applicable statistical methods, and a summary of relevant region-specific distributional information. It will demonstrate the applicability of certain discrimination methods, and describe how they can be incorporated in a statistical package, which will include estimation of classification probabilities. This work will also benefit other identification systems, either by addressing unresolved statistical issues, or by providing a framework to combine promising elements of those systems.

MO-SCI CORP.
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ROLLA, MO 65401
Phone: (314) 364-2338
Topic#: 92-028 ID#: 9210447
Office: DSO
Contract #: DAAH0192CR223
PI: YONGREN PENG
Title: High Strength Silicon Nitride and Oxynitride Glass Fibers
Abstract: A new technology of preparing silicon nitride and silicon oxynitride glass fibers is proposed. Continuous silicon nitride and oxynitride fibers will be prepared at low processing temperatures and at low material, equipment and operating cost. Silica and other selected porous high silica (nanometer pore size; ~96wt%. SiO(2)) glass fibers will be prepared. These glass fibers will be nitrided in a separate process in ammonia using proven procedures. The key development will be establishing a dynamic nitriding profile that takes into account the property changes as more nitrogen is chemically dissolved/diffused into the glass fiber. Important parameters such as optimum nitriding temperature and time, and optimum nitrogen content in these fibers will be investigated. Anticipated benefits/potential applications - Potential applications for this work include the use of silicon nitride and oxynitride fibers as reinforcement in high strength/high temperature composite components for engines, heat engines, and light weight armor. Also, the lower cost will permit such fibers to be used in polymer composite systems.

MOLECULAR PROBES, INC.
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Phone: (503) 344-3007
Topic#: 92-129 ID#: 9211146
Office: UWO
Contract #: DAAH0192CR224
PI: RICHARD HAUGLAND
Title: Tracers and Instrumentation for Velocity Measurements in Complex Vertical Fields

Abstract: The Defense Advanced Research Projects Agency (DARPA) has identified a need for new instrumentation techniques capable of velocity measurements for highly unsteady, complex vortical fields characteristic of flow around a submarine. This proposal, prepared in collaboration with the Princeton University Laser and Applied Physics Group, offers a new optical flow field diagnostic capable of three-dimensional tracking of specific fluid elements in both space and time. The technique is readily performed in water and has the potential to be used in large-scale flow facilities with a minimum of instrumental complexity and image post-processing. Molecular probes will design and synthesize new Photoactivated Fluorophores (PAFs). When a UV laser beam (or suitable non-laser source) illuminates a flow containing the PAF, it induces a photochemical reaction that permanently alters the chemical structure and absorption/fluorescence characteristics of the tracer. This effectively "tags" the flow with an arbitrary pattern "written" in with the uv illuminating optics. The temporal and spatial evolution of this pattern can be tracked indefinitely with a second, visible wavelength "interrogation" laser by recording the time-evolving image sequence with a video camera. Anticipated benefits/potential applications - The phantom flow tagging method offers unique capability for obtaining quantitative velocity data in incompressible flow fields. It is anticipated that a very significant group of researchers, both federally-sponsored and government labs, in a variety of fluid mechanic disciplines will benefit from the development of suitable probes. The commercial potential for the large-scale manufacturing of these probes is significant.

MOLTECH CORP.
ENGINEERING BUILDING - SUNY
STONY BROOK, NY 11794
Phone: (516) 632-7565
Topic#: 92-060 ID#: 9211020
Office: ESTO
Contract #: DAAH0192CR225
PI: TERGE SKOTHEIM
Title: Laser Patterning of Organic Electroluminescent Devices
Abstract: The overall objective of this research project is to develop multicolor thin film electroluminescent devices. The key to achieving high brightness and efficiency is the use of a new class of luminescent organometallic lanthanide complexes as emitter materials and new materials for electron and hole injection. Efficient injection type thin film electroluminescent devices require electron and hole injecting materials with low and high work functions respectively . By using organic hole conductors and alkali metal alloys as electron injectors, it will be possible to develop electroluminescent devices of high brightness and contrast for multicolor flat plate displays. High resolution displays will be fabricated using laser patterning of the electrodes. Anticipated benefits/potential applications - This research will lead to a new generation of electroluminescent displays for instruments, television and computers.

MORGAN RESEARCH CORP.
2707 ARTIE STREET, SUITE 17
HUNTSVILLE, AL 35805
Phone: (205) 533-3233
Topic#: 92-099 ID#: 9210822
Office: MICOM
Contract #: DAAH0192CR226
PI: WILLIAM TAYLOR
Title: High Speed Image Capture of the 3-D Peel Point Geometry During Payout
Abstract: An accurate knowledge of the maximum fiber stress occurring during payout is critical to improve the reliability of current and future dispenser designs for fiber optic guided vehicles. The fiber deformations occurring at the peel point are a direct indication of the maximum fiber stresses under normal payout conditions. In addition, the fiber deformations at the peel point provide an invaluable measure of the adhesive rupture characteristics during payout. The enclosed proposal describes an approach to demonstrate the feasibility for modifying an existing Image Capture System (ICS) to measure the 3-D geometry of the peel point from one end of the bobbin to the other during fiber payout. Anticipated benefits/potential applications - The proposed research will result in capability, which is magnitudes above the state-of-the-art for experimentally validating theoretical models of the peel point dynamics and for characterizing the adhesive rupture characteristics during payout through direct observation of the 3-D fiber geometry.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-3111
Topic#: 92-144 ID#: 9220144
Office: CSTO
Contract #: DAAH0193CR011
PI: MICHAEL SHELLHAUSE
Title: Tools for Hardware/Software Design Modeling and Simulation
Abstract: MTL Systems, Inc. and the University of Cincinnati propose to conduct a preliminary design for, and feasibility

assessment of, a tool for hardware/software tradeoff design modeling and simulation. The tool will be based upon a versatile, standardized and proven tool already developed called RPDI, which implements VHDL as the hardware description language, is loosely coupled to ada or other programming languages, and contains an X-windows-based graphical interface. The objectives of the program will be to quantify all aspects of the required tool, determine which portions of RPID may be applied and which portions require original design, and from a preliminary design concept using structured design techniques. Feasibility will be established as a function of assessed design capability through experimentation, demonstration and analytical means. Tasks include requirements definition, rapid analysis, other capabilities determination, design concept production, feasibility assessment, critical aspect demonstration and final report production. The approach offers an innovative means for capitalizing on the existing rapid tool to achieve the program objectives. Anticipated benefits: The benefit of this tool will be to provide an easy-to-use simulator by which hardware/software tradeoffs may be conducted in computing system design. Applicability will encompass the full breadth of commercial and military computing system design needs.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-3111
Topic#: 92-145 ID#: 9220845
Office: CSTO
Contract #: DAAH0193CR012
PI: DAVID GEIS
Title: Tools for System Level Modeling of Computing Systems
Abstract: MTL Systems, Inc. and the University of Cincinnati propose to develop a preliminary design approach for, and feasibility assessment of, a tool for system-level modeling of computing systems. The tool will be based upon a versatile, standardized and preliminary-tested methodology currently under development, named PDL (Performance Description Language). PDL implements VHDL as the fundamental simulation medium, with translators to permit the description, simulation and tradeoff of performance attributes efficiently and effectively under this common simulation structure. The objectives of the program will be to quantify all aspects of the required tool, determine which portions of the existing PDL may be applied and which portions require additional design, and form a preliminary design approach using structured design techniques. Feasibility will be established as a function of assessed design capability through experimentation, demonstration and analytical means. Tasks include requirements definition, PDL analysis, other capabilities determination, design approach production, feasibility assessment, critical aspect demonstration and final report production. The approach offers an innovative means for capitalizing on the existing PDL tool, its inherent standardized structures, and the significant research behind its development, to achieve the program objectives. Anticipated benefits: The benefit of this tool will be to provide an easy-to-use performance description language tool by which diverse computing system performance attributes may be simulated. The tool will permit tradeoffs to be conducted, to achieve optimal performance balance in computing system design. Applicability will encompass the full breadth of commercial and military computing system design needs.

N.S. GOWADIA, INC.
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ALBUQUERQUE, NM 87111
Phone: (505) 298-7184
Topic#: 92-123 ID#: 9210104
Office: ASTO
Contract #: DAAH0192CR227
PI: N. GOWADIA
Title: Passive Contrail Suppression
Abstract: Low Observable (LO) operations are thwarted when contrails are formed. It is essential that means be sought to automatically detect and once detected, eliminate this visual signature so that the operational advantage of reduced radar cross section and infra-red signatures can be fully exploited for obtaining combat advantage. A passive, exhaust system design is proposed which provides extremely high level of supersaturation in the exhaust flow by a unique non-uniform flow field design technique. This technique has been successfully applied for greatly reducing plume infra-red and acoustic signatures of an LO aircraft; the application to simultaneously reduce contrail visibility is unique. Preliminary analysis indicates minimal impact on performance and other signatures. Analysis by the Los Alamos National Laboratory indicates that for this type of nozzle design, homogeneous condensation will dominate over heterogeneous condensation for typical turbofan exhaust massflow (species), and an extremely large number of very small droplets will form. General Electric's plume visibility code calculates (1) the growth of the water droplets in the plume as external flow mixes with it, and (2) the visibility of the condensed water trail (contrail). GE's analysis indicates that for the initial water droplet distribution indicated by Los Alamos code, the contrail will be invisible to human eyes as well as to passive contrail detection system using CCD camera with advanced real time image processing. Anticipated benefits/potential applications - Commercial aircraft have neither the engine cycle nor free expansion exhaust nozzle

required for passive contrail suppression. Also, contrail visibility is not a problem to their effectiveness.

NETROLOGIC, INC.
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Phone: (513) 253-1558
Topic#: 92-120 ID#: 9210734
Office: NMRO
Contract #: DAAH0192CR228
PI: JAMES JOHNSON
Title: Seismic Waveform Character Representation Using Wavelet Transform
Abstract: Netrologic will use the continuous wavelet transform to operate on seismic signals in Phase I. We will use the CWT to produce a synthesized signal which is represented with elements of both time and frequency domain. This representation will be fed to a cascade correlation network which will be trained to detect the waveform which is indicative on onset of a regional event. This technique will be interfaced with the IMS system to allow it to automatically monitor manmade seismic events. In Phase II we will develop software to test new concepts using the IMS and conduct tests in conjunction with the staff at the DARPA center for seismic studies. Anticipated benefits/potential applications - In operation this system will be capable of real time monitoring and alarm when seismic events indicative of nuclear events are detected. It will be a permanent and valuable addition to the IMS tool box.

NEURODYNE, INC.
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BOSTON, MA 02116
Phone: (617) 437-9106
Topic#: 92-089 ID#: 9210965
Office: UWO
Contract #: DAAH0192CR229
PI: DONALD SOFGE
Title: Learning Optimal Control System for Fiber Placement Processing
Abstract: Significant progress has been achieved in the development of new equipment and modification of existing filament winding equipment to accommodate in situ fabrication of thermoplastic parts. Advantages of on-line consolidation through fiber placement are continuous winding of thick-walled parts, elimination of oven or autoclaving curing, low void content, and less material scrap. One of the challenges to widespread use of fiber placement is the reduction of production costs to be competitive with that of epoxy systems. A key to reducing manufacture costs is the increase of fabrication speeds while maintaining process quality. A robust control system for rapid consolidation of composite material requires the ability to obtain accurate feedback information from the process and the ability to adapt to unforeseen changes in the process dynamics. Neurodyne will apply internally developed innovations in neural network based learning optimal control to learn and optimize fiber placement process dynamics on-line. Neurodyne will also use new innovations in signal processing to optimally filter process feedback to provide accurate line non-destructive evaluation (NDE) measures to ensure the quality manufacture of composite parts. Anticipated benefits/potential applications - Modern manufacturing processes require increasing flexibility to accommodate changes in processes due to improved materials, degraded sensors, and machine wear. The control system developed in Phase I will be capable of learning complex process control, robust in the presence of noise, and be able to adapt on-line to changes in process dynamics. The applications for this system include any nonlinear manufacturing process which requires robust adaptive control.

NEURODYNE, INC.
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Phone: (617) 437-9106
Topic#: 92-197 ID#: 9220802
Office: MTO
Contract #: DAAH0193CR072
PI: THERESA LONG
Title: Adaptive Diagnostics and Control of the Plasma Etching Process
Abstract: A key automation problem in the semiconductor manufacturing area is the efficient high-yield fabrication of semiconductor circuits. Plasma etching is the key process by which desired circuits are patterned on a semiconductor wafer. As pattern geometries become more intricate in the submicron range, etching processes become more complex. Because the intractable. Semiconductor manufacturers typically use a trial and error procedure to realize a repeatable fabrication process that has acceptable yield. This is expensive in time and material. Better control and instrumentation techniques that remove this uncertainty in etching will have a major impact on semiconductor manufacturing and integrated circuit fabrication. Process models of the complex, time-varying nonlinear dynamics of the plasma etching process will be achieved through neural network based system identification and integrated into a learning-optimal control system to provide adaptive nonlinear process control. Neural network state estimation techniques will be used for on-line monitoring of spectroscopic process measures to provide a

fast, fault tolerant means of determining composition of the surface or the plasma in real-time. The Neurodyne and Honeywell team will leverage research performed under the Sematech advanced equipment control program to support this effort. Anticipated benefits: As expressed in an enclosed letter of support from Sematech, automation of the plasma etching process will have a significant impact upon commercial and military IC fabrication. Anticipated manufacturing applications of this effort at Honeywell SSDC include: high density arrays, advanced pressure sensors silicon accelerometers, and micromechanical actuators and microvalves.

NIELSEN ENGINEERING & RESEARCH, INC.
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MOUNTAIN VIEW, CA 94043
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Topic#: 92-001 ID#: 9210536
Office: ASTO
Contract #: DAAH0192CR230
PI: MICHAEL MENDENHALL

Title: Computational Aerodynamic Methodology for Flight Vehicles Undergoing Rapid Maneuvers

Abstract: The Phase I investigation will demonstrate the feasibility of an analytical approach to predict the high angle-of-attack aerodynamic characteristics of agile fighter aircraft and tactical missiles in dynamic multi-axis maneuvers. An innovative combination of theory and experiment will produce improved mathematical models for the direct simulation of unsteady aerodynamic forces and moments which, when combined with a six-degree-of-freedom equation-of-motion solver, will have the capability to predict flight trajectories and maneuvering performance of maneuvering flight vehicles. The proposed computational method, suitably economical for preliminary design and analysis purposes, will be applicable to study configurational effects on unsteady separated flows and the subsequent induced dynamic characteristics. The unsteady nonlinear aerodynamic prediction method, including propulsion effects, will be considered in combination with a structural deformation model to provide a complete simulation method. Emphasis will be placed on (1) the understanding and modeling of the physics of complex flow phenomena associated with flow separation, and (2) an analytical prediction method which does not require a priori knowledge of the aerodynamic characteristics for specific configurations. Anticipated benefits/potential applications - Successful completion of the Phase I feasibility study and demonstration will lead to a Phase II effort to produce a simulation method for the analysis of fight vehicles in unsteady maneuvers involving high angles of attack. This unique capability will provide greater understanding of the physics of the complex unsteady flow fields and improved analysis techniques for future flight vehicles.

NONLINEAR PREDICTION SYSTEMS
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NEW HAVEN, CT 06511
Phone: (203) 432-1266

Topic#: 92-073 ID#: 9211125
Office: MTO
Contract #: DAAH0192CR361
PI: JOHN MOODY

Title: Statistically Robust Neural Network Time Series Prediction

Abstract: Time series prediction techniques are central to a number of broad application areas critical to both defense and civilian industry, including weather forecasting, economic forecast and a variety of signal processing and control applications. Many specific application problems involve intrinsic nonlinearity which the well-established linear prediction methods (e.g., Arma, Arima, FIR and IIR filters, Kalman filters, LMS filters, etc.) are unable to capture effectively. Nonlinear prediction models using neural networks (such as multilayer perceptrons and radial basis functions) offer the possibility of substantially improved performance over conventional linear models in predicting the behavior of nonlinear systems. A number of critical issues must be addressed in the development of appropriate nonlinear prediction models, such as the selection of variables, architecture selection, architecture pruning, the estimation of prediction risk (generalization performance). Phase I of the project will focus on the development of statistically robust and computationally efficient algorithms and techniques for constructing neural network time series predictors. Weather forecasting will serve as a test problem for Phase I. Phase II of the project will use the algorithms techniques developed in Phase I to solve one or more large scale forecasting problems of direct interest to defense or commercial clients. Anticipated benefits/potential applications - Developing statistically robust methods for nonlinear neural network time series prediction systems will allow NPS to solve a number of problems of practical interest, including short-term, localized forecasting of weather.

NOVEX CORP.
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Phone: (310) 649-4576
Topic#: 92-067 ID#: 9210087
Office: LSO
Contract #: DAAH0192CR232
PI: ALFRED GOLDSMITH
Title: Impulse Radar for Airborne Detection and Discrimination of Buried Land Mines
Abstract: Analysis of the mission requirements coupled with available technology indicates that an airborne monostatic pulsed radar would have sufficient sensitivity to detect surface and land mines. The system uses incoherent detection coupled with a sharply pulsed radar signal: the sharp pulse (about 1 nanosecond) eliminates the overlap between the transmitting pulse and the return signal. The average pulse repetition frequency should be limited to 5E6 pulses per second to avoid range ambiguities, as estimated at 100 feet altitude and a 30 knot sweep rate. The pulse rate is also a function of scan width (100 meters) and target size resolution requirements, an estimated pulse rate of 15E3 pulses per second should be adequate. The average radar power under these conditions is strongly dependent on target radar cross section but would not exceed approximately 100 watts for most targets. A major issue is the discrimination of the mine from other objects (natural and decoys); neural network algorithms and clutter rejection algorithms will be utilized to develop an user friendly system. To reduce risk, a proof of concept hardware demonstration is scheduled at the end of Phase I. Anticipated benefits/potential applications - Rapid detection of buried and surface mines is necessary to support swiftly moving military operations. Other applications include detection of buried treasure, plastic or metal utility pipes and conduits (commercial and utilities), and buried evidence such as guns (police).

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Phone: (703) 359-6017
Topic#: 92-137 ID#: 9220409
Office: CSTO
Contract #: DAAH0193CR071
PI: KEVIN HEATWOLE
Title: Porting Mach to the IBM RISC System/6000
Abstract: The public domain Mach version 3.0 will be developed into a commercial offering for the IBM RISC System/6000. The effort to target an existing ada compiler for the IBM RISC System/6000 to this version of mach will be investigated, and if appropriate, prototyped. Anticipated benefits: The Mach OS is gaining acceptance as a viable operating system. The commercial user community will make more use of this kernel if it is adequately supported.

OCA APPLIED OPTICS
7421 ORANGEWOOD AVENUE
GARDEN GROVE, CA 92641
Phone: (714) 895-1667
Topic#: 92-189 ID#: 9220880
Office: MICOM
Contract #: DAAH0193CR015
PI: EDMUND ARRIOLA
Title: Applications of Binary Optics in Missile Systems
Abstract: The proposed project will result in a definitive characterization of the benefits provided by employing Binary Optical Elements (BOEs) in a missile system optical sensor. The study will use a current state-of-the-art missile sensor, which does not contain BOEs, as the basis for comparison. This optical system will be redesigned to employ BOEs. The location of the BOEs within the sensor will be the subject of a series of trades which will culminate in a fully optimized final design at the end of Phase I. The mechanical design, fabrication, assembly and test will follow in Phase II. Anticipated benefits: The successful completion of this Phase I program will make possible a significant increase in performance and reductions in size and cost for the next generation military and commercial sensors, with emphasis on missile systems and robotics applications.

OPTICAL CONCEPTS, INC.
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LOMPAC, CA 93436
Phone: (805) 737-7391
Topic#: 92-196 ID#: 9220356
Office: MTO
Contract #: DAAH0193CR070
PI: KEVIN KILCOYNE
Title: Practical Optical Interconnect Devices and Packaging, for High Speed Computing
Abstract: In recent years, there have been many approaches to high bandwidth optical signal distribution and optical computing systems. Although many of these approaches were innovative and intriguing, they typically involved cumbersome optical systems, gratings, holographic optics, etc. which have thus far not been embraced by the electronic computing industry. This proposal offers an approach to optical interconnects based on surface normal devices in hybrid optoelectronic packages with

multimode fiber. The optically or electronically configurable interconnects can be directly interfaced to present electronic computer systems. The key component is the vertical-cavity surface-emitting laser, also referred to as a microlaser. By using standard multimode fiber connectors, the modular design allows the use of commercially available optical splitters and combiners to completely eliminate the need for switching ICs and all their limitations. Anticipated benefits: For the first time, the optoelectronic components have been developed which allow the development of modular optoelectronic packages at reasonable cost. The use of these modules will enable the computer industry to take advantage of the inherent bandwidth and fan-in/fan-out capability of the optical domain without comprising practicality or cost.

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Topic#: 92-125 ID#: 9210165
Office: ESTO
Contract #: DAAH0192CR233
PI: LARRY MCADAMS

Title: A High-performance BUS for Multichip-module to Multichip-module Interconnects

Abstract: High performance electronic systems are making increasing use of Multichip Module (MCM) technology. Such a system may contain many such MCMs, some or all of which must communicate with one another. We propose a high-performance optical technique for connecting MCMs on a single board. The virtues of the approach proposed here, as compared with other approaches known to us, are: 1) rather than requiring one optical source per MCM, this approach requires at most two optical sources for the entire interconnect system, thus increasing reliability and reducing power dissipation, and 2) a receiver on any single MCM experiences a constant level of optical power, regardless of which MCM on the interconnect is sending data, thus minimizing receiver complexity. A particular realization of the interconnect method proposed here uses organic polymer optical waveguides on silicon. Anticipated benefits/potential applications - This research addresses key design and feasibility issues necessary to evaluate the use of photonics for interconnection of multichip modules. If successful, it will provide the hardware foundation for the next generation of high performance electronic systems. These interconnects are broadly applicable to many communication and computer systems requiring high speed interconnections between multichip modules.

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Topic#: 92-196 ID#: 9220728
Office: MTO
Contract #: DAAH0193CR061
PI: ROBERT KALMAN

Title: Packaging Optoelectronic Modules

Abstract: Packaging poses a major impediment to the practical implementation of Opto-Electronic Modules (OEMs). OEMs may require multiple fiber-optic interfaces and large electrical pin-out, and may dissipate significant power. We propose a program to develop new packaging techniques to address the needs of OEMs. In this project, we will utilize Optivision's previous experience in the packaging and application of opto-electronic devices. A major thrust of this program is the investigation and development of several novel multi-fiber optical interfacing techniques based on the use of planar optical waveguides made from SiO2 on a silicon substrated. SiO2/Si waveguide technology may provide high-performance, low-cost, compact, rugged optical interfaces which can be applied to a broad class of OEMs. The application of current advanced electronic and opto-electronic packaging to OEMs will be explored, including the use of advanced metals and ceramics, thermoelectric cooling, and flip-chip device mounting. Package performance over a range of environmental conditions (temperature, vibration) will be investigated. A candidate OEM will be selected for packaging during the Phase II effort, and a detailed package design will be developed for this device. Anticipated benefits: This research project addresses key design and feasibility issues in the packaging of opto-electronic modules (OEMs). It will provide advanced in packaging technology necessary to allow the use of OEMs in wide variety of DoD and commercial applications including fiber-optic networks, optical backplanes, and phased array antennas.

OPTRA, INC.
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Topic#: 92-195 ID#: 9220849
Office: MTO
Contract #: DAAH0193CR060
PI: MICHAEL HERCHER

Title: Improved Metrology for Advanced Lithography

Abstract: As feature sizes in semiconductor lithography approach the 0.1 micron level, existing metrology techniques are being pushed beyond their limit. The high resolution metrology needed for step-and repeat lithography and mask inspection and quality control has relied on 2-frequency laser interferometry. Unless such systems are operated in a vacuum, however, they are subject to atmospheric turbulence induced errors on the order of 50 to 100nm. These errors arise from the fluctuations in atmospheric density which occur along the optical path from the interferometer cube to the mirror on the moving stage. There is widespread consensus on the existence and magnitude of this problem, and on the need to either solve it or circumvent it. We are proposing two quite separate approaches, either of which appears capable of improving semiconductor metrology precision by between one and two orders of magnitude. Our goals are to determine which approach is optimum and to achieve a positioning precision of + 0.01 microns. The first approach involves the use of a relatively coarse xy scale in conjunction with precision interpolation techniques; the second approach is to make conventional interferometric measurements at two well-separated wavelengths in order to compensate for the effects of atmospheric turbulence. Anticipated benefits: The proposed atmosphere compensated position/metrology technology, if successful will make an important contribution in overcoming a major barrier towards the goal of reaching 0.1 micron design rules and thereby benefit us chip manufacturing competitiveness.

OPTRON SYSTEMS, INC.
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BEDFORD, MA 01730
Phone: (617) 275-3100
Topic#: 92-163 ID#: 9220780
Office: DSO
Contract #: DAAH0193CR069
PI: JAMES HUBBARD
Title: High Speed VLSI/polymer-based Spatial Light Modulator
Abstract: We propose to develop a new VLSI-circuit-driven Spatial Light Modulator (SLM) based on the electrooptic effect in a poled organic polymer. Because of the inherent speed and gray scale capabilities of organic polymer SLMs, this device is expected to offer performance exceeding that of both ferroelectric and nematic liquid crystals. The proposed device uses a Charge Transfer Plate (CTP) to transfer modulation voltages from the VLSI circuit to the polymer light modulation element and to provide an optically flat substrate for the polymer alignment layer. The Phase I research involves, (a) the development of a new, simple, and versatile an isotropic surface alignment layer technique for producing high-quality, poled polymer films, (b) flip-chip solder bump-bonding of MOSIS-fabricated FLSI circuitry onto the CTP, (c) assembly of hardwire-addressed and VLSI/CTP-addressed polymer SLMs, and (d) measurement of their framing speed, contrast ratio, spatial resolution, and operating voltage. Also, by combining the anisotropic surface alignment layer technique with a novel electric field-poling process we will be able to build SLMs with transversely poled polymer films that are optimized for amplitude modulation. The advantages of this approach over the current non-CTP technology include: (1) higher contrast ratios, since the CTP is optically flat and a second alignment layer can be deposited on it, (2) larger and more densely-packed arrays offering significantly increased parallelism at lower cost, (3) high optical readout efficiency because of the use of a highly reflective dieletectric mirror on the CTP, and (4) excellent spatial uniformity and the elimination of unwanted fixed pattern noise because of the optically-flat smooth and spatially continuous dielectric mirror surface provided by the CTP will be evaluated. Anticipated benefits: Commercial applications of the VLSI and hardwire electrode polymer-based SLMs include large-screen projection displays, industrial inspection and machine vision systems, adaptive optical systems, phase-only filters of optical correlators, reconfigurable optical interconnects, visual displays, "smart pixel" image processors, and neural-network circuit elements.

ORBITAL RESEARCH, INC.
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Phone: (216) 791-6720
Topic#: 92-058 ID#: 9211172
Office: ESTO
Contract #: DAAH0192CR234
PI: ROBERT SCHMIDT
Title: Tight Shutoff Microvalve
Abstract: Microvalves previously made cannot be relied upon for long term tight shutoff. If microfluidic systems are to become a reality, tight shutoff must be achieved by micromachined valves. Although surfaces on microvalves in theory should be atomically smooth, thus allowing for tight shutoff, practice has shown this not to be the case. Even the best american-made microvalve exhibits leakage rates in the range of 0.045 cc/min. This is much too severe to use for the storage of gases or for other applications where leakage through the valve seat cannot be tolerated. This SBIR will explore the feasibility of development of a novel valve seat which will allow a microvalve manufactured with micromachining techniques to shut tight. Anticipated benefits/potential applications - Projected results will allow microvalves to better control systems for microcooling electronics, antilock braking systems, microbotic fluidic control systems, and implantable drug delivery systems.

PACIFIC-SIERRA RESEARCH CORP.
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Phone: (310) 820-2200
Topic#: 92-100 ID#: 9211278
Office: MICOM
Contract #: DAAH0192CR288
PI: JIM SHIRLEY
Title: Identification Friend or Foe (IFF) System for Ground Vehicles
Abstract: PSR Services, Inc. (PSRS), a wholly owned subsidiary of Pacific-Sierra Research Corporation (PSRC), will conduct a study of the requirements of an identification friend or foe (IFF) system for providing identification of friendly ground forces to friendly aircraft and other ground forces. The study will produce a list of critical design elements against which candidate systems will be evaluated. PSRS will evaluate candidate electro-optical (EO) and radio frequency (RF) IFF schemes against the critical design elements list, using a point rating system, and will select the best candidate IFF system or composite system. PSRS will produce a complete, detailed design of the proposed IFF system, which meets or exceeds the identified requirements. The proposed design will be analyzed in detail to determine its expected performance. Finally, it will be demonstrated in field tests, using a breadboarded minimal IFF transmitter and receiver, whether or not the signal to noise ratio (SNR) of the proposed system, at the maximum ranges at which it will be used, is adequate. Anticipated benefits/potential applications - A ground vehicle IFF system would significantly reduce the potential of vehicles being killed by fire from friendly aircraft or other ground vehicles, such as occurred on 27 occasions in the 1991 Persian Gulf conflict.

PERFORMANCE SIGNAL INTEGRITY, INC.
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Phone: (412) 682-7101
Topic#: 92-148 ID#: 9220748
Office: CSTO
Contract #: DAAH0193CR073
PI: J. BRACKEN
Title: A Framework for the Design of High Speed Interconnections
Abstract: Interconnections between logic blocks play an increasingly important role in today's high performance microcircuit designs. Performance violations due to interconnect effects such as propagation delays, dispersion, attenuation, ringing, reflection and crosstalk must be detected before a design is committed to production. The recently developed Asymptotic Waveform Evaluation (AWE) technique promises to drastically reduce the complexity of the extraction and simulation problems, the crucial verification steps in interconnect design. The increased efficiency of the verification techniques will allow the incorporation of the verification technique within the design phase to ensure that system specifications are met. A design system incorporating the verification and layout tools and interacting with an interconnect database, as well as libraries of nonlinear driver and load models and industry standard lay-out databases is proposed for an automatic and comprehensive solution to the interconnect design problem. This automation will significantly reduce design time and thus time to market of high performance systems. Anticipated benefits: An automated design system for high speed interconnect will significantly reduce the design time of high performance electronic circuits. The reduction in design time can be translated into improved time to market.

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TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 92-132 ID#: 9220881
Office: ASTO
Contract #: DAAH0193CR059
PI: ROBERT LIEBERMAN
Title: Fiber-laser Ultrasound Delamination Sensor for Cost-effective Inspection of Composite Parts
Abstract: POC proposes a novel method of lowering the cost and complexity of laser-induced ultrasound nondestructive evaluation (NDE). The proposed technique utilizes an optical fiber to deliver laser "excitation" pulses, causing rapid localized heating, and generating shallow outward-propagating shockwaves. In a radical departure from previous NDE schemes based on fiber optic ultrasound techniques, poc proposes to use "side-looking" optical fibers to detect the ultrasonic shock-wave fronts as they travel through the structure under test. These "optical pickups" could be embedded in tapes that would be easy to attach to, and remove from, the structure or component to be evaluated. The technique is particularly suited for the rapid scanning of composite parts for deliminations, voids, or other surface or subsurface defects anticipated benefits: Phase I and Phase II will lay the groundwork for the development of side-looking fiber laser ultrasound NDE products. Such products would have many applications, including NDE of composite aircraft parts, "field testing" of aircraft, and civil structure evaluation. Benefits of this approach to NDE include "retrofitability", flexibility, speed, and low cost.

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Phone: (508) 689-0003
Topic#: 92-166 ID#: 9220828
Office: DSO
Contract #: DAAH0193CR067
PI: ALAN GELB
Title: Reactive Alkali Hydride For Hydrogen Storage
Abstract: Physical Sciences Inc. (PSI) proposes to demonstrate the feasibility of using reactive alkali metal hydrides for the generation of hydrogen for fuel cells. The proposed hydrogen storage system will be light and compact and useable for single soldier and other portable power applications. Alkali hydrides react readily and rapidly with water to generate hydrogen and metal hydroxides. This system offers the potential of lightweight and compact hydrogen storage. Moreover, the hydrogen produced will not contain impurities that can poison fuel cells. A screening task will determine the optimal hydride system. Mixtures of alkali hydrides with aluminum and boron will also be considered. The Phase I program will demonstrate feasibility by experimentally demonstrating sustainable hydrogen production at rates required for 100 to 500w fuel cell power plants. The acquired data will be used to design a full-scale system. Anticipated benefits: The development of an lightweight and compact hydrogen source is a necessary step in the implementation of portable fuel cells. The proposed device will be of benefit in any application requiring portable electric energy sources, both commercial and military.

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Phone: (617) 277-4480
Topic#: 92-194 ID#: 9220156
Office: MTO
Contract #: DAAH0193CR068
PI: MALCOLM MCGEOCH
Title: Compact X-ray Source
Abstract: The pinch plasma soft x-ray source is much simpler and less expensive than the laser plasma source of equivalent power. Prior pinch plasma work has not paid sufficient attention to the critical role of circuit inductance in achieving a sufficiently hot plasma, with efficient conversion of electrical to x-ray energy. An approach to low inductance communication is proposed which is very much more compact and less expensive than the only alternative scheme of magnetic switching. The proposed Phase I work will consist of a demonstration of single pulse switching at the desired low inductance and high current for efficient key x-ray production. Anticipated benefits: This work is expected to lead to an x-ray source which is commercially very competitive with the synchrotron for x-ray lithography. It also has applications in materials processing, medicine and biology.

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Phone: (609) 275-0070
Topic#: 92-198 ID#: 9220388
Office: NMRO
Contract #: DAAH0193CR062
PI: CHUNI GHOSH
Title: Definition and Development of Advanced Multi-sensor Components for Inclusion in a Global Nuclear Proliferation Monitor
Abstract: Worldwide monitoring of nuclear proliferation requires the development of a suitable system with appropriate sensors to monitor the nuclear processes and events in different parts of the world. In this Phase I study we will identify the suite of sensors to monitor the nuclear programs in countries in different parts of the world. Initially the indian subcontinent will be selected for monitoring the nuclear activities. Both indian and pakistani nuclear programs will be studies to identify the suitable radionuclides for monitoring. Subsequently, a monitoring system will be designed with suitable sensors to have high sensitivity for detection of radionuclides and can be manufactured at a reasonable cost. The system will be suitable for monitoring the nuclear activities in other parts of the world with only minor modifications. The work will be carried out in collaboration with indian atomic energy. The actual system development will be carried out in Phase II of the program. Anticipated benefits: Improved ability to monitor global nuclear proliferation.

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Topic#: 92-193 ID#: 9220305
Office: MTO
Contract #:
PI: JAMES BEARD
Title: Metrology Cell for Linewidth and Registration in a Cluster Tools Environment

Abstract: The options in CD and overlay measurements at 0.25 um geometries are very limited. Electrical measurements appear to provide the necessary accuracy an repeatability to make these cd and overlay measurements. However, particulate contamination is largely an unknown. In the course of this Phase I study, the following areas will be investigated: - a probing contamination study to understand the level of particulate contamination introduced in the probing process - design and testing electrical structures for traceable measurements - design and testing of structures for non-contact electrical measurements anticipated benefits: the ability to perform in-line CD and overlay measurements at 0.25 um design rules on product wafers.

Q-DOT, INC.
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Phone: (719) 590-1112
Topic#: 92-070 ID#: 9211104
Office: MTO
Contract #: DAAH0192CR289
PI: DONALD HERMAN
Title: RTD/HBT Analog-to-Digital Converter

Abstract: Innovative circuit design and advanced processing is proposed to create a 25 - 50 gs/s, 6- to 8-bit analog-to-digital converter (A/D). The design combines the rapid quantum switching (< 1 ps) and multiple-state operation of resonant tunnel diodes (RTD's) with the isolation, high speed (130 GHz ft), and flexibility of InP heterojunction bipolar transistors (HBT's). This combination, available with a state-of-the-art process, allows Q-Dot to exploit the advantages of both devices. RTD's have been operated to 2.5 thz, but their practical use is limited by their two-terminal nature (no isolation and low drive capability). InP hbt's provide the isolation and drive required to effectively combine functional blocks, but care must be taken to avoid limiting the RTD's quantum switching speed. The proposed design interfaces RTD's and HBT's without serious speed degradation by using innovative cell designs which do not limit RTD switching speeds. The A/D design will produce both analog and digital RTD/HBT building blocks which can be incorporated into cell arrays useful for a broad range of applications. During Phase I, modelling and simulation will result in a preliminary A/D design with its performance projected. Final design, fabrication, and test of A/D prototypes will be accomplished during Phase II. Anticipated benefits/potential applications - X, k, and mmw radar and communication transmissions can be directly converted by the proposed A/D, substantially reducing front-end complexity. Converted data can be processed by advanced RTD/HBT cells. Applications targeted include GPS, HDTV/DBS links, and phased-array antenna systems. The proposed design provides substantial performance and flexibility increases when compared to existing designs.

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Topic#: 92-172 ID#: 9220454
Office: ESTO
Contract #: DAAH0193CR064
PI: DONALD HERMAN
Title: SiGe Delta-Sigma Decimation Filter

Abstract: Present silicon IC's are reaching fundamental limits on gain, speed, and power density. Heterojunction devices promise ten-fold performance improvements but large-scale IC's are required to assess these emerging technologies. SiGe heterostructures offer substantial performance increases while coexisting with current processing and packaging technology. Silicon substrates are easier to manufacture than GaAs or InP substrates. GE doping provides ten times the performance of silicon homojunctions. Thus, SiGe IC's can be manufactured rapidly with relatively low cost. Large-scale IC's will assess SiGe's performance, yield, and potential as drop-in upgrades to silicon-only systems. Q-Dot proposes a delta-sigma decimation filter IC as a process monitor. The high-speed filter can be initially partitioned into smaller, pipelined chips before integration into a single IC. The process technology and chip design can evolve together, minimizing the overall program risk while providing useful intermediate IC's for determining LSI/VLSI yield and reliability. Smaller test cells utilizing HBT's, FET's, and/or RTD's will provide high-yielding process characterization cells. Q-Dot currently has a delta-sigma and program, providing immediate sige technology insertion. Initial filter and cell designs will be performed during Phase I. During Phase II, final design and test of the filter and appropriate test cells will be performed. Anticipated benefits: The proposed filter will provide small test cells to assess SiGe's performance and large IC's to assess LSI/VLSI yield and reliability. It also fulfills an immediate need for a complex high-speed digital IC. The program will pave the way for high-performance SiGe drop-ins to upgrade existing and future computers, digital receivers, and high-speed logic systems.

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Topic#: 92-042 ID#: 9210213
Office: DSO
Contract #: DAAH0192CR330
PI: SUNNY AUYANG

Title: Photon Number Amplifier for Optical Communications and Detections

Abstract: The novel concept of photon number amplifier has been recently suggested, which is quantum device capable of noise-free amplification of the input signal photon number. No experimental progress on the realization of this device has yet been reported. In principle, photon number amplifier can greatly improve the sensitivity of direct optical detection which is important in many scientific and technological applications. It can enhance the data rate by up to an order of magnitude compared to ordinary amplifiers in a conventional optical communication link. It can lead to greatly improved optical communications by orders of magnitude in conjunction with intensity-squeezed sources. In this report propose to analyze three new schemes which promise to provide effective realizations of photon number amplifier. One of these schemes does not involve electronic intermediate processing and can thus operate at pico- and femto-second rate. We will analytically derive the amplifier performance of these schemes in a realistic implementation as a function of the system parameters. The results will enable us to design the most efficient experiments demonstrating noise-free photon number amplification. Anticipated benefits/potential applications - By replacing ordinary optical amplifiers by photon number amplifiers, one can enhance the performance of any direct detection optical communication or signal processing system by a moderate to a large amount depending on the situation, for both commercial and military applications.

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Topic#: 92-058 ID#: 9210718
Office: ES.O
Contract #: DAAH0192CR290
PI: MARK ZDEBLICK

Title: Microfabricated Thermopneumatic Actuator for Valve Applications

Abstract: A microfabricated thermopneumatic actuator is being developed for low pressure, commercial valve and regulator applications. Using a microfabricated normally open valve as the actuator and a piezo-resistive pressure sensor for feedback, a closed-loop pressure regulator controlling up to 100 psi has been demonstrated. Normally closed operation has been demonstrated. It is anticipated that this actuation concept is capable of controlling fluids at pressures up to and possibly exceeding 3000 psi. During the Phase I stage of this proposal, the performance envelope of this actuation technology will be reported, designs for extension of that performance envelope will be explored, and a pressure regulator suitable for controlling 100 psi nitrogen supply will be delivered to the end-user for evaluation and verification of the actuation concept. Anticipated benefits/potential applications - Miniaturization and integration of valve function will lead to capabilities not presently available. Microfabricated valves and integrated electrofluidic circuits (IEFC's) have commercial applications in the automotive, biomedical, medical, process control, analytical chemistry and industrial sectors as well as government applications in the defense, energy, and environmental sectors.

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Topic#: 92-160 ID#: 9220710
Office: DSO
Contract #: DAAH0193CR065
PI: SUNIL SHAH

Title: A Methodology and Software Tools for Advanced Control of Manufacturing Processes

Abstract: We propose to develop a new methodology for advanced control of manufacturing processes. We propose to encode the methodology in software tools. Unlike currently available tools, these tools will allow users without extensive expertise in control sciences to develop advanced control systems. It will allow them to easily integrate existing simulation codes, take advantage of distributed computing and advances in computer interface technology. The tools will support the entire control engineering cycle, including control configuration, testing, design and implementation not just as separate tool boxes but as a well-planned activity. Reliability and ease-of-use will be enhanced by exploiting the logical structure of the design cycle, on-line planning and use of multiple alternate algorithms. Phase I research will address thermal control of oxidation processes in manufacture of integrated circuits as an application domain. Anticipated benefits: The proposed methodology permits advanced control of complicated manufacturing processes requiring computation intensive modeling codes and learning from test data.

REVEO, INC.
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Topic#: 92-041 ID#: 9210544
Office: DSO
Contract #: DAAH0192CR291
PI: SADEG FARIS
Title: Novel Multi-layer Optical Mass Storage Technology
Abstract: Numerous problems in science and engineering require powerful computers with tera-flop speeds which will demand the concurrent availability of mass storage media with t-byte capacities and data rates exceeding 1 giga-bit/sec. This proposal introduces a new read-write optical storage technology that meets the requirements to enable many processors to work in parallel where data can be stored in three dimensions and retrieved very fast. The new technology, which will enable the development of materials for optical storage and data retrieval methods without cross-talk between channels, is based on the Cholesteric Liquid Crystal (CLC) polymer property of selective reflection at a characteristic wavelength. Each layer in a multi-CLC-layer storage medium has a different characteristic wavelength, making it possible to randomly select any layer for reading or writing. It is projected that a 16 t-byte erasable mass storage system with a data rate of 1.6 t-bit/sec can be built using Reveo's breakthrough technology. In Phase I a 5-layer storage system will be designed and the feasibility of random layer addressing demonstrated. The Phase I design will be built in Phase II to demonstrate the feasibility of technology, with product development and commercialization of the technology to follow in Phase III. Anticipated benefits/potential applications - Supercomputers with tera-flop speeds will greatly benefit numerous applications such as aerodynamics for advanced aircraft designs, chemical modelling, galactic dynamics, and atmospheric science. Such machines demand concurrent availability of mass storage systems capable of tera-byte capacities and data rates > 1 giga-bit/sec.

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Topic#: 92-132 ID#: 9220886
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Contract #: DAAH0193CR025
PI: COLLEEN FITZPATRICK
Title: Cost Effective Nondestructive Evaluation of Composite Parts with Laser Shearography
Abstract: The aim of this project is to develop a low cost laser diode shearography system for use in the inspection of advanced composite aircraft components and structures. Laser shearography is a relatively new nondestructive evaluation techniques that is used with excitation methods to measure differential displacements and subsequent strains in a material. Shearography has proven successful in locating flaws such as ply-ply and bondline delaminations. The intent is to optimize the operating efficiency and design of the system. This means increasing inspection throughout while reducing the amount of human interaction necessary to inspect composite parts. Sample composite aircraft parts will be obtained with known defects and tested using several shearography excitation techniques. A laser shearography camera will be used to record and evaluate the shearograms in real time. Laser diodes will be studies as a compact, high powered alternative to hene and argon lasers in use today. The outcome of the Phase I research effort will be: 1) proof of concept; 2) well documented test procedures; 3) recommendations for the development in Phase II of field-deployable, portable instrument for military and commercial applications; 4) recommendations for the development of an automated test system for the production line environment. Anticipated benefits: Some potential markets for using laser diode shearography as an NDE tool are: on aircraft inspection, aging aircraft, process control, quality control, bridge inspection, and NDT service companies. NDE inspectors would use LS to complement ultrasonics, x-ray, etc. This alone presents a large existing market. A portable system could be used on the production line for process control, in the inspection area for quality control, and would be useful for in-situ inspection.

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Topic#: 92-106 ID#: 9210655
Office: MICOM
Contract #: DAAH0192CR293
PI: SINA BARKESHLI
Title: Frequency-Dependent Characteristics of Millimeter-wave Integrated Circuit Elements on Anisotropic Substrates
Abstract: A serious lack of efficient Computer Aided Design (CAD) procedures exists for high-performance monolithic millimeter wave integrated circuits, that operate between 30 and 100 GHz. This is due to the high-frequency behavior of the various (passive) components and high speed interconnectors of the system, as well as to the anisotropy of the substrate. This behavior is not significant at lower frequencies. Therefore, cut-and-try design procedures become extremely time-consuming, inefficient, and sometimes unreliable. A typical millimeter wave integrated circuit involves various types of discontinuities, such

as the bends and discontinuities. Nevertheless, it is a well known fact that any impedance or geometrical change causes the excitation of higher order (evanescent) modes and energy loss through radiation and scattering. At higher frequencies these spurious effects become even more pronounced, and must be accurately taken into account as an integral part of system design. We propose to develop an accurate and rigorous analysis of monolithic millimeter wave integrated circuit elements with complex geometries on anisotropic substrates. The model will be based on the method of moments, which employs an efficient dyadic green's function for anisotropic substrates. The green's dyadic function has been recently developed by the authors in another (SBIR) project. Anticipated benefits/potential applications - Among the users of our research would be designers of microwave and millimeter wave systems, as well as designers of high-speed digital microelectronic devices. The theoretical complexity of the problem has prevented these people from having a systematic, accurate, and reliable computer code.

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Topic#: 92-193 ID#: 9220678
Office: MTO
Contract #: DAAH0193CR027
PI: RICHARD KRUKAR

Title: Overlay and Grating Lineshape Metrology Using Optical Scatterometry

Abstract: In microelectronics processing diffraction grating test patterns are created on the wafer for characterizing a process step. In this application the shape of the line is measured since it is determined by processing conditions. Complete characterization of grating lineshape is tedious and often destructive, such as by using SEM techniques. Rapid, non-contact, non-destructive techniques to characterize grating lineshape do not exist, especially for sub-micron geometries and for in-situ applications. This Phase I effort addresses novel techniques to determine lineshape, based upon scattered light. The intensity of light diffracted into different orders is very sensitive to the lineshape (e.g., the height and width, for a specific pitch), and this distribution is easily measured. Deviations from the optimal shape, due to processing errors, can be easily be monitored. Quantitative grating lineshape data obtained using statistical analysis of scattered light which is based on a rigorous diffraction analysis. We will identify key applications for monitoring processing in cluster tool arrangements and overlay, design scatterometer arrangements for these applications, and determine optimal analysis techniques to use. These will be implemented in a Phase II effort. Anticipated benefits: Overaly and process monitoring arrangements will be developed for small geometries.

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Topic#: 92-124 ID#: 9210263
Office: ASTO
Contract #: DAAH0192CR294
PI: VIJAY GONDHALEKAR

Title: Electric Propulsion System

Abstract: High flying drones propelled by fixed speed fans have been successfully flown before. The fixed speed is dictated by the characteristics of the turbine prime driver which delivers highest efficiency at a particular speed. The fixed speed constraint compromises the fan performance considerably, even with variable pitch blades. An appropriate electric drive can convert the fixed speed power output of the turbine to a variable speed output at the fan. The motor adds mass and imposes an additional energy loss in the "drive train" but allows optimal drive performance over the entire altitude range. This in turn leads to lower fuel requirements and a longer flight range and/or duration of the UAV. However, a light-weight, efficient drive motor is crucial for a successful tradeoff between added mass and increased efficiency. This proposal describes two innovative compact motor designs which provide these characteristics. In the Phase I program, the project team, consisting of experts in high altitude fan driven vehicles and variable speed motor drives, will design a variable speed motor which, together with a variable pitch fan, will deliver efficient thrust power over the whole altitude range. A prototype will be built and tested in a Phase II program. Anticipated benefits/potential applications - This research will improve the performance of military unmanned air vehicles by developing a scalable, compact, and quiet electric propulsion system. Potential commercial applications include improved electric motors and converters for commercial and military vehicles.

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Topic#: 92-010 ID#: 9211005
Office: ASTO
Contract #: DAAH0192CR295

Phone: (508) 371-2299 PI: GLEN RINES
Title: High-Pulse-Rate Blue Optical Source
Abstract: Laser-based submarine communications systems have been under investigation for a number of years. One recent systems concept, designed for communications uplinks, involves the use of a frequency-agile, KHz-repetition-rate source operating in the water-transmission window. In this proposal we present a plan to develop a solid state, Ti:sapphire-based, rapidly tunable, narrow-linewidth laser that would be the master oscillator in a high-power, injection-seeded system. The laser could be used to demonstrate and test any tunable receivers developed for the entire communications package and could serve as a seeding source for high-power slave oscillators. Anticipated benefits/potential applications - A rapidly tunable source, either at the Ti:sapphire fundamental wavelength or at the second harmonic, could be used in conjunction with diffractive optics to rapidly access optical disks, expose photorefractive crystals or steer a beam over a large angle.

SCIENCE RESEARCH LABORATORY, INC. Topic#: 92-032 ID#: 9210321
15 WARD STREET Office: DSO
SOMERVILLE, MA 02143 Contract #: DAAH0192CR332
Phone: (617) 547-1122 PI: DANIEL GOODMAN
Title: Electron Beam Processing
Abstract: The use of high energy (e ~ 1-5 MeV) electron beams (HEEB) at high average power (p ~ 200 kW - I mw) allows the cost effective processing and fabrication of unique graded composition materials which are not economically viable using conventional fabrication methods. Examples of such materials are superalloys and metal-matrix composites with graded thermal and mechanical properties. A graded composition nickel-based superalloy aircraft turbine disk fabricated using HEEB powder metallurgy techniques would operate at higher temperatures with the improved deformation resistance needed for the high speed civilian transport and next generation fighter aircraft. A HEEB material processing system would also allow cost effective surface hardening of steel up to depths of 5 mm. The average power levels now available using HEEB are 5-25 times higher than competing processing technologies such as laser layer glazing and plasma spraying. High average power contributes to high throughput and cost effective HEEB material processing systems. Science Research Laboratory (SRL) has developed a new generation of pulsed induction linear accelerators which allow reliable, cost efficient production of high average power electron beams with the necessary parameters for HEEB material processing. A unique feature of these accelerators is the high repetition rate (>5000 pps) all-solid-state pulsed power drivers which make these accelerators scalable to mw power levels at an electron beam cost of less than $1/watt. A HEEB material processing system based on this technology is described. Experiments to be conducted in Phase II will demonstrate cost effective HEEB processing systems for fabrication of graded alloy turbine disks and surface heat treatment of rail steels. Anticipated benefits/potential applications - Induction accelerator based HEEB material processing systems have the potential to produce new materials of military interest. Two applications described in this proposal are graded superalloy aircraft turbine disks and rail steels surface hardened to depths of up to 5 mm.

SCIENCE RESEARCH LABORATORY, INC. Topic#: 92-158 ID#: 9220638
15 WARD STREET Office: DSO
SOMERVILLE, MA 02143 Contract #: DAAH0193CR085
Phone: (617) 547-1122 PI: DANIEL GOODMAN
Title: Surface Strengthening of Advanced Structural Ceramics with High Energy Electron Beams
Abstract: The use of high energy (e ~ 1-5 MeV) electron beams (HEEB) at high average power (p ~200 kW - 1mw) allows the introduction of deep-layer compressive stresses (q ~ 100,000 psi) into the surface of advanced structural ceramics. Surface stress levels of this magnitude will result in a significant enhancement of bend strength, reducing fractures related to the as-fabricated surface defect population. Ceramics with HEEB-induced, deep-layer (2-10 mm) compressive stresses will also tolerate deeper surface abrasion during use. The strengthening process utilizes the deep penetration volumetric heating ability of high energy electron beams to establish a temperature gradient at the ceramic surface. For high temperature structural ceramics with low creep rates, the gradient must be maintained for several minutes at high (1500-2200°C) temperatures. Sciences Research Laboratory (SRL) has developed a new generation of pulsed induction linear accelerators which allow reliable, cost efficient production of high average power electron beams with the necessary parameters for ceramic surface strengthening. A unique feature of these accelerators is the high repetition rate (>5000 pps) all-solid-state pulsed power drivers which make these accelerators scalable to mw power levels at an electron beam cost of less than $2/watt. The induction accelerator technology developed by SRL consistent with the power densities (100-1000 w/cm2) and beam energies (2-5 MeV) required for ceramic

strengthening. A HEEB ceramic strengthening system based on this technology is described. Experiments to be conducted in Phase II, based on Phase I simulations and designs will demonstrate the introduction of surface compressive stresses into the high temperature structural ceramics relevant to DoD applications. Anticipated benefits: Advanced, high purity ceramics are candidate structural materials for use in engines at high temperatures. Enhanced surface properties are needed to improve the fracture resistance of these materials. The proposed process will introduce larger surface compressive stresses and produce this strengthening layer to greater depth than is possible with conventional methods.

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Topic#: 92-066 ID#: 9210259
Office: LSO
Contract #: DAAH0192CR333
PI: TIMOTHY RYNNE
Title: Detection of Guerrilla Forces in a Jungle Environment
Abstract: Scientific Applications and Research Associates (SARA), Inc. personnel, under internal private funding have devised an innovative concept for solving the difficult problem of detecting enemy foot soldiers in a jungle environment. Exploiting the unique physical phenomena of the sub-very low frequency (S-VLF) region of the electromagnetic spectrum, together with recent advances in integrated electronics, small processors, and signal processing algorithms, we have performed preliminary analytical calculations and laboratory measurements which provide collaborating evidence of the viability of our concept. Our proposed passive electromagnetic detection technique is based on the interaction of a target with various natural electromagnetic fields as well as the development and (time-varying) distribution of charges on the target. Taken to its logical conclusion, our concept could result in a low cost passive detection system composed primarily of off-the-shelf components, providing accurate and definitive detection characteristics, and yet easily deployed by the typical soldier in the field. We are proposing a considerable program for the Phase I activity; our previous investment in this S-VLF technology, extensive experience in research programs, and enthusiasm make us believe that we will successfully complete the Phase I program. Anticipated benefits/potential applications - Applications of S-VLF electromagnetic detection systems will be pursued in both the government and commercial sectors. An array of S-VLF detectors may be used to effect a perimeter intrusion alert system for government installations. The S-VLF technology is relatively simple and may lead to low cost, highly effective commercial security alert devices.

SCIENTIFIC COMPUTING ASSOC., INC.
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Topic#: 92-219 ID#: 9220472
Office: SSTO
Contract #: DAAH0193CR036
PI: SCOTT FERTIG
Title: A Tool for Management and Maintenance of Large Multi-user Knowledge Bases
Abstract: Large multi-user databases are already one of the most significant applications of computers, and their importance will only grow as we enhance our abilities to automatically generate and capture huge amounts of data. Users increasingly will demand access to very large distributed knowledge bases that can assimilate vast quantities of information from multiple diverse sources while still presenting a consistent conceptual picture to a large, distributed group of users. This demand will be met only by expert database systems capable of classifying, extending, and cross referencing their contents and providing very flexible and general user interfaces. The FGP (for fetch, generalize, project) expert database model is one that possesses the required capabilities. We propose to investigate a full implementation that will support a number of key features including: 1. Heuristically-based generalization and extension of stored knowledge ("speculation"); 2. Automatic reflection of the evolution of the knowledge base in responses to queries, including reassessment of earlier responses in light of new information ("symmetric recall"); 3. Heuristic merging of records ("forgetting") based on similarity measures; 4. Graceful degradation in the presence of inconsistent or noisy data; and 5. Great generality and flexibility in its user interface. Anticipated benefits: The product that will result from this work will be a domain-independent expert database system that would be adaptable to a wide variety of knowledge bases both with the DoD and in commercial industry. As the use of such knowledge bases becomes commonplace due to the availability of massively parallel multiprocessors and enhanced desktop computing capabilities with high-speed wide-area networks, our technology will play a crucial role as the underpinning of widely used commercial products.

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Phone: (617) 933-5355
Topic#: 92-031 ID#: 9210126
Office: DSO
Contract #: DAAH0192CR326
PI: R.K. MEHRA

Title: An Environment for Concurrent Software Design

Abstract: While computer speeds have been doubling every couple of years, the process of software development tends to proceed in the same way as before, one line of code at a time. Concurrent software design attempts to change that several team members, or designers, work simultaneously to develop a single software product. Concurrent design is expected to cut the development time significantly. Successful concurrent design involves two seemingly incompatible aspects. One, the different designers should be able to work concurrently (or, simultaneously) as much as possible. And two, they should not offset each other's work, or otherwise produce designs that are somehow conflicting. Garg and Raghunathan [9,10] recently described a novel scheme to obtain both concurrency and compatibility without compromising one for the other. While this scheme has several features that are ideally suited for concurrent design, its performance (in terms of the amounts of sharing and conflict) is as yet untested. We point out three key factors that might enhance or adversely affect its performance. The objective of this project is to investigate these factors and to develop schemes to enhance the performance. We intend to pursue these goals by both theoretical analysis and by experimental verification. In Phase II of this project, we intend to build such a concurrent design environment. Such a system, if successful, will greatly speed up the tedious and time-consuming process of software development. We believe that these ideas are highly original & innovative in that they combine traditional engineering design database concepts with advanced combinatorics and optimization. We further believe that there is a niche for such systems, and that they hold great commercial potential. Anticipated benefits/potential applications - A system based on the proposed R&D will be highly valuable as an environment for concurrent software development. The product resulting from Phase II has great commercial potential due to the vast amount of funds being spent worldwide on software development.

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Topic#: 92-016 ID#: 9211241
Office: ASTO
Contract #: DAAH0192CR331
PI: GARY LOMP

Title: Low-cost Multi-spectral Signal Processing to Simultaneously Process Spatially and Temporaneously Disjoint Wideband Signals

Abstract: In this proposal, we present an innovative technique for multispectral signal processing using multichannel acousto-optic bragg cells to simultaneously process spatially and temporaneously separate wideband signals. This optical system when used in conjunction with a conventional spread-spectrum receiver will be able to identify and acquire the code of the transmitting emitter. The processor will perform close to that of a parallel matched filter receiver, thus being LPI and AJ by reducing the required synchronization period. It relies on a nonheterodyning space/time integrating multichannel acousto-optic correlator. We propose to carry out a thorough investigation on the possibilities of using such a system, analyze it's performance capabilities and present a feasible design architecture for system implementation. The product of this research will be a valuable system for both the military and the commercial sector. Anticipated benefits/potential applications - The proposed multichannel signal processing system will benefit both civilian and military communications. It's ability to operate on many possible emitters will make it applicable to battlefield surveillance systems and to mobile and personal communication networks where multi-user receivers are required.

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Topic#: 92-130 ID#: 9220331
Office: ASTO
Contract #: DAAH0193CR026
PI: TUVIA APELEWICZ

Title: Multi-media Network-layer Protocols to Support Meteor Burst (MB) and Other Communication Media

Abstract: This proposal describes the research needed to design a unified access interface that facilitates access to meteor burst, high frequency, and lightsat channels. It also proposes the use of an Asynchronous Transfer Mode (ATM) cell-base architecture to provide multimedia services using these channels. The modular design of the unified interface stems from the fact that user service profiles are carefully mapped to the bearer capabilities of the proposed communications channels. In this proposal, we shall design a unified access interface, ATM protocol, specify user multimedia service profiles, a hierarchical network

performance management framework for routing and congestion control and perform analysis using real time simulation. The key aspects of the research include the development of "detection of channel fading" and "dynamic switching of the channel during a session". Anticipated benefits: The research and development proposed in this proposal will provide DARPA with the network-layer protocols required to transmit multimedia information over fading channels. It is expected that these results will yield major military and industrial benefits

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Topic#: 92-031 ID#: 9211014
Office: DSO
Contract #: DAAH0192CR350
PI: MICHAEL GRASSO
Title: Engineering Design Database
Abstract: During complex engineering efforts, the definition and control of requirements is typically accomplished through a large set of project documents. Today, manual methods are used to handle these requirements. This however, results in problems in various areas such as maintenance, traceability, and the evaluation of the potential impact of design changes. The objective of this proposal is to design a computer system for the management of requirements and constraints in an engineering design effort. Specifically, we intend to develop an Engineering Design Database (EDD) to manage the development, storage, verification, and analysis of design requirements. Concurrent engineering will be enabled through centralized tools used to automate the management of requirements and constraints as well as stimulate communications between engineers throughout the design process. In Phase I, a prototype system of limited scope will be developed and field tested. This will verify the feasibility of the project and provide a basis for the development of a complete system during Phase II. Anticipated benefits/potential applications - The engineering design database will provide innovative tools for the collection, storage, retrieval, analysis, and verification of requirements and constraints. The integration of these tools along with the ability to support multiple hardware platforms using a scalable architecture will result in a system with broad commercial potential.

SENSORS UNLIMITED, INC.
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Phone: (609) 446-4661
Topic#: 92-091 ID#: 9210472
Office: MICOM
Contract #: DAAH0192CR316
PI: GREGORY OLSEN
Title: A Universal Multiplexer Readout for Automated Testing of Infrared Focal Plane Arrays
Abstract: As part of the development for automated testing of Infrared Focal Plane Arrays (IRFPA), we propose to design and build a universal silicon multiplexer for readout of hybrid IRFPA's which have high dark current. The unit would operate with all detector materials (e.g. Si, InGaAs, HgCdTe, InSb, multiple quantum wells) and would be far superior (in terms of pixel noise and charge capacity) to anything now available commercially. The innovation consists of applying novel CMOS technology together with recent design improvements to make a detector multiplexer that would be available to the entire scientific and defense community. In Phase I, we would develop a demonstration test station and survey DoD's needs and design several versions of the multiplexer. In Phase II, we would have the multiplexers fabricated at a foundry in both one- and two-dimensional forms, bonded to InGaAs and HgCdTe focal plane arrays and tested for readout quality. Dr. William Kleinhans (Valley Oak Semiconductor) and Prof. Walter Kosonocky (NJIT) will consult. Anticipated benefits/potential applications - Commercial hybrid multiplexers for infrared focal plane arrays have very limited availability and do not have state-of-the-art performance. This program would develop a universal mux which would allow automated testing of various IRFPA's with a single test station for the scientific community in general and DoD in particular, and open up improved performance in infrared applications such as NIR spectroscopy, process control, remote sensing and atmospheric monitoring.

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Topic#: 92-119 ID#: 9211239
Office: LSO
Contract #: DAAH0192CR313
PI: JAMES HARRIS
Title: Feasibility Demonstration of a Novel Concept to Provide Positive Combat Identification Among Diverse Friendly Forces
Abstract: The research efforts associated with this Phase I SBIR proposal, and its possible Phase II follow-on, are expected to establish conceptual feasibility and demonstrated practicality of a novel concept for providing positive combat identification

among diverse friendly forces. The associated Positive Combat Identification Device (PCID) concept incorporates Sesco proprietary (patent pending) SW&RM hardware/software which has been demonstrated under an earlier DARPA sponsored project. The six month Phase I research will: a) coordinate and document efforts to formulate a multi-service assessment of operational and doctrinal merits of the concept, and b) establish technical compatibility of the concept as p(3)i to existing military systems. The Phase I research is expected to establish sufficient technical/operational/doctrinal merit in the concept to justify advancing to Phase II (selected hardware demonstrations). During the proposed Phase I effort, Sesco expects to work closely with the sponsor and with many of the following organizations: DARPA and LABCOM - IFF/C(3)I aspect demonstration interests; DCSOPS - Army doctrinal compatibility; USAF/TAC - Air Force doctrinal compatibility; TACOM - vetronics and operational capability; AVSCOM - avionics and operational capability; Fort Huachuca - electronic equipment compatibility; ARDEC - weapons/artillery compatibility; USAF/ASD - avionics systems compatibility; USAF ADTC - weapon system compatibility; Special Operations Forces; tri-service project C(3)I office. The Phase I research product will be a report in three parts: part I - compatibility of the concept with established operational requirements and doctrine; part II IFF/avionics/weapons/troop compatibility; and part III - identify Phase II technical demonstration issues. If awarded, the twelve month Phase II research is expected to provide selected hardware and technical performance compatibility demonstrations of the PCID concept for representative avionics, vetronics, weapons and troop systems. It is hoped that an additional Phase III project for joint service operational air/land field trials would follow successful conclusion of Phase I and II research.

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Topic#: 92-173 ID#: 9220840
Office: ESTO
Contract #: DAAH0193CR029
PI: LEO WADSWORTH

Title: Low-cost Bare Die Testing for Multichip Modules

Abstract: We propose to develop a simple, low-cost method of fully testing and burning-in bare die before assembly to multichip modules. Previous approaches in the industry have proved cumbersome, costly or inefficient in their use of substrate real estate. The proposed approach employees enclosing the bare die in a temporary reusable package. This package, which matches the footprint of the existing packaged version of the chip, allows full functional testing and burn-in by the manufacturer. No additional testing equipment is required. The chip is removed from the temporary package and either wirebonded or flip-chip attached to the MCM. In Phase I we will carry out feasibility studies, build and demonstrate elements of the approach and create a plan for implementing the approach in an actual MCM design. Phase II will include the development of an MCM demonstrating the approach on several different chip types from different sources. Anticipated benefits: MCMs for a broad range of systems including computers, signal processors, mass memory and communications equipment.

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Topic#: 92-196 ID#: 9220766
Office: MTO
Contract #: DAAH0193CR030
PI: NICHOLAS TENEKETGES

Title: Optical Communications for High-speed Digital Processing

Abstract: The problem which we address in this proposal is the utilization of III-V semiconductor optoelectronics in massively-parallel, general-purpose processors implemented with 3-D Multichip Module (MCM) technology. In principle, such processors can replace traditional special-purpose, hard-wired systems for many high-performance signal processing applications, providing full programmability as well as important economic advantages. The key problem with massively-parallel architectures, however, is implementation of the required interprocessor communications network, which grows rapidly in complexity as the number of processing elements increases. In our approach, we employ free-space optical interconnects within a stacked-substrate MCM structure to implement a highly-parallel, extremely high-bandwidth network. In order for the light to be transmitted through the substrates, a substrate material transparent to the wavelength employed is used (or alternatively, small holes are fabricated in thinned portions of the substrate). The substrates are held together in compression with spacer elements made from the same material as the substrate, permitting the fabrication of keying structures which maintain precise registration (to within a few microns) as well as allowing individual substrates to be removed for repair. The optical transmitters and receivers are mounted on the substrated with flip-chip solder bonding techniques, which permit registration of these devices on their substrates to an accuracy of about two microns as well as angular alignment to within 0.05 degree. Anticipated benefits: The proposed project will have potential for a wide range of both federal government and commercial applications, including

high-speed signal processors for synthetic aperture radars, infrared surveillance systems, etc., as well as supercomputers, robotics and portable information-processing systems requiring extremely high-throughput computation in a compact package.

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Topic#: 92-164 ID#: 9220222
Office: DSO
Contract #: DAAH0193CR031
PI: ELLIOT KENNEL
Title: Diamond P-N Junction Cold Cathode
Abstract: A cold cathode capable of delivering several hundred amps per square centimeter (under ambient conditions without the introduction of cesium vapor) would be valuable for a number of applications in high power high frequency electronics. One of the most highly sought applications is that of cathode ray tube visual displays. Decreased voltage requirements would simplify the power supply requirements and allow a shorter crt to be manufactured. This is of obvious utility for aerospace applications and could also be very attractive for consumer video displays as well. A method is described herein for manufacturing a cold cathode device using p-type diamond in direct contact with highly doped n-type silicon. Unlike other schemes for using diamond as a cathode material, there is no need to manufacture n-type diamond. Anticipated benefits: Cold cathodes can be used for lower voltage, compact cathode ray tubes for video monitors and displays. Widespread aerospace and commercial applications are expected.

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Topic#: 92-088 ID#: 9211212
Office: UWO
Contract #: DAAH0192CR322
PI: BARRY SWARTZ
Title: Laser-Digicon: Range-Gated Underwater Imaging System for Small Object Search & Identification
Abstract: This proposal presents a program to develop a design for a laser range-gated underwater imaging system incorporating a state-of-the art laser illuminator and an optical digicon receiver. This type of system will exhibit superior range and resolution capability relative to any other practical underwater imaging approach and will offer operational features which lend the system extremely well to the small object locating and identification application. Although the range-gating concept is not new, the availability of an optimal receiver has been lacking. The coupling of a new type of phototube, the efficient and low noise digicon, with an advanced solid state laser will bring revolutionary technology to bear on both the illuminator and receiver of the imaging system and result in unprecedented performance. The range gate approach effectively eliminates backscatter which is the major source of noise for active through water imaging. It is also insensitive to relative motion and thus places little requirement on platform stability. It is also amenable to compact packaging for ease of deployment. Anticipated benefits: The program effort is relevant to most agencies who operate in a maritime environment. It will be beneficial to many groups within the navy in uses ranging from detection, classification,and identification of mines and assisting in explosive ordinance disposal to aiding the full range of underwater vehicles, as well as divers, to navigate, avoid obstacles, and detect and identify threats and targets. Applications also include inspection and aid in construction and repair of commercial offshore equipment.

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Topic#: 92-119 ID#: 9211066
Office: LSO
Contract #: DAAH0192CR323
PI: PAUL ZIDEK
Title: Positive Combat Identification
Abstract: Spectra Research, Inc. proposes to research and synthesize advanced covert multi-spectral IFF concepts which employ unique low cost discrimination techniques to detect and positively identify friendly forces. The proposed interrogating sensor operates on a combination of passive non-cooperative emissive radiation and backscatter augmented by non-radiating cooperative multispectral retroreflective IFF devices. These devices employ digitally encoded multispectral EO/IR and RF retroflection to assure high accuracy, robustness, and low intercept non-compromising operation. This combination of non-cooperative and cooperative encoded multispectral returns provides substantial, secure sensor source data for operations over a broad set of adverse weather conditions. Neural net signal processing techniques will fuse this data to enhance reliability over this diverse set of operational conditions. Anticipated benefits/potential applications - This technology has direct application to the

commercial sector including monitoring of transportation, manufacturing, shipping, and inventory resource identification.

SPIRE CORP.
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Topic#: 92-174 ID#: 9220321
Office: ESTO
Contract #: DAAH0193CR033
PI: H. PAUL MARUSKA
Title: Gallium Nitride Phosphors for Display Applications
Abstract: Spire proposes to develop a sequence of advanced deposition and processing techniques for creating superior nitride semiconductor films (alloys of AlN, GaN, and InN) suitable for producing full color, flat targeted at nitrides, deploy ion implantation to introduce p-type dopants and color centers, and institute Pulsed Electron Beam Annealing (PEBA) to activate the implants and optimize crystalline perfection. The high efficiency, short wavelength p-n junction diodes will define the path to full color flat panel displays, including an excitation source for ZnS-based phosphors. Phase I investigations will center on realizing reproducible, high conductivity p-type GaN samples based on ion-implantation of zinc, followed by PEBA activation. We propose that the PEBA environment offers precise, controllable annealing conditions, especially over the full surface of samples; ion implantation allows exact definition of doping profiles and positioning of individual pixels. Starting in Phase II, all samples will be deposited in Spire's electron cyclotron resonance plasma deposition chamber, assuring that activated reactants are available to enhance crystalline perfection at reduced deposition temperatures. Alloys of AlN, GaN, and InN, will be implanted with dopants and processed by PEBA to provide light emission throughout the visible spectrum. Phase II devices will lead to an invaluable resource for displays, communications (including intersatelite), and data processing and storage anticipated benefits: because alloys of the III-V nitrides span the entire visible spectrum, they promise to allow full color displays for HDTV; the blue and ultraviolet light emitters would provide high density optical data storage and advanced bar code readers.

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Topic#: 92-174 ID#: 9220851
Office: ESTO
Contract #: DAAH0193CR032
PI: WARD HALVERSON
Title: Ion Implanted Phosphors for Full Color Flat Panel Displays
Abstract: A key to high definition, full-color, flat panel displays with improved luminance, chromaticity, efficiency, and low manufacturing cost is replacement of powdered phosphors with thin film phosphors. The new phosphors are needed in color plasma displays, field emission displays, thin film electroluminescent backlights for liquid crystal displays, and could even be used in a new generation of Cathode Ray Tubes (CRTs). Spire proposed to deposit and ion implant thin film phosphors which are more robust and adherent than powdered phosphors and which exhibit higher luminance and longer operating life. In Phase I, powdered phosphors which have been used in flat panel displays and CRTs will be deposited as thin films, activated by ion implantation, and evaluated by measurements of UV photoluminescence and cathodoluminescent excitation parameters will be those used in plasma, field emission and CRT displays. Based upon these measurements, modifications to the film and activators to achieve highest light output will be implemented. Phase I research will lead to demonstration of bright red, green, and blue phosphors in a flat panel display in Phase II. Working relationship will be established with an american manufacturer of displays to facilitate transfer of the technology to an industrial partner at the conclusion of Phase II. Anticipated benefits: Flat panel displays with increased luminance, greater color gamut, higher electrical efficiency, and longer operating life can replace cathode ray tubes in computer terminals, instrument panels, and many other government and commercial display applications.

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Topic#: 92-004 ID#: 9210812
Office: ASTO
Contract #: DAAH0192CR292
PI: MICHAEL ANAPOL
Title: Low Cost, Multi-mission Remote Sensing for Climatic Change and Tactical Surveillance
Abstract: Limited funding drive future spaceborne remote sensing systems to an affordable solution which comprises multi missions, flexible and simple data collection and processing techniques and low cost launch to space. Candidate missions include tactical and space object surveillance, photo reconnaissance and intelligence, weather forecasting and next generation landsat and goes applications, as well as, earth resource (ocean, terrestrial, cloud imaging), and atmospheric climatic change

measurements. This proposal will develop a single instrument design capable of simultaneously obtaining high spatial (3m VIS, 12m IR) imaging with continuous spectral resolution ($\cap/\ \cap \approx 250$) resultant hardware could (1) revolutionize the DoD space deployment philosophy to a cost effective multi mission capability; (2) demonstrate the next generation, highly flexible "landsat class" imaging spectrometer approach with capability not currently available (continuous spectral resolution and 3 times better spatial resolution); (3) have a primary role in DoD treaty compliance, global monitoring and environmental impact assessment; and (4) provide important scientific data to support climatic change research. SSG has developed spaceborne telescope systems (Cirris IA and Spirit 3/MSX) which have performed multi DoD imaging and target tracking missions, while simultaneously, obtaining scientific atmospheric and terrestrial spectral measurements. SSG is also working the integration of key sensor technologies with emphasis on ultra lightweight SiC reflective telescope (0.6M diameter weighing < 50 lbs) to permit launch on a pegasus class low cost booster. Anticipated benefits/potential applications - Combining tactical surveillance and possibly other DoD missions with climatic change research measurement will provide a cost effective multi mission capability. Coupling the multi mission aspect with a low cost, very lightweight sensor systems, capable of being launched on a low cost pegasus class booster, will revolutionize DoD's and NASA's deployment philosophy. In addition, the scientific data on a global basis will be significant making the DoD a major player on the climatic change/earth resource community.

SUBMICRON TECHNOLOGY CORP.
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Topic#: 92-076 ID#: 9211058
Office: MTO
Contract #: DAAH0192CR315
PI: MICHELE MALITZ
Title: Resists for 193-nanometer Photolithography
Abstract: Newly synthesized organosilicon negative resists offer potential applications for microlithography at sub-half-micron dimensions, -- not only for 193-nm photolithography, but also for e-beam and x-ray lithographs. The resist composition and structure allow robust stable layers; problems related to runaway of sensitometric parameters, linewidth shrinkage and nonrepeatability of topology during processing have been minimized. A comprehensive computer model describing the mechanisms of the reactions taking place in the resist material during exposure has been developed, and has been useful in improving the resist composition and structure; the model will also be useful in further optimization of resist characteristics such as sensitivity, contrast and resolution. Sub-half-micron features have been demonstrated using a dose near 50 mJ/cm(2) for 193-nm exposure, a dose of 7(10)(-6) coulomb/cm(2) for e-beam exposure (24 KeV), and a dose of 5 mJ/cm(2) for x-ray exposure (44 å). The resist has been demonstrated in single-layer, bi-layer, and tri-layer applications. The resist manufacturing technology can be expanded to large-scale commercial production. Anticipated benefits/potential applications - Anticipated benefits for the federal government include the ability to allow manufacture of low-cost high-yield VLSI circuits for wide-spread DoD usage, and to allow fabrication of cost-effective military custom asic chips with features at or below 0.25 micron (using photolithography, e-beam or x-ray lithography). Potential commercial opportunities include going into large-scale production of the resist for submicron as well as sub-half-micron utilization.

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Topic#: 92-140 ID#: 9220179
Office: CSTO
Contract #: DAAH0193CR034
PI: ARTHUR ROBINSON
Title: Fault Tolerant Mach Server
Abstract: The fault tolerant mach server presented in this proposal will provide developers and users of high performance, mach based, military and commercial computing systems with facilities for substantially increasing system dependability. Currently, these systems do not provide adequate fault tolerant services. In addition, many of their key operating system functions are highly susceptible to input and application program faults. Because fault tolerant services cause performance degradation, the fault tolerant mach server will provide a flexible, dynamically tunable, design, so that users will be able to "dial their own degree of paranoia", depending on their specific system dependability requirements. The design will utilize "server-sentry" fault management concepts derived from fault tolerant server research at Carnegie Mellon University (CMU), and from related earlier CMU automated instrumentation and testing research results currently being customized for industrial applications by System/Technology Development Corporation (STDC). During Phase I of the proposed program software requirements specification and a preliminary design for fault tolerant mach server will be documented, and advanced automated software instrumentation and testing tolls required for its implementation will be demonstrated. This work will establish the foundation

required for server implementation and demonstration in Phase II. Anticipated benefits: Continuing increases in the performance and complexity of both military and commercial computing systems is creating growing classes of system applications in thick errors and failures in the system's service will have the potential of causing catastrophic physical, security and/or economic impacts. The fault tolerant mach server environment that will result from Phase II of this proposed project will serve as both a proof of principal and as the technical foundation for servers that will significantly increase the dependability of the systems in which they are incorporated.

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Topic#: 92-073
Office: MTO
Contract #: DAAH0192CR319
PI: JAMES SMITH

ID#: 9210803

Title: Neural Network Techniques for Practical Applications to Time Series Prediction

Abstract: Although it is widely known that neural networks have, in specific cases, demonstrated performance superior to traditional methods of time series prediction, there is still much to be learned with respect to their application to problems where the dynamics of the underlying system are non-stationary. This proposal addresses a specific application of neural network technology to a forecasting problem with broad military implications. The proposed problem, that of forecasting the motion of a ship due to ocean-wave activity, has a number of features that place a high value on its solution at this time. Since the problem is presently under study using another prediction methodology, it is proposed to: (1) derive a neural network that is appropriate to the ship motion forecasting problem, (2) compare and contrast the performance characteristics of the alternative forecasting technique with those of the neural network approach utilizing the same set of aircraft carrier motion data in a unified experimental design, (3) develop performance metrics and validation techniques for other neural network approaches to time series forecasting, and (4) lay the groundwork for a Phase II effort comprising advanced techniques for forecasting fluidic wave motion using the best properties of either technique or, if appropriate, a combined approach. Some preliminary data are presented, suggesting that the neural network approach exhibits superior forecasting capabilities over other techniques. Anticipated benefits/potential applications - The anticipated benefits of the proposed forecasting scheme will be improved safety and performance of a variety of ship-board aircraft operations by the U.S. Coast Guard, Marines, and Navy. Potential commercial applications include: rotary wing operations, economic and logistical models, climate and weather predictions, and inventory control for large companies.

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Topic#: 92-156
Office: DSO
Contract #: DAAH0193CR036
PI: RODNEY MORISON

ID#: 9220666

Title: Data Consistency Network Services

Abstract: We propose to define a data consistency network service, including the protocols, formats, programming interfaces and utilities needed to support the service. We will also develop a prototype implementation. The Data Consistency Network Service (DCNS) will address the problem of general purpose revision control for designs with files distributed across a network. Within the general purpose system, particular emphasis will be placed on design files and libraries found in multi-user engineering project on a network that supports IP (internet protocol). DCNS services and applications will allow users to identify slave files that are linked to master files across the network. Options will allow the user to be automatically notified when the master changes, will allow for manual update of the slave file at the push of a button, and will allow for automatic update of the slave whenever the master changes. These services will provide a fundamental capability of data consistency and update control across the internet. These capabilities have the potential of saving tremendous manual effort now associated with updating tasks, reduce problems associated with using out-of-date information (e.g., failed electronic designs), and speed up the rate of interaction between users of the internet. Anticipated benefits: DCNS is of direct benefit to network-based cad projects, improving quality control, time to market, and enabling advanced cad techniques such as concurrent engineering. Further, the network-wide usage of this service could revolutionize the process of software shipping and updating.

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Topic#: 92-158
Office: DSO

ID#: 9220741

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Phone: (301) 261-8373
Contract #: DAAH0193CR054
PI: EDWARD PAQUETTE
Title: Surface Strengthening of Advanced Ceramics by a Thin Composite Skin
Abstract: The objective of this Phase I SBIR project is to demonstrate that a monolithic ceramic core-composite skin structure has significantly increased fracture toughness as compared to the core material, while substantially maintaining its flexural strength. The core material is reaction bonded silicon nitride, a formable and relatively inexpensive structural ceramic. The composite skin is a chemical vapor infiltration processed SiC matrix with SiC, Si3N4, or aluminosilicate fiber reinforcement. A further objective is the development of a low cost microwave-based fabrication process, for which Phase I feasibility will be demonstrated via microwave in situ nitriding of the green RBSN core. Anticipated benefits: This core-skin structure approach is expected to provide composite behavior without the expense of fabricating thick section composites. If successful, this would make the ceramic core-composite skin structures cost-effective for such components as combustor liners, hot section components and nozzles in aerospace and commercial turbine engines.

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Topic#: 92-015
Office: ASTO
Contract #: DAAH0192CR317
PI: CHARLES BENTON
ID#: 9211111
Title: Development of a New System Architecture for Generating Imagery Using Head-Worn Displays
Abstract: Development of a system architecture targeted specifically for head mounted displays and a personal synthetic environment (virtual world) interface is proposed. This new architecture will eliminate many of the traditional problems associated with HMDS. Phase I will include, as proof-of-principle, rapid prototyping of a lightweight, man-portable assembly using Commercial Off The Shelf (COTS) sensors, Computer Image Generators (CIGs), and a Head Mounted Display (HMD). This system will then be linked to a host system for interface into a distributed interactive simulation environment. The most significant feature of the system architecture is that the entire user interface loop remains physically local to the user. By physically removing all components for the user interface from the host, the entire interface becomes decentralized. This will enable a paradigm shift in the ways in which users interface to synthetic environments. Implementations of this new architecture which utilize existing graphics standards (PHIGS, GKS, CGI) will have widespread impact. The Phase I work plan exploits cots hardware, existing software and a highly visible military synthetic environment to demonstrate this revolutionary new system architecture. Anticipated benefits/potential applications - This effort will have short term benefits in that it will provide a proof-of-principle for a new, revolutionary system architecture. The effort will have long term impact resulting from the paradigm shift enabled by the new system architecture, and its execution using an open system, standards based approach.

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Phone: (310) 536-0011
Topic#: 92-007
Office: ASTO
Contract #: DAAH0192CR318
PI: JAMES SUTTLE
ID#: 9210831
Title: Small Satellite Cost Estimating Category: Advanced Development
Abstract: This effort will provide DARPA with a top-level, integrated design and cost estimating model, the small satellite integrated design (SSID) cost model, to assess and calculate the design and cost ramifications of a variety of small satellite concepts. The four Phase I activities required to develop this model are (1) identify the parameters necessary for technical design and top-level costing of small satellites; (2) prioritize those parameters into the appropriate order of importance; 3) develop a top-level integrated design and cost estimating model; and 4) identify and acquire relevant historical data and compile that data into a formal structured database. The SSID cost model will allow variations in design parameters including, but not limited to, weight, range, altitude and plane of orbit, type and complexity of mission, type of power subsystem, commercial availability of piece parts, and launch time of year. The nonrecurring and recurring portions of the system life cycle will be treated. The Phase I model will, in essence, be a top-level working tool designed to demonstrate the features of the model to be completed in Phase II.

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Phone: (505) 345-8623
Topic#: 92-225 ID#: 9220721
Office: UWO
Contract #: DAAH0193CR055
PI: JUAN ELIZONDO
Title: Holographic Interferometry for the Analysis of the Electro-acoustic Effect
Abstract: This proposal describes the use of holographic interferometry to study both the mechanical and electrical stress characteristics of thin polymer films, specifically those exhibiting electroacoustical behavior such as polyureas and polyurethanes. We propose to correlate the holographic fringe pattern, created by the mechanical stress induced by the applied electric field, to the charge distribution induced in the polymer by the electric field. The correlation is initiated by the knowledge of the electric field distribution in the sample and its surrounding. The induced mechanical stress is then mapped in relationship with such electric field distribution. Two and three dimensional imaging of stress distributions are considered in the proposed work. The macroscopic correlation of these two parameters yields the understanding of the surface to bulk interfacing and interaction. The next step is to understand the coupling, at the molecular dipole level, to the electrical stress and the induced mechanical deformation. Anticipated benefits: Wide applications for line inspection of polymers producing and coated high voltage cable transmission lines for power distribution. Development of "flat" speakers for the new generation of flat screen television monitors, is possible with this technology, with great impact on consumer electronics.

THOMAS L. CLARKE
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Phone: (407) 658-5030
Topic#: 92-017 ID#: 9210688
Office: ASTO
Contract #: DAAH0192CR321
PI: THOMAS CLARKE
Title: Hybrid Approaches to Orthogonal Localization and Orientation Systems
Abstract: An Orthogonal Localization and Orientation Systems (OLOS) that utilize a combination of magnetic, gravitational and acoustic sensors will be investigated. Currently, the best approach seems to be a combination of magnetics to provide horizontal direction, gravity to provide tilt, and acoustics to provide position. Position accuracy should be $<$ 1 arc minute, and response time $<$ 20 msec. Other approaches will be considered through an extensive search and review of available technologies. Feasibility of the favored approach has been demonstrated at the university of central florida using adapted components. During Phase I a design using standard components will be developed. This design will be engineered for production during Phase II. Micron/Green Incorporated of Gainesville, FL will be able to market resulting products during Phase III as the OLOS fits naturally into its product line. Anticipated benefits/potential applications - The proposed approach will provide a compact, easy to set up orientation and localization system whose benefits over existing systems include: improved accuracy, longer working range, and ability to operate multiple systems in close proximity.

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Phone: (510) 658-3172
Topic#: 92-058 ID#: 9210828
Office: ESTO
Contract #: DAAH0192CR320
PI: A. JOHNSON
Title: Micro-Actuator Valve Employing Shape-memory Alloy Film
Abstract: By combining silicon micromachining techniques with shape-memory alloy in the form of sputtered films, it is possible to make compact forceful micro-actuators. Such devices are useful in valves and pumps for implantable drug delivery systems and, in combination with microsensors, in miniature robots and portable chemical analysis systems. Miniature medical robots under development in research laboratories cannot be realized without the development of micro-valves. Centimeter-sized valves using electrically-powered shape-memory film have been fabricated in our laboratory. These devices can be greatly scaled down from their present state of development. Medical minimally-invasive robotic systems require creation of devices in the size range of one hundred microns to one millimeter. In Phase I we will design a valve, based on our work to date, for use in miniature pneumatic-powered robots, and fabricate and test micro-valve components. In Phase II, we will construct working prototypes including integrated multiple-valve systems for medical micro-robots. Research proposed herein will lead to micro-valves for use in a variety of micro-electro-mechanical systems. Anticipated benefits/potential applications - Micro-electromechanical systems will have commercial applicability in industry, aerospace, medicine and biological engineering because they will increase portability of equipment, enable cost-effective medical techniques, and facilitate analyses of micro-liter samples.

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Topic#: 92-023 ID#: 9210988
Office: ASTO
Contract #: DAAH0192CR314
PI: KEVIN SULLIVAN

Title: Transform Mission Planning into Classical Mechanics Domain

Abstract: One of the most challenging problems in automated mission planning is the creation of a route for an aircraft to follow which is both feasible, based on aircraft kinematic capability, and minimizes the exposure of the aircraft to enemy air defenses. Several techniques are currently in use which approach the problem by discretizing either the scenario region or the route of the aircraft. In this proposal we briefly discuss some of the drawbacks of these techniques and then we describe a new approach. The new approach is to formulate the problem as an optimal control problem. Optimal control theory has previously been used to solve problems in classical mechanics and for finding optimal trajectories for spacecraft. This approach has the advantage that the dynamics of the aircraft are explicitly modeled in the problem formulation so that it will always produce feasible routes. In addition, it can be used to find an optimum route directly, without a time-consuming trial-and-error process. Anticipated benefits/potential applications - The successful completion of this proposed effort will lead to the development of better automated mission planning systems. This will allow aircraft to have a greater chance of successfully completing their missions and returning safely.

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Topic#: 92-181 ID#: 9220856
Office: MICOM
Contract #: DAAH0193CR035
PI: ROBERT CHAPMAN

Title: A High Yield Synthesis Process for Ammonium Dinitramide (ADN)

Abstract: Ammonium dinitramide (ADN) was invented at SRI International (Menlo Park, CA) in 1989. Its discovery is significant in that theoretical calculations predict it to exhibit better performance as an advanced ordnance material than most classical nitramine ingredients. A problem with ADN at the outset was the low yields offered by the synthetic routes to the compound. The most important objective of the Phase I program is to demonstrate the feasibility of an improved synthetic route to ADN. Several proposed routes to the product are based on various precedence for similar reactions. A key question in the assessment of the proposed alternative routes is whether or not the economics of the synthetic schemes should allow or preclude their consideration as more economical alternatives to the current best route to ADN. Another objective of the Phase I effort will be to scale up a procedure of choice to demonstrate practical preparation of one-pound batches of ADN. Anticipated benefits: The practical availability and use of ADN for ordnance systems would result in improved performance in many explosive and propellant applications: new ASW explosives, high-energy LOVA propellants, and ADN-augmented aluminum composite propellants. Other obvious applications are as a superior minimum-signature propellant oxidizer and as a novel melt-castable explosive.

TRANS-SCIENCE CORP.
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Topic#: 92-027 ID#: 9210904
Office: DSO
Contract #: DAAH0192CR324
PI: G. HEGEMIER

Title: Incorporation of Ceramics in Advanced Shield Systems

Abstract: The protective shields against hypervelocity impact to be considered in the proposed research effort are systems which incorporate a number of different material types and geometrical layouts. The primary purpose of the study is to explore the judicious use of structural ceramics as one or more components of such a shield system. For this purpose, several promising shield system designs which include ceramics will be considered under the Phase I study. Each design will be modeled numerically and computer simulations of a suite of hypervelocity impact events will be performed in an effort to assess overall shield performance and the contribution of the ceramic component(s) to this performance. These computer simulations will be based upon an advanced physically-based model of ceramics which was recently developed by trans-science corporation for application to armor/ anti-armor problems. Shield system designs will be selected in conjunction with martin marietta who has gained valuable design/test experience under a previous SDI Defense Shields Demonstration (DSD) program. The advantages of ceramic insertion into a shield system will be delineated and a candidate design will be selected for a more detailed theoretical/experimental study in Phase II. Anticipated benefits/potential applications - Stand-off shield for all long-term

spacecraft/satellites.

U.S. COMPOSITES CORP.
RENSSELAER TECHNOLOGY PARK, 105 JORDAN RD
TROY, NY 12180
Phone: (518) 283-8700
Topic#: 92-093 ID#: 9211056
Office: MICOM
Contract #: DAAH0192CR334
PI: A. KRUESI
Title: Composite Material Wet Braiding Fabrication Technology Development
Abstract: Composite materials have advantages for rocket motor cases: lightweight, high strength, and favorable 'insensitive munitions' behavior. Wet braiding offers economic advantages over filament winding for the production of composite cases. However, there are several areas in which improvements in the structural efficiency of braided rocket motor cases are needed to match the structural efficiency of filament wound vessels. These areas are the creation of domed ends and translation of fiber modulus in the composite structure. U.S. Composites proposes several unique methods for introducing these features. Our approaches are compatible with the use of our patented wet braiding technology. Anticipated benefits/potential applications - The proposed research will be directly applicable to the future development and manufacture of braided composite tactical rocket motor cases. Lower cost and improved IM performance will result.

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Phone: (513) 426-6900
Topic#: 92-157 ID#: 9220367
Office: DSO
Contract #: DAAH0193CR056
PI: TAI II MAH
Title: Feasibility Study of Refractory Oxide Fiber Production Through the Melt Spinning Technique
Abstract: A melt spinning process is proposed to produce the alumina-YAG fibers. The objectives of the proposed program are to study: 1) the feasibility of producing Al2O3-Y3Al5O2 (YAG) fibers through the melt spinning technique, 2) the morphologies and diameters of the fibers as a function of various processing parameters (e.g., melt viscosity, temperature, composition, growth rate, etc.), 3) The variations of crystallinity, microstructure and room temperature strength of the fibers as a function of processing parameters, and 4) the microstructure/mechanical property relationships of the fibers. The proposed research project will proceed as follows: 1) melt charge material preparation, 2) alumina-YAG fiber growth by the melt spinning technique, 3) macro and microstructural characterization, and 4) mechanical property measurements of the fibers. Anticipated benefits: Through the utilization of the melt spinning technique, small diameter alumina-YAG fibers will be produced. Based upon the results from the proposed R&D program, efficient processing conditions to produce alumina-YAG fibers will be determined. The candidacy of these fibers as reinforcements in ceramic matrix and intermetallic matrix composites will be established through the investigation of processing microstructure-property relations.

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Topic#: 92-060 ID#: 9211299
Office: ESTO
Contract #: DAAH0192CR286
PI: NICHOLAS COLANERI
Title: Flexible Light Emitting Diodes from Semiconducting Organic Polymers
Abstract: The recent demonstration of conducting polymer light emitting diodes (LEDs) expands the potential application of these materials into the area of active light sources, with the possibility of significant advantages over existing LED technology. These advantages include the ease of processing associated with thin film coating techniques used to fabricate devices from optically active polymers and the capability of producing low power light sources which emit selected colors ranging throughout the visible spectrum. In addition, recent work at Uniax has exploited the mechanical flexibility of polymer films to make a "plastic" led which can be curled or bent during operation without failing. A principal technical issue which must now be addressed is the environmental stability of the metal contacts used to inject electrons into the emissive layer in these devices. Their oxidative degradation is an important source of device failure and, hence, of short operation lifetimes. The proposed research will study a variety of approaches to the solution of this problem. Anticipated benefits/potential applications - The invention of LEDs using conjugated polymers as the emissive layer represents an important new alternative to existing devices made of inorganic semiconductors. If the remaining technical barriers to the commercial exploitation of this precompetitive technology can be overcome, the display, indicator, and optoelectronic industries are expected to be impacted by these novel low-cost multi-color light

sources.

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Topic#: 92-027 ID#: 9210816
Office: DSO
Contract #: DAAH0192CR335
PI: JOSEPH BROWN
Title: Ceramic Shields for Satellite Protection Against Hypervelocity Impact
Abstract: A research program is proposed to meet the challenges of protecting costly spacecraft systems from man-made orbiting debris or by meteoroids as well as debris generated by hostile action. The program is structured to benefit from the technology transfer of the proposal teams experience that includes an extensive database and prediction techniques for hypervelocity particle impacts. Optimum candidate spacecraft stand-off shield designs will be identified based on system figures of merit. Also critical technical issues associated with these candidate designs will be identified. Lightweight ceramic ballistic armor (carbide, nitrides, and borides) will be investigated that feature functionally gradient composites that can mitigate debris penetration as well as enhance debris shattering. A Phase I program has been structured to use the extensive database generated by the proposal team (which includes impact data on ceramic alloys) together with a higher order engineering level hydrodynamic code, in order to perform a design trade-off study for whipple type shield featuring single or multiple layers as well as corrugated designs. Use of hydrodynamic codes and testing of the candidate stand-off shield design in a hypervelocity impact facility will be identified for a Phase II program. Anticipated benefits/potential applications - The proposed effort can provide the DoD with a prediction tool (and methodology) and material development program to protect spacecraft systems from hypervelocity impacts. The technology can be transferred to a number of important U.S. military systems as well as international space technology systems. Commercialization of the methodology can be extended to the international market as well as technology transfer of lightweight structures to industrial applications.

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Phone: (619) 364-3560
Topic#: 92-128 ID#: 9210599
Office: UWO
Contract #: DAAH0192CR336
PI: M.S. CAHN
Title: Blunt Body Separation Control and Vorticity Management and Concept Development
Abstract: VE&A proposes to study the viscous flow and separation dynamics around a typical submarine configuration at high angles of attack. A "Prandtl tank" method of analysis will be used. This technique has been designed by VE&A and is based on the well known studies of l. prandtl. fast, inexpensive PC computer programs developed by VE&A will be used to guide the tests. These methods also allow prediction of Reynolds no. effects. These programs are described herein. Flow control methods to be studied in this program include: (1) body oscillations, (2) suction and blowing, (3) oscillating surfaces, (4) moving surfaces, and (5) magneto hydrodynamics. A feasibility comparison chart will be made for these methods. Anticipated benefits/potential applications - (1) the proposed project is expected to have application to improve the performance of submarines and ships. Methods of improving performance and control will result. (2) Commercial application of the concepts developed will be used to improve all ships. This includes cargo ships, tankers, and recreation and pleasure boats. Also America's Cup vessels will benefit. The concepts developed with modification will also apply to aircraft designs.

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Topic#: 92-222 ID#: 9220427
Office: UWO
Contract #: DAAH0193CR057
PI: ROY KESSINGER
Title: Lightweight, Intelligent Speed Reducers and Controllers
Abstract: In the future, automated machinery will require distributed intelligent actuators, sensors and controls. This Phase I effort will produce a conceptual design for an integrated set of lightweight, low-cost, modular, intelligent controllers and speed reducers for use in a variety of automation and robotic systems. These will be extendable hardware/software modules utilizing alternative and adaptive control strategies. A trade-off analysis of the candidate conceptual designs and basic technologies will be provided. The feasibility of the resulting conceptual designs will be demonstrated in three ways: 1) computer modeling and analysis of individual components and complete servo positioning systems; 2) a Computer Aided Visualization (CAV) system

will be used to produce photo-realistic animation of conceptual designs in operations. 3) A physical model of one speed reducer/controller module will be constructed to illustrate the speed reduction principle as well as the relative size, shape and interconnection project components. A final report will be produced documenting the project objectives, work carried out, results obtained and estimates of technical feasibility. This effort will lay a foundation for future development of modular controllers and speed reducers. Anticipated benefits: The proposed concepts for modular speed reducers and controllers hold great promise for improving the cost/performance of future military and industrial automation systems. These will allow faster design and production of robotic devices for numerous applications, at greatly reduced costs over traditional methods.

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Topic#: 92-197 ID#: 9220323
Office: MTO
Contract #: DAAH0193CR058
PI: PHILIP SCHAEFER

Title: Applications of Artificial Neural Nets to Process Monitoring and Control

Abstract: The overall objective of this project is to demonstrate automation in the monitoring and control of the manufacture of Solid Rocket Booster (SRB) parts. Specifically, monitoring of structural quality via ultrasonic measurements and process control decisions will be implemented. This is an ideal application for the near-term migration to the manufacturing floor because the measurement data is already being taken, the control response time is well within the capabilities of typical neural network implementations, and tangible improvements in productivity and accuracy can be expected. The proposed technical approach utilizes a cooperative neural network/qualitative physics monitoring module, which allows both experimental and casual knowledge to be used in 'programming' the system. During the project, a qualitative physics model of the relevant parts of the SRB manufacturing process will be constructed, the model will be integrated with a neural network to learn the specifics of monitoring, and a neural network for control decisions will be implemented. The resulting prototype will be tested with real data from the manufacturing floor. The feasibility and requirements for introduction to the manufacturing floor will be documented. Anticipated benefits: The proposed project will provide a practical monitoring and control technology integrating the experimental capabilities of neural networks with underlying process knowledge. In addition to SRB manufacturing monitoring, the technology will be applicable to inspection of aircraft, bridges, pressure vessels, rails, pipelines, and other systems critical to the infrastructure of our society.

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Topic#: 92-097 ID#: 9211049
Office: MICOM
Contract #: DAAH0192CR337
PI: RICHARD MINCH

Title: Micro-SWCL Pumping of High-Power Solid State Lasers

Abstract: Micro-short wavelength chemical lasers (SWCLs) are proposed for pumping solid state lasers. SWCLs are able to generate high power level CW beams in the 450 to 550 nm spectral range which have good optical quality and are capable of pumping solid state lasers at high average power levels. Micro-SWCLs are compact, light weight, require no external electrical energy, have high efficiencies, and in high altitude or space applications are self-pumping. Several micro-SWCLs are discussed with particular emphasis on a bismuth monofluoride concept which overcomes previous constraints on a BIF SWCL and which includes features facilitating effective coupling to solid state lasers for the purpose of creating tuneable solid state lasers with high average power levels. Operable in a tactical environment. Additionally, micro-SWCL lasers are discussed based on NF and on alkali cluster halogen kinetics. Specific problems of coupling SWCLs with solid state lasers are discussed with a program for designing a complete system for demonstration in Phase II. Anticipated benefits/potential applications - High average power tuneable solid state lasers useful for working, heat-treating, drilling and cutting of materials; multiple medical surgery applications; fusion power systems and isotope separation; communication; lidar; pointing, tracking and navigation; entertainment systems; and microlithography.

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Phone: (703) 750-3434
Topic#: 92-014 ID#: 92-P1-140
Office: DNA
Contract #: DNA001-92-C-0139
PI: MR. NINO R. PEREIRA
Title: Conductive Polymers for Pulse Power Applications
Abstract: Slightly conductive plastics are used to delay electrical breakdown in the power industry and to avoid static charging in packaging sensitive electronics. Likewise, electrical breakdown and static charging set limits to pulse power technology, but conductive polymers may overcome these limits. Homogeneous conductive polymers will be tested for their applicability as vacuum-water barriers, as structural elements in oil, and as high-power resistors.

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Phone: (703) 750-3434
Topic#: 92-014 ID#: 92-P1-141
Office: DNA
Contract #: DNA001-92-C-0105
PI: MR. JAMES L. GEARY, JR.
Title: Conversion of the Particle Code ISIS to the Connection Machine 5 for Decade Design
Abstract: Particle codes such as ISIS are useful for modeling vacuum power flow, electron beam motion, and plasma behavior in pulsed power devices. The Connection Machine 5 (CM-5) going to the Los Alamos National Laboratory (LANL) will have the potential for executing computer codes significantly faster and larger than currently exists with the Cray vector supercomputer on which ISIS runs. We propose to convert ISIS to the CM-5 and compare its performance with the versions running on the Cray supercomputers in the open partition at lanl. The fortran in isis will be converted into the parallel Fortran constructs used in the CM-5. The converted version on the CM-5 will be benchmarked for accuracy and speed on test problems relevant to pulsed power devices.

CARPENTER RESEARCH CORP.
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Phone: (310) 541-2227
Topic#: 92-005 ID#: 92-P1-70
Office: DNA
Contract #: DNA001-92-C-0170
PI: MR. HERMAN JERRY CARPENTE
Title: Miniature Dusty Coundary Layer Probes (CRC-9024)
Abstract: The ultimate objective of the proposed work is to provide the government with proven miniature pressure instrumentation for measure dusty flow boundary layers in small-scale windtunnel, and shock tube tests. Small probes are needed for making measurements near the wall or dust bed. Phase I will evaluate the technical capabilities of existing small sensors for use in snob/greg probes and will investigate the feasibility of miniaturizing LDV probes. It will produce a design for a miniature snob/greg probe system, using the smallest reliable sensors available, and a preliminary design for a small LDV probe. A prototype greg probe will be developed in Phase I. A preliminary design of a rake to accommodate the small snob/greg. LDV probes with be completed. Successful output of Phase I will fully support standardized hardware development in Phase II. The goal will be to develop sensors and a rake capable of accurately measuring the dusty flow for subscale tests as low a 1/100 scale (based on 1-mt burst). Successful completion of Phase II will provide the government with a new capability to test at small, cost-effective scales, and to study dust particle size scaling phenomena. It also will support basic studies of turbulent dusty flows needed for hydrocode development and evaluation.

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Phone: (505) 268-8853
Topic#: 92-003 ID#: 92-P1-79
Office: DNA
Contract #: DNA001-92-C-0115
PI: MR. CHARLES A. WAKELAND
Title: Second Generation Laboratory Simulator for Single Event Effects Testing of Microelectronics
Abstract: We propose to prove the scientific and technical feasibility to use electrostatic acceleration to boost the energy of CF-252 fission fragments as a laboratory simulation of Cosmic Ray Effects I microelectronics. The project objective is to boost the energy such that a large fraction of the accelerated ions have a range in silicon grater than 20 micrometers. This solves a number of problems associated with the current generation of laboratory simulators for single event effects testing. First, the ions will have a sufficient depth of penetration required for the certification of the single event hardness of the device under test.

Second, use of nuclear instrumentation for particle identification will provide an accurate characterization of the device under test in terms of the particle Linear Energy Transfer (LET). A precise cross section versus LET curve can be obtained for single event rate estimation in the natural space radiation environment. Finally, the lower cost of performing single event characterizations will permit the certifiable tests to be performed at the microcircuit foundry. Routine lot acceptance tests will be affordable, permitting large scale testing of microelectronics of unspecified hardness. The cost of space qualification will be reduced thereby enhancing the competitiveness of the aerospace industry.

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Topic#: 92-012 ID#: 92-P1-132
Office: DNA
Contract #: DNA001-92-C-0168
PI: MR. AL WYATT

Title: Treaty Verification and Compliance Monitoring of Chemical Weapons

Abstract: The program proposed by Dese Research and its proposed subcontractor, Brookhaven National Labs., is designed to demonstrate the technical feasibility of remote technical monitoring of chemical agents. Technical objectives during Phase I of the program are to: demonstrate the conceptual feasibility of remote sensing of chemical agents through a program that defenses treaty driven system requirements, evaluates the proposed technology in a requirements driven systems context, and provides conceptual definition of laboratory proof-of-principle experiments that will demonstrate the technical feasibility of remote monitoring systems. Previous analyses have revealed that laser-based optical techniques might be appropriate for remote monitoring. Initial screening has indicated that there are several candidate technologies for instrumentation development coherent anti-stokes raman spectroscopy and infrared fluorescence. These analyses have revealed that the raman scattering by a given molecule is unique to that molecule (thus fingerprinting that molecule). Hence the technique is amenable to pattern recognition technology. Thus, even without detecting the agents themselves, their manufacture can be deduced from the presence of eith precursors, processing chemicals, or byproducts. The product of Phase I will be a conceptual model that demonstrates the feasibility of detecting chemical agents production by detection of either agents or precursors using cars and/or infrared fluorescence. Selected laboratory proof-of-principle experiments will be conducted under Phase II that will demonstrate the technical feasibility of remote detection of chemical weapons.

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Topic#: 92-007 ID#: 92-P1-49
Office: DNA
Contract #: DNA001-92-C-0123
PI: MR. WILLIAM S. CHAN

Title: Ultra-hard, Si-based LWIR FPA for Advanced Seekers

Abstract: Electro-Optek proposes to develop an innovative large-area, long wavelength infrared (LWIR) detector array that can operate at room as well as cryogenic temperatures, and is extremely radiation hard. The fabrication of the array uses established technologies of micro-machining and microelectronic processing of silicon (Si) wafers. The detector elements of the array are formed by an ultra-thin bolometer material possessing a high immunity to nuclear radiation effects, and the highest temperature coefficient of resistance know. The readout electronic microcircuit is fabricated on the same silicon chip next to the elements. The resultant detector arrays will possess features of radiation hardness, low cost, low weight, high responsivity and high sensitivity. The high radiation hardness is due its ultra thinness. The low cost is due to a single bach process in the array fabrication. The low weight is due to a monolithic array structure requiring no cooling. The high responsivity is due a large temperature coefficient of resistance (>600% compared to 0.2% for a conventional bolometer) of our new bolometer material. The high sensitivity is due to the combined effects of high responsivity, low noise and high thermal isolation of the bolometer from its surroundings.

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Topic#: 92-004 ID#: 92-P1-114
Office: DNA
Contract #: DNA001-92-C-0147
PI: MR. ROBERT GRAY

Title: Nuclear Weapons Effects Simulation (Inductive Coupler Development for Direct Drive Simulation)

Abstract: One common nuclear weapons effects simulation technique simulates the EMP response of long cables using direct

current injection. Direct current injection typically involves the connection of high voltage pulse sources to the cables that are attached to a military system. A recently developed military standard specifies that direct current injection testing will be used in conjunction with several other test techniques in the acceptance and hardness verification testing process. New pulse sources designed to meet the test requirements of the new standard must be directly connected to the penetration under test. The need exists for a simple, non-conductive method of connecting high level pulse sources to penetrations under test. Desirable characteristics for the coupler include low cost, compatibility with existing pulsers and small volume and weight. The overall program objective is to develop and demonstrate an inductive coupling technique for use the pulse current injection sources. The inductive coupler will aid in the simulation of threat level emp effects on system penetrations such as ac power lines and long line communication cables. The proposed effort will apply recent advances in inductively coupled cable driver work to the development of an inductive coupler that will interface with direct drive pulsers. The inductive coupler will be connected to the high voltage source and will clamp around the cable under test.

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Phone: (703) 321-4534
Topic#: 92-005 ID#: 92-P1-108
Office: DNA
Contract #: DNA001-92-C-0118
PI: MR. ROBERT GRAY
Title: Advanced Instrumentation for Standardized EMP Testing
Abstract: A great deal of effort has been spent in recent years to develop standardized methodologies for accepting and verifying EMP hardened military facilities. The first of these standardization efforts to be put into effect applies to fixed site, critical, time urgent C^4I facilities. The requirements exists for an advanced instrumentation approach that can overcome the difficult acquisition environment associated with standardized EMP testing of facilities and military electronics systems will minimizing the probability of lost or inaccurate data. The overall objective of the Phase I effort is to develop and demonstrate an enhanced instrumentation architecture that offers significant increases in productivity and data quality control over traditional approaches. Our proposed approach to meeting this challenge is to integrate several diverse but complementary technologies into an advanced instrumentation system. The technology needed to support the development of an advanced instrument with these characteristics is generally available but the methodology for developing the instrumentation is not firmly established. The first phase of the effort will fully demonstrate the feasibility of the advanced instrumentation and provide a design concept. The Phase I concept will be developed under the second phase funding.

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Topic#: 92-006 ID#: 92-P1-53
Office: DNA
Contract #: DNA001-92-C-0159
PI: DR. PETER D. ZAVITSANOS
Title: Kinetic Energy Effects and Lethality Enhancement
Abstract: A program is proposed which exploits highly exothermic solid state reactions in an effort to (a) enhance lethality and (b) study target material(s) performance and failure mechanism(s) of penetration during hypervelocity impact and penetration. The effort will involve high density pellets of metal powders capable of shock ignition and rapid exothermic conversion into intermetallic solids. Target and penetrator interactions will be investigate to determine the effects of very high temperatures and high internal gas pressures on penetrator and target materials.

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Phone: (617) 964-7070
Topic#: 92-005 ID#: 92-P1-157
Office: DNA
Contract #: DNA001-92-C-0135
PI: MR. BRUCE N. NELSON
Title: Fiber Optic Measurement Systems for Moldable Explosives Cure Monitoring and Charge Characterization
Abstract: Twenty ton spherical explosive charges made from moldable explosives have become increasingly important to DNA's aboveground test programs. These charges provide longer duration free field pressure signals than can be produced in the underground test environment. The safety of manufacturing these 20 ton spherical charges could be greatly enhanced through the development of fiber optic based instrumentation to monitor process parameters. The ability of this same instrumentation to characterize the explosives material density prior to and measure time of arrival during the detonation of the moldable

explosives would further enhance the value of the proposed measurement systems to DNA. In Phase I program, the requirements for systems to both monitor critical process parameters and to characterize the explosive charges after manufacture will be assessed. Sensors will be fabricated and initially characterized in the laboratory. Conceptual designs for complete measurement systems for both process monitoring and charge characterization will be developed. In addition, a demonstration of the measurement system will be developed. In addition, a demonstration of the measurement system will be arrange at the dna contractor facility responsible for charge manufacture.

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Topic#: 92-005 ID#: 92-P1-158
Office: DNA
Contract #: DNA001-92-C-0134
PI: MR. BRUCE N. NELSON

Title: Fiber Optic Electric Field Sensors for Use in Harsh Radiation Environments

Abstract: Fiber optic electric field measurement systems offer electromagnetic pulse and electromagnetic interference immunity that is not provided by standard electron based instrumentation. To date fiber optic based electric field measurement systems have been used mostly in above-ground test applications. In the underground test environment, sensors are exposed to a harsh radiation environment. Techniques have been demonstrated that compensate for the transient light production and optical attenuation effects associated with radiation environment. However, no adequate technique has been developed to compensate for the ionizing radiation induced surface charge buildup on dielectric sensor heads. This proposal addresses the development of a technique to compensate for surface charge buildup. If successful, fiber optic electric field measurement systems suitable for use in harsh radiation environments will be available to support dna test applications. In the proposed Phase I program, the requirements for electric field measurement systems for use in underground tests will be assessed. Experiments will be performed to demonstrate the proposed technique's ability to accurately measure electric field in the presence of time varying surface charge buildup on the sensor head. In addition, detailed mechanical designs for fiber optic electric field sensors for use in underground tests will be developed.

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Topic#: 92-019 ID#: 92-P1-109
Office: DNA
Contract #: DNA001-92-C-0126
PI: MR. EDWARD J. YADLOWSKY

Title: Development of Uniform Gas Discharge Plasma Sources for Plasma Opening Switch Applications

Abstract: Plasma Opening Switches (POS) are widely used for current compression and lower amplification in inductive energy store pulse power systems. Flashboard plasma sources are widely used as plasma injectors in these POS's. The flashboard plasma is produced by surface breakdown on an insulator in vacuum. Since the surface conditions depend on the previous history, the resulting plasma is not uniform, reproducible or of high purity. A gas breakdown plasma source is proposed to replace flashboard sources. This source is a variation on the coaxial plasma gun investigated in the early 1960's for fusion applications. The plasma gun consist of two concentric electrodes filled with gas from a puff valve prior to application of a voltage pulse from a capacitor bank. The plasma is accelerated out of the gun by the j x b forces acting on the current sheet that first forms on the insulator when the gas breaks down. The gun produces plasmas densities of 10 13th to 10 15th/cm^3 at velocities of 10 cm/us which are in the range required for POS applications. Furthermore, a reproducible gas puff insures a reproducible plasma with little contamination from the electrodes or insulator. The pulse power designer can achieve a wide range of plasma conditions by varying the plenum pressure, time delay between energizing the puff valve and capacitor bank, the capacitor voltage, and the gas specie. Comparable control with flashboards would require varying the number of flashboards with virtually no control of plasma specie. Compact sources 15 cm or less are anticipated with the electrode cross section modified to match the transmission line geometry.

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Topic#: 92-007 ID#: 92-P1-168
Office: DNA
Contract #: DNA001-92-C-0114
PI: DR. L. ALLEN

Title: Improved Simox SOI by Independent Control of Beam Current Density and Wafer Implant Temperature

Abstract: The built-in buried oxide of Simox SOI material has promoted recent advances in radiation-hardened, aerospace, automotive, and communications applications. A significant issue related to the use of Simox technology is the capability of the Si and buried oxide layers to support advanced CMOS and bipolar circuitry. Recent techniques for silicon and buried oxide defect density measurements show that further improvements are necessary to assure advanced circuit yields. The experiments planned for this program capitalize on the first opportunity to apply totally independent control of oxygen ion beam current parameters and wafer temperature during implantation. The program is structured to optimize implant parameters for reduced silicon and buried oxide defects. The proposed program is predicted to result in the improved capability of advanced circuitry systems for the above field applications.

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Topic#: 92-013 ID#: 92-P1-170
Office: DNA
Contract #: DNA001-92-C-0130
PI: MR. EDWARD S. GAFFNEY

Title: Electrically Driven Two-stage Gun for Tactical Applications

Abstract: Hypervelocity gun technology will play a decisive role in the future tactical battlefield. Weapons with muzzle velocities of 2.5 to 4 Kn/s (8,000 to 12,000 ft/s) or greater have potential uses in almost every aspect of warfare. Recent advances in pulsed ower technology, specifically the high energy densities available with Integrated Pulse Forming Networks (IPFNs) and Advanced Rotating Electrical Machines (AREMs), have opened the opportunity to develop new electrically powered guns for tactical applications. The current state of the art for OPFNs is an energy density of about 600 J/Kg with an increase to about 3,000 J/Kg expected by 1997. Corresponding values for AREMs are 2,000 J/Kg and 10,000 J/Kg. These high energy densities for storage of electrical energy offer the potential for eliminating the mobility penalty previously associated with tactical applications of pulsed power. Ktech proposes a novel, unique approach to two-stage gun design which uses modern pulsed power technology to overcome the problems of mass and size which currently prevent two-state guns from being applied on the battlefield. We will design a two-stage hybrid gun which will combine several proven technologies into a single system. It is termed a "hybrid" gun because it uses an electrically powered gun as the first transition section. The hot, high pressure gas in the transition section then propels the projectile down a gun barrel in the second, gas gun stage. It is, therefore, a hybrid of pulsed power guns and gas guns, not lying clearly in either the Electric Gun (EG) or Electrothermal-Chemical (ETC) category.

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Topic#: 92-001 ID#: 92-P1-61
Office: DNA
Contract #: DNA001-92-C-0106
PI: DR. SCOTT M. FRASIER

Title: Online, Quasi-stationary, Channel Impulse Response Model for Nuclear Disturbed RF Propagation

Abstract: We propose to investigate the feasibility of an online, channel impulse response model for RF propagation through nuclear-distrubed ionospheres. The proposed model would generate realizations of the received signals at a set of antennas by linearly combining independent random variable. The correct linear combination would be determined from the matrix of correlation coefficients for the voltages at the set of receiving antennas. For stationary channel conditions and fixed antenna orientations this method is very fast and requires only a small array space. For non-stationary conditions the linear coefficients can be periodically updated thereby allowing the signal realization to evolve in a quasi-stationary manner. This model is known to be feasible under restricted channel conditions (the turbulent model). We would evaluate whether the model can be extended to encompass the DNA general channel impulse response model that is currently implemented in ACIRF/RCIRF. The advantages of the proposed channel model, relative to current models, are: 1) signal realizations provided directly to a communications/radar simulation by means of a subroutine call; 2) channel conditions and antenna orientation could change continuously with time; 3) smaller RMA, disk storage and CPU requirements than current methods.

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Topic#: 92-005 ID#: 92-P1-80
Office: DNA
Contract #: DNA001-92-C-0113
PI: H. JAKE TAUSCH

Title: Development of a Hardness Assurance Throughput Optimized Tester

Abstract: Integrated Circuit (IC) production lines operating under MIL-I-38535 have Radiation Harness Assurance (RHA) and reliability designed and built into their technology. Hardness and reliability are maintained by applying Statistical Process Controls (SPCs) to test structures fabricated alongside product microcircuits. Measurement and data reduction techniques presently employed are slow and costly and create a bottleneck in test facilities. Several parameters important to certain radiation environments are not presently tested because the requisite test capabilities are not available. Under this effort, we will develop a Hardness Assurance Throughput Optimized Tester (HATOT) which will provide high-speed parametric testing and parameter extraction, test critical RHA parameters not presently being measured, and remove the RHA testing bottleneck.

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Topic#: 92-019 ID#: 92-P1-78
Office: DNA
Contract #: DNA001-92-C-0119
PI: MR. RICHARD J. ADLER

Title: Improved Flashboards for High Power Opening Switches

Abstract: NSRC proposes an ambitious experimental program designed to investigate flashboard plasma source improvements with application existing opening switches in DNA simulators. We will investigate power system options including DC charging and external trigger systems with modest trigger requirements. Modifications to the electrode geometry of the flashboards are expected to improve DC hold-off capabilities by at least a factor of 3. Materials and physical flashboard configurations will also be varied with the objective of increasing plasma densities into the $>3 \times 10^{15}$ th/cm^3 range. These experiments will be performed primarily with existing equipment in an standard setup leading to a cost effective program of testing with standardized diagnostic setups.

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Topic#: 92-022 ID#: 92-P1-76
Office: DNA
Contract #: DNA001-92-C-0107
PI: DR. THOMAS N. HORSKY

Title: Dynamic Scene Projector for the UV-through-LWIR Spectral Bands

Abstract: A dynamic scene projection system is proposed which can simulate multi-spectral scenes in the ultraviolet, visible, and near-through long-wave infrared wavelength bands. It is based on a light valve technology which uses CRT electronics to drive a dense array of deformable mirrors. This light valve, called an Electron Beam-addressed Membrane Mirror Light Modulator (EMLM), is a maturing technology which projects a spatially modulated input light beam possessing the desired spectral dynamic imagery in at least three difference spectral bands may be simultaneously projected onto the system under test. The proposed operational system consists of several devices which are each individually optimized for performance in a given waveband. For example, the UV device promises 512 x 512 resolution elements and a flicerless frame rate of at least 30 Hz. In Phase I, a sing-color display will be constructed, using our proprietary light valve technology which has been developed for visible display. The performance of the prototype display will be fully characterized in terms of its response time, pixel uniformity, dynamic range and contract ratio, and simulated temperature range. Full dynamic imagery will also be demonstrated using an RS-170 electronics drive. The devices(s) will be read out in the UV, the visible, and the MWIR, and radiometric data will be collected and analyzed. Recommendations will be made for the structure of the Phase II effort based upon these findings.

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Topic#: 92-006 ID#: 92-P1-137
Office: DNA
Contract #: DNA001-92-C-0171
PI: FREDERICK JONAS, PH.D.

Title: Correlation of Nuclear Weapons Effects Data to Directed and Kinetic Effects

Abstract: Several directed (DE) and kinetic energy (KE) weapon technologies are presently in the laboratory, either as design concepts or prototype models. Fortunately, none of these technologies have been put to full operational use. Thus, real data is lacking of the effects to these technologies to an array of materials and structures. However, nuclear weapon technology has been researched in-depth for the last 50 years. The effects of nuclear weapons on materials and structures are, in some ways similar to what might be expected from DE and KE weapons. It is proposed that methodologies may be derived that will enable the correlation of nuclear effects data to the anticipated de and ke effects. As an example, it is anticipated that correlations may

be developed between the amount of deposited laser energy required for material ablation/vaporization and corresponding thermal energy from a nuclear explosion. If appropriate correlation functions can be developed, that is, if it can be found that there exist a certain regime where similar quantities of laser energy required for destructive damage is similar for nuclear explosion, then it is possible that nuclear effects data from nuclear effects tests may be used to describe DE and KE effects in enable scientists and engineers the opportunity to extend their current understanding of material and structure effects for de and ke to other regimes of interest.

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Topic#: 92-008 ID#: 92-P1-96
Office: DNA
Contract #: DNA001-92-C-0122
PI: MR. DAVID CREMER

Title: A Concept for Using RF as a Non-lethal Deterrent to Intruders into Nuclear Weapons Storage Facilities

Abstract: The device described in this Phase I proposal incorporates a novel technique for using RF as an enhancement to facility security systems. RF has often been investigated as a method for providing a non-lethal deterrent to intrusion into secured facilities such as storage facilities for nuclear weapons. The primary problem associated with the systems that have been studied has been the ability to concentrate enough power onto the intruder without having to radiate RF over an extensively broad area. The concept described in this proposal alleviates this problem by providing a technique where the RF is coupled directly to the intruder. The system provides a non-lethal deterrent to a potential intruder where the RF power and subsequent penalty to the intruder increases as the intruder penetrates further into the facility.

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Topic#: 92-005 ID#: 92-P1-45
Office: DNA
Contract #: DNA001-92-C-0102
PI: DR. MAHADEVAN KRISHNAN

Title: Instrument Suite to Measure Space & Time Resolved XUV & X-rays from X-pinches

Abstract: It is proposed to design, build and test a novel suite of XUV and X-ray measuring instruments for radiation from X-pinches. This suite will offer space and time resolution and cover emissions over the entire course of the implosion, from XUV (100-500 eV) to sft X-rays (1-10 KeV). The suite consists of an X-ray crystal spectrometer, an X-ray pinhole camera and an XUV pinhole camera. The basic detector element for all these instruments is a 2-dimensional array of silicon-pin diodes. These diode arrays offer 1000:1 dynamical range, <1 ns time resolution with a continuous read-out, and provide a constant response over the entire range of measured emissions, from 100 eV to 10 KeV and beyond. Phase I will produce a prototype X-ray crystal spectrometer with an 3-element, linear pin diode array detector. This time resolved spectrometer will be tested on an available, 10 J/pulse X-ray source at SRL. In Phase II we will upgrade the linear detector to a 2-dimensional pin diode array, as well as build the X-ray and XUV pinhole cameras, also with 2-d detector arrays. This suite of instruments will be tested at SRL and subsequently field tested and delivered to the Phoenix simulator at NSWC. Phase III will further upgrade the detector package to 100 pixel arrays, including an innovative data acquisition approach that will allow the use of a four-channel, fast array digitizer to capture all 100 pixels of data from each shot. The integrated instrument suite, including data acquisition hardware and software, will be developed as a flexible package that can be used on existing as well as future above ground simulators, such as decade.

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Topic#: 92-010 ID#: 92-P1-81
Office: DNA
Contract #: DNA001-92-C-0101
PI: MR. JOHN H. MORDESON

Title: Automated Tercom Placement and Evaluation

Abstract: Determining sites to build new Tercom maps have proven to be a very complicated and time consuming task, as evidenced in both SIOP cruise missile planning and Operation Desert Storm. The cruise missile planner, with some difficulty, can determine needed candidate Tercom sites, but all too often, because of insufficient terrain roughness, the Defense Mapping Agency (DMA) is unable to create a Tercom at this location. According to DMA, as many as 90% of the Tercom requests they receive are infeasible or repeat infeasible requests. As a result, the planner is left with unsatisfied Tercom needs, and DMA's

time is wasted. SCT proposes to develop an interactive graphics program which integrates our operationally proven cruise missile routing algorithms with DMA-endorsed Tercom site validation criteria. This program will provide a window based user interface with graphical plots, optimal path computations, data management of past and present Tercom request, Tercom site validation tests, request form production, and message handling between DMA and the JSTPS. This nuclear planning tool will result in Tercom requests being sent to DMA which are not only feasible, but which truly satisfy the cruise missile routing needs.

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Topic#: 92-010 ID#: 92-726
Office: SDC
Contract #: DASG60-92-C-0113
PI: Che-Chih Tsao
Title: True Three Dimension (3D) Display
Abstract: We live in a three dimensional world, where we can go around an object and observe it from all angles. The current displays: TVs, movie screens, and computer monitors are all two dimensional devices. These displays give us only "flattened" realities. The missing third dimension carries with it tremendous amounts of information that is absolutely vital to the users. ACT has demonstrated the principles of and is currently working on a ground-breaking display device that can display true three-dimensional images. It is not pseudo-3D or even 2.5D like some current display devices. It is truly 3D so that viewers can walk around the device and see a 3D object from all angles. This true 3D display device displays truly three dimensional images; uses existing CRT and flat panel display technologies, reducing development cost and time; easily incorporates current and future 2D technologies; and can be easily made compatible with current 2D television broadcasting signals and computer graphics software. It is not unscrupulous to predict that this technology will generate immense impact on the computer and consumer electronics industries.

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Topic#: 92-004 ID#: 92-454
Office: AFWL
Contract #: F33615-92-C-2262
PI: Gary O. Fitzpatrick
Title: Two-Stage Thermionic Converter
Abstract: Recent advances enable thermionic converters to achieve energy conversion efficiencies of up to 30%. Advanced Energy Technology will explore this technology for nuclear space power. High efficiency means that more power can be obtained with a smaller system radiator; this reduces spacecraft mass and increases maneuverability, as well as improved packaging. Our converter is inherently survivable against laser and nuclear threats - in fact, it can continue to operate and produce power at elevated heat sink temperatures. Its modular for survivability against pellet threats. This device uses SAVTEC close-spaced thermionic converter technology and barium-cesium thermionic converter technology. High efficiency is achieved by an optimized two-stage configuration. Potential uses of the conversion technology with non-nuclear heat sources are more efficient terrestrial commercial power plants and cogeneration of electricity in industry.

ADVANCED FUEL RESEARCH, INC.
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Phone: (203) 528-9806
Topic#: 92-003 ID#: 92-118
Office: SDC
Contract #: DASG60-92-C-0095
PI: Peter Solomon
Title: Miniaturized FT-IR Sensor for Infrared Measurements
Abstract: The sensing of infrared radiation is important in many military applications because this region of the spectrum provides data on both the temperature and chemical composition of the target. This information is contained in the spectrum or spectral signature of the target. The more complete the spectral signature, the better the discrimination between one source of IR and another. An excellent way to rapidly obtain spectra is with a Fourier Transform Infrared spectrometer which allows detection of all regions of the spectrum simultaneously with a single detector. This proposal is for the development of a unique FT-IR sensor which is fast, small, totally vibration tolerant, and permanently aligned. Such an instrument could be employed in a satellite or aircraft. The proposed FT-IR is based on a dynamically balanced interferometer. Phase I will demonstrate the following tasks: 1) determination of SDIO requirements on sensitivity, resolution, speed, and lifetime, and the development of possible configurations to meet these requirements; 2) analysis of the design for mechanical, thermal, and optical properties; 3)construction of a prototype interferometer; 4)test the operation of the interferometer under conditions of vibration and determine other properties of the interferometer such as energy throughput, potential maximum scan speed, resolution, etc.; and 5) develop a design for a complete FT-IR sensor based on the Phase I tests.

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Phone: (203) 528-9806
Topic#: 92-003 ID#: 92-691
Office: SDC
Contract #: DASG60-92-C-0115
PI: David Fenner
Title: Vortex-Avalanche Device for Photo-Detection Based on High-Temperature Superconducting Films
Abstract: AVALANCHE PHOTO DETECTOR. With this novel design, enhanced sensitivity and high speed can be obtained in a high-temperature superconductor (HTSC) microelectronic device, using a shingle layer of HTSC thin film. A collaboration between David Genner's group at Advanced Fuel Research Inc. (East Hartford, CT) and Prof. J.I. Budnick's group at University of Connecticut (Storrs, CT) will seek to demonstrate this important application for the motion of magnetic-flux vortices in type-II superconductors. The novel pile up and avalanche of the vortices has enormous potential for Phase 2 exploitation as a new basis for HTSC device physics. Government market: IR and Optical spectroscopy, detector array and imaging.

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Phone: (203) 528-9806
Topic#: 92-015 ID#: 92-196
Office: SDC
Contract #: DASG60-92-C-0068
PI: David Fenner
Title: Thin Film High-Temperature Superconductor Switching Devices on Si Wafers
Abstract: Future technology for fast switching HTSC devices will require large-area arrays of thin-film switches and materials and device compatibility with semiconductor devices. Advanced Fuel Research will: 1) take advantage of the high normal-state resistivity of HTSC to provide impedance matching directly to semiconductor devices, 2) utilize Si Wafer substrates to provided board-level hybrid integration with semiconductor devices, and 3) fabricate these relatively simple devices. Quality films and devices of YBCO are now fabricated on silicon wafers, using pulsed-laser deposition and a process invented at the Xerox Palo Alto Research Center. The proposed effort will begin development of two types of novel superconducting devices: 1) current-controlled switches, and 2) optically-triggered switches.

ADVANCED PHOTONIX, INC.
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Phone: (805) 484-2884
Topic#: 92-014 ID#: 92-312
Office: SDC
Contract #: DASG60-92-C-0085
PI: R. Michael Madden
Title: Avalanche Photodiode Arrays
Abstract: This research will substantially advance the state of the art in single-chip photodetector arrays. Advanced Photonix, Inc. manufactures unique large-area, single-element silicon avalanche photodiodes (currently 16mm active-area diameter,but potentially up to 75mm). The research will demonstrate feasibility (Phase I) and produce a prototype (Phase II) of such a photodetector subdivided into an array of individually isolated "pixels". Each 1x1mm(2) pixel will have a gain of 1000 and a noise equivalent power (NEP) of 2x10(-15) W/Hz(1/2) at 800nm - about a factor of twenty better than conventional (gain=1) silicon photodetectors of the same pixel area. This innovation will permit breakthroughs in strategic defense applications, including the imaging laser radars in "brilliant" antimissile interceptors. Breakthroughs will also be possible in civilian applications, such as Positron Emission Tomography (PET) scanning, and optical fiber readout of high energy physics detectors.

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Phone: (805) 523-2585
Topic#: 92-002 ID#: 92-540
Office: AFTL
Contract #:
PI: Joseph Humphrey, PhD
Title: Ground Based Scramaccelerator Launcher
Abstract: Phase I will analyze use of a hypervelocity launcher to provide a high mass (2 to 20 kilograms), hypervelocity (4 km\sec) demonstrator for a Theater Missile Defense (TMD) System. Current ballistic powder guns, along with one and two stage light gas guns, cannot meet the high mass requirements while maintaining high velocities required for rapid target acquisition. A concept that would provide low cost options with the mass and velocity requirements above will be investigated. Advanced Projects Research, Inc. will design a propulsion concept using controlled and stabilized Oblique Detonation Waves (ODW) to enhance launcher technology and capability. When this propulsion concept is applied to the acceleration of tube launched

projectiles, an ODW Scramaccelerator can be designed using conventional gaseous propellants and accelerating projectiles of practical size (.1 to 100 kilograms) up to five kilometers per second and beyond.

ADVANCED SCIENTIFIC CONCEPTS, INC.
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Phone: (805) 966-3331
Topic#: 92-003 ID#: 92-065
Office: SDC
Contract #: DASG60-92-C-0067
PI: Roger Stettner, PhD

Title: High Quantum Efficiency Nd:YAG Photocathode

Abstract: Phase I will develop an advanced photocathode for high quantum efficiency, photon-counting sensitivity of 1.06 microsecond, Nd:YAG laser pulses. As far as maximum ladar range is concerned the proposed photocathode is equivalent to an increase of a factor of 15 in laser power. The photocathode is called the High Quantum efficiency Photocathode (HiQ-PC) and is characterized by: (1) High Quantum Efficiency: about 75% at 1.06 micrometers; (2) High Sensitivity: gain sufficient for single photon detection; (3) High Speed: sufficient to distinguish 10 ns laser pulses with a pulse repetition frequency of 1 megahertz; (4) Multiple or Single Pixel Compatibility: single-pixel ladars or multiple-pixel focal planes; and (5) Room Temperature Operation. Military and commercial applications of the HIQ-PC are extensive: it can be used as the detector in a Nd:YAG laser radar system and it will substantially increase the range-performance of acquisition and tracking ladar. Other ladar applications include those where long-range or increased range is important.

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Phone: (805) 966-3331
Topic#: 92-003 ID#: 92-066
Office: SDC
Contract #: DASG60-92-C-0098
PI: Roger Stettner, PhD

Title: Super Sensitive Solid-State Detector

Abstract: Phase I will develop a breakthrough in a Infrared (IR) detector, called the Super Sensitive Solid-State Infrared Detector because it: does not require indium bumping readout technology; can detect individual IR photons between 2 and 24 micrometers; is insensitive to gamma rays; has very low dark current; and has a large dynamic range from the lowest possible flux to 10E14 photons/cm2-sec. The Super Sensitive Solid-State Detector's outstanding performance results from a unique multi-layered silicon structure. Military and commercial uses are far reaching: it will improve the performance of all passive low-background acquisition and tracking infrared systems by more than an order of magnitude and/or reduce the cost of these systems. Commercially, devices using infrared detectors can be dramatically increased in sensitivity. Cost of these systems, for example those using Co2 lasers, can be reduced because of lower power requirements.

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Phone: (203) 794-1100
Topic#: 92-003 ID#: 92-357
Office: AFWL
Contract #: F33615-92-C-1067
PI: Peter Van Buskirk

Title: Ferroelectric Films for IR Focal Plane Array Storage Capacitors

Abstract: Infrared radiation sensing has grown rapidly as both a military and commercial detection and measurement technique. Recently the sensitivity of infrared detection has been improved by the used of focal plane arrays which have the capability of imaging scenes of very low contrast by collecting radiation over long periods of time. This technique can be dramatically enhanced by the use of new materials which have the capability of extending the storage period for the electrical charge generated infrared radiation striking the detector. ATM of Danbury, CT has developed a new material that will be fabricated into the thin film form required for incorporation into infrared detectors during Phase I. Phase II will allow for the fabrication of both storage capacitors and prototype devices.

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Phone: (203) 794-1100
Topic#: 92-014 ID#: 92-616
Office: NASA
Contract #: NAS3-92-C-26708
PI Douglas Gordon

Title: Organoerbium Source Reagents for MOCVD of Erbium-Containing Alloys
Abstract: The use of optoelectronic materials, such as gallium arsenide, in applications ranging from fiber optics to solid-state lasers has been growing rapidly. The fabrication of these materials requires exacting control over material composition, purity, uniformity and production rate. Typically these materials contain small amounts of rare earth dopants or impurities which are designated to enhance the optoelectronic effect. Advanced Technology Materials, Inc. has designed novel precursors for these rare earth dopants. These new "source reagents" should facilitate the manufacturing process by increasing the efficiency of incorporation of dopants into optoelectronic materials effectively reducing cost and increasing quality at the same time.

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Phone: (203) 794-1100
Topic#: 92-014 ID#: 92-728
Office: ONR
Contract #: N00014-92-C-0108
PI: Charles P. Beetz, PhD
Title: Migration Enhanced of (SiC)x(AlN)1-x
Abstract: The need for compact solid state ultraviolet light sources includes clinical light sources for a variety of surgeries, analytical instrumentation sources and communications systems based on shorter wavelengths that will be able to handle higher information densities. Such advanced optoelectric applications demand totally new materials. Of those available, silicon carbide is the most promising for near term applications since in many ways it be processed like silicon. Several deficiencies presently limit the acceptability of silicon carbide including the commercial availability of semiconductor grade silicon carbide crystals and wafers and the low efficiencies of optoelectronic devices based on this material. Advanced Technology Materials, Inc. has developed a new approach to the growth of silicon carbide crystal which addresses both problems. Successful growth of these crystals will permit the fabrication of extremely efficient and compact solid state UV light sources.

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Phone: (203) 794-1100
Topic#: 92-015 ID#: 92-374
Office: NASA
Contract #:
PI: Jiming Zhang, PhD
Title: HTSCs as Electrodes in DRAMs
Abstract: The continuing drive toward increased circuit densities in dynamic random access memories (DRAMs) has spurred great interest in new dielectric materials that permit greater storage capacitor charge density. Ferroelectrics are particularly attractive because of their intrinsically large dielectric constant, and non-volatile and radiation-hard memory capability. Application of ferroelectrics in microelectronics has been severely limited by materials processing and compatibility problems. Advanced Technology Materials, Inc., has developed a novel approach to solving these compatibility problems through the utilization of high temperature superconductors (HTSCs) as electrode materials. Their development and subsequent use in DRAMs will allow significant increase in memory storage while affording designers maximum flexibility in device configuration.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DR.
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 92-015 ID#: 92-595
Office: AFRL
Contract #:
PI: Peter S. Kirlin
Title: Low Loss Cryogenic Switching for Electronic Warfare
Abstract: High temperature superconducting (HTSC) materials offer the potential for major cost and performance advantages in advanced high frequency communications and radar systems. Key to the use of these materials in subsystems is the fabrication of components, especially low loss switches, which can replace standard components. Advanced Technology Materials, Inc., in conjunction with Harris Corporation, has designed a unique low loss, broad band HTSC cryogenic switch for direct insertion into existing electronic warfare microwave receivers. The fabrication of this switch will allow the construction and testing of a phased array antenna and its eventual insertion into commercial superconducting microwave systems.

ADVANCED TECHNOLOGY MATERIALS, INC.
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DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 92-016 ID#: 92-654
Office: ONR
Contract #: N00014-92-C-0108
PI: Charles P. Beetz, PhD
Title: Gas Microcontroller
Abstract: Many key steps in semiconductor "chip" manufacture utilize gases to form thin films which are critical to both device performance and cost. Over $2 billion worth of equipment, materials and peripherals are now sold annually to the semiconductor manufacturers who use gas phase processing. As increased memory demands escalate the need for thinner films, higher quality and lower costs, ever more exacting control over the introduction of gases into this equipment is required. Advanced Technology Materials, Inc is constructing mini-controllers for these gases which have response times nearly 1000 times faster than existing controllers, control over extremely low flows, and can be fully electronically controlled and integrated with gas purification and impurity detection modules. These controllers can be manufactured using micromachining techniques and should therefore be highly cost effective while providing exact control during thin film deposition.

AMERICAN GNC CORP.
9131 MASON AVENUE
CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 92-012 ID#: 92-175
Office: AFAL
Contract #: F29601-92-C-0084
PI: Jerry Juang, PhD
Title: Neural, Modular, Adaptive Structures
Abstract: The success of any strategic defense system depends on the control of space structures. Space structures facilitate precise and rapid retargeting maneuvers without adverse jitter and to provide decision making in the presence of uncertainties and failures. Two enabling technologies; piezoceramic sensor/actuator and neural networks will be blended in a modular, miniaturized, light-weight, adaptive structure in this project to meet the challenge for space applications. The adaptive structure can either be embedded in the structural member or mounted on the surface of the host surface. Use of miniaturized electronics, distributed sensor/actuator designs, and advanced control concepts, the adaptive structure patch meets the weight, size, power, and reliability requirements for space applications. Another innovation is the use of dual neural networks to perform stabilization and reconfiguration in a real-time environment. A back propagation type neural network is used for stabilization and precision control. A cerebellar model articulation computer is used for health monitoring and reconfiguration control. The mutual-aid concept can be exploited to reinforce learning and enhance decision making capability for the adaptive structure.

AMERICAN RESEARCH CORP. OF VIRGINIA
PO BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655
Topic#: 92-014 ID#: 92-627
Office: ONR
Contract #: N00014-92-C-0254
PI: M.G. Niimura, PhD
Title: Material Growth and Bandgap Engineering of DMS Crystals and Q-Switching and Isolation of Near/Mid IR Lasers
Abstract: Development of reliable (Q-) switching and isolation materials is being sought for near-to-mid infrared lasers for safety, extended life and fiber optic communication. The voltage or E-field controlled (Q-) switching materials such as Pockels cells and liquid Kerr cells are not reliable for long term operation in tactical applications due to crystal surface (e.g., KDP, ADP) degradation by moisture or due to loss of index-matching fluid. Recently developed magneto-optic crystals such as the doped CdTe crystal exhibit a giant Faraday effect approximately 100 times greater than that of crystal quartz, optical fiber or zero-doped CdTe. Only a small magnetization current is needed for 90-degree rotation of the polarization plane. Because the crystal is water resistant the switch and isolator are reliable for long times; this allows systematic growth of the key crystal, Cadmium Manganese Tellurium (Cd1-xMnxTe), Diluted Magnetic Semiconductor (DMS). The insertion loss will be minimized by band-gap engineering and by carefully controlling the manganese content (x) so that the crystal will be transparent to the laser line of interest. A high-speed switching time on the order of nanoseconds is anticipated. This includes growth of large diameter, homogeneous DMS crystals at $x<0.7$, band-gap engineering pertinent to near and (Q-) switching performance test with appropriate laser sources. The expected result is a sufficient supply of DMS crystals for reliable and high speed (Q-) switching elements to operate at high peak powers.

ANRO ENGINEERING, INC.
FIVE MILITIA DRIVE, SUITE 104
LEXINGTON, MA 02173
Phone: (813) 957-3080
Topic#: 92-003 ID#: 92-031
Office: SDC
Contract #: DASG60-92-C-0136
PI: Gerald Ross, PhD
Title: Electronic Laser Beam Scan with a Switched Focal Array
Abstract: A laser beam will be totally electronically scanned among any number of discrete angular positions within a nearly 180 degree sector by exciting an array of elements disposed over the focal surface of a lens or reflector through a set of controlled switches. Feasibility of the proposed switched array will be established through fabrication and test of a prototype. The configuration of objective and focal plane array of guide elements will be modeled analytically to arrive at a design which optimizes the performance-potential inherent in the proposed configuration and new technology. Phase I experimental and Phase II through design and fabrication of a full prototype electronic scan laser system. High speed electronic scan will enable realization of volumetric search and track-while-scan LIDAR systems. Optical electronic switches integrated with compatible focal surface arrays may find use in display and computer applications.

APA OPTICS, INC.
2959 NE 84TH LANE
BLAINE, MN 55434
Phone: (612) 784-4995
Topic#: 92-002 ID#: 92-521
Office: AFTL
Contract #: F08630-92-C-0029
PI: M. Asif Khan, PhD
Title: Multicolor UV Seeker Based on GaN/GaAs Heterostructures
Abstract: APA Optics will develop a monolithic UV seeker for use in flame sensing and passive or tactical threat warning systems. The key to the technical approach is the deposition of high optical/electrical quality Al(x)Ga(1-x)N over GaAs substrates and using it to fabricate back to back Schottky barrier detectors. Al(x)Ga(1-x)N is a compound III/V semiconductor system with a bandgap tunable from 220 to 365 nanometers (x=1 to x=0). Thus selecting x=0.4 we expect our UV sensors to detect only the UV emission from the flame (or plume) and not respond to the IR signal. This makes the sensor immune to false signals from the hot furnace background or the missile body. We also plan to use the GaAs substrate to monolithically integrate the preamplifier with the UV sensor. Our sensor approach is unique because we can also use the substrate to integrate an IR sensor on the same chip. This opens up interesting possibilities of target and flame type discrimination.

APA OPTICS, INC.
2950 NE 84TH LANE
BLAINE, MN 55434
Phone: (612) 784-4995
Topic#: 92-014 ID#: 92-529
Office: ARO
Contract #: DAAL03-92-C-0036
PI: Jonathan Kuznia
Title: GaAs/GaN Strained Layer Superlattice Material for High Temperature Transistors
Abstract: Electronic devices which operate at high temperatures could be used in many military and commercial systems. GaAs and Si based devices cannot operate at these temperatures and require cooling. Wide bandgap material such as diamond, SiC and GaN have greater breakdown voltages, higher operating temperatures, and higher saturated electron velocities than either GaAs or Si. However, these material systems are still hampered by material quality and low electron mobility. APA Optics, Inc. will solve this problem by combining the high temperature properties of wide bandgap GaN with the superior mobility of GaAs through the use of strained layer superlattices. These GaAs(x-1)N(1-x) superlattices form the basis for a new and high performance transistor capable of operating at high temperature. This approach will substantially reduce the temperature needed for single crystal material. The low temperatures should allow two dissimilar materials to be deposited together without intermixing and thereby making possible GaAs/GaN layers with atomic dimensions. In Phase I, APA Optics, Inc will deposit and characterize the strained layer superlattices for crystalline, electrical and optical quality.

APPLIED PULSE POWER, INC.
140 LANGMUIR LAB., 95 BROWN ROAD
ITHACA, NY 14850
Phone: (607) 257-1971
Topic#: 92-006 ID#: 92-394
Office: NASA
Contract #: NAS326705
PI: Steven Glidden
Title: Compact Efficient 1 kW Electric Thruster
Abstract: A proof-of-concept prototype of a new type of pulsed plasma thruster with a specific impulse of 3000s will be built.

Based upon a recently developed plasma source, the "X-line thruster" concept operates by inductively driving an electrodeless discharge in a small volume of gas, and then accelerating the resulting plasma with a pulsed magnetic field. A novel continuous flow gas feed and magnetic field configuration makes it possible to build a 1kW class thruster in a volume of about 1 liter. By operating at a 20 kHz repetition rate, only a fraction of a joule is needed per drive pulse, allowing a simple circuit design with small, lightweight, reliable capacitors and solid-state switching to be used. High gas efficiency, electrical efficiency of 30-50% and long component life are projected in steady state operation. The gas feed arrangement permits scaling the X-line thruster to larger area and higher average power without penalty in gas or electrical efficiency, or in repetition rate.

ASTRALUX
2386 VASSAR DR.
BOULDER, CO 80303
Phone: (303) 492-7327
Topic#: 92-014 ID#: 92-292
Office: DNA
Contract #: DNA0001-92-C-0071
PI: Christopher M. Walker
Title: High Temperature Optoelectronics
Abstract: There are no commercial amplifiers that can operate at temperatures above 125 degrees Celsius. We will combine two comparable wide bandgap semiconducting materials to make electronic amplifiers and switches that operate at high temperatures (at least 500 degrees Celsius). These devices can be controlled remotely by a light beam. Hence wireless coupling to a room temperature microprocessor is possible. The vast potential market for these devices includes monitoring and control of engines: diesel engine on trains, ships, ships, subs, trucks and buses; also rocket engines, power stations, nuclear plants, and heating systems.

ASTRALUX
2386 VASSAR DRIVE
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Phone: (303) 786-1442
Topic#: 92-014 ID#: 92-475
Office: ONR
Contract #: N00014-92-C-0220
PI: Christopher Walker, PhD
Title: IV-II-VI Wide Bandgap Alloys and Superlattices
Abstract: Astralux will develop IV-II-VI compound semiconductors by synthesizing compounds and characterizing their properties as a function of the deposition parameters. The material will be a combination of lattice-matched semiconductors that will be generated as alloys and superlattices. Electronic and optical properties will vary by adjusting the composition. The II-VI compound semiconductor has optical and piezoelectric properties that can enrich use of the technologically more advanced group I material. II-VI semiconductor piezoelectric properties can be used to generate acoustic waves, which permit acousto-optic modulation of light signals. Such modulation can be controlled by integrated circuits in the group IV semiconductor. The new technology for making IV-II-VI semiconductors is capable of automated deposition of epitaxial semiconductors at one-half of the substrate temperature used in more conventional methods.

ASTROPOWER, INC.
SOLAR PARK
NEWARK, DE 19716
Phone: (302) 366-0400
Topic#: 92-003 ID#: 92-437
Office: AFWL
Contract #: F33615-92-C-1066
PI: Paul E. Sims
Title: AlGaP/GaP Heterostructure Ultraviolet Detector
Abstract: AstroPower is developing a highly sensitive UV detector based on epitaxial AlGaP/GaP heterostructures, a promising new material system for ultraviolet detectors. Detecting ultraviolet light is important to spectrophotometry, astronomy, high-energy physics, medicine, UV curing, photoresist exposure, and chemical processes. The large bandgap and crystalline quality of gallium phosphide will provide superior performance in high temperature, high radiation environments such as in earth orbit and article accelerators. Leakage currents lower than 10 to the -16 A/cm2 will result in an increase in detector sensitivity of up to three times. Advanced device design will increase ultraviolet sensitivity and decrease response to longer wavelength light. Continued development and optimization of this device will lead to the production of high performance cost-effective gallium phosphide UV detectors.

ASTROPOWER, INC.
SOLAR PARK
NEWARK, DE 19716
Phone: (302) 366-0400
Topic#: 92-005 ID#: 92-293
Office: AFWL
Contract #: F33615-92-C-2265
PI: Louis C. DiNetta

Title: AlGaInP/GaAs 27% Efficient Top Solar Cells

Abstract: AstroPower will develop a two-junction monolithic tandem solar cell composed of (AlxGa1-x)0 51 In(0.49)P, which is lattice matched to GaAs, as the top cell in a three-junction, two-terminal tandem solar cell. This new tunable bandgap Al-Ga-In-P material is capable of current matching in a two-junction monolithic tandem solar cell two-terminal design of the Al-Ga-In-P over GaAs yielding a best case predicted efficiency of 27.2%. The direct bandgap of the material system can be tuned to as high as 2.3 eV, where a bandgap of 2.03 eV is necessary for current matching in a two-terminal stack. The tandem solar cell can in turn be applied as a current-matched top solar cell in a triple-junction, two terminal configuration with silicon or other suitable bottom solar cells. The success of this project will lead to deployment of high performance solar cells in the space environment, and will impact the longevity and power generation of space power supplies.

ASTROPOWER, INC.
SOLAR PARK
NEWARK, DE 19716
Phone: (302) 366-0400
Topic#: 92-014 ID#: 92-434
Office: ONR
Contract #: N00014-92-C-0162
PI: Robert B. Hall

Title: GaP ZnS for Blue Light Emitting Diodes

Abstract: AstroPower is developing a two-junction monolithic tandem solar cell composed of (AlxGa1-x)0.51In.49P lattice matched to GaAs for use as the top cell in a three-junction, two-terminal tandem stack. This tunable bandgap material system is capable of current matching, at 2.03eV, in a two-junction monolithic tandem solar cell two terminal design of (AlxGa1-x)0.51In0.49P/GaAs yielding a best case predicted efficiency of 27.2 %. This solar cell can in turn be applied as a current matched top cell on a triple-junction, two-terminal configuration with silicon solar cells with a predicted efficiency of 34.1%. The Al-Ga-In-P material system can also be useful for integration of sensor arrays, monolithic LED displays, or optical computing systems as well as ultra-bright green LED and laser technology with a bandgap as high as 2.3 eV.

ASTROPOWER, INC.
SOLAR PARK
NEWARK, DE 19716
Phone: (302) 366-0400
Topic#: 92-014 ID#: 92-435
Office: DNA
Contract #: DNA0001-92-C-0066
PI: Sandra Collins

Title: Large Area Thin Film Silicon Carbide Using Zone Melt Synthesis and LPE

Abstract: AstroPower is developing a new process for the growth of large area, thin film 3C-SiC using a proprietary deposition technique followed by liquid phase epitaxy (LPE). Successful development of the growth process will provide high quality, thin film SiC in typical silicon wafer areas, allowing compatibility with existing silicon circuit foundries for devices where SiC is the material of choice. New techniques will be used to control the crystallization of SiC on single crystal silicon and anneal out defects at the SiC/Si interface. LPE layers will form device active layers providing high quality material by further annealing growth defects and minimizing stress induced defects which plague state-of-the-art 3C-SiC on silicon. SiC offers a unique combination of properties that are ideal for semiconductor devices which operate at high temperatures or deliver high power at microwave frequencies and is a suitable material for the fabrication of wide bandgap LEDs and detectors.

BELTRAN, INC.
1133 EAST 35TH STREET
BROOKLYN, NY 11210
Phone: (718) 338-3311
Topic#: 92-014 ID#: 92-660
Office: SDC
Contract #: DASG60-92-C-0134
PI: John Carter, PhD

Title: Organometallic Monomer Precursors and Intrafilm Annealing for a LiNbO3 Crystal Film Production

Abstract: A feasibility study of a new route to the formation of crystalline films of the ferroelectric LiNbO3 is proposed. Two aspects of the proposed route are unique in themselves and, combined, should permit the development of a low temperature, scalable production process, to make electronic grade LiNbO3 more widely available to the integrated circuit (IC) industry. Preparation and reaction of novel volatile or metallic alkoxide monomer precursors in CVD and sol-gel process experiments are

described. Three approaches to highly localized, intrafilm annealing are also outlined. Each seeks to minimize heat transport to the silicon substrate during the annealing step required to form the crystalline LiNbO3 from a film deposited by a CVD or sol-gel process. These include rapid high-energy pulsed laser annealing, localized microwave annealing on a deposited sol-gel layer and a chemical exothermic reaction within the sol-gel derived film.

BLACK FOREST ENGINEERING, INC.
12930 MORRIS TRAIL
COLORADO SPRINGS, CO 80908
Phone: (719) 495-0735
Topic#: 92-003 ID#: 92-473
Office: SDC
Contract #: DASG60-92-C-0074
PI: Stephen Gaalema
Title: Pixel Level Gamma-spike Deletion

Abstract: Sensitive operation of passive sensors in a radiation environment requires a means to eliminate the signals caused by ionizing radiation. Black Forest Engineering proposes a signal processing technique to delete these gamma-spike signals that can be integrated into each unit cell of an infrared planar hybrid sensor chip assembly. This technique is applicable to both scanning and staring systems with unit cells as small as 30 micrometers square. In Phase I, a detailed design of a complete silicon readout IC will be analyzed, and a small test chip to verify key portions of design will be built and tested. A full scale readout chip hybridized to IR detectors will be built and tested under radiation conditions in Phase II. This work will provide an effective means to eliminate gamma-spikes in a wide range of sensor systems at low cost on the focal plane without burdening downstream data acquisition and signal processing.

BRIMROSE CORP. OF AMERICA
5020 CAMPBELL BLVD., SUITE E
BALTIMORE, MD 21236
Phone: (410) 931-7200
Topic#: 92-003 ID#: 92-234
Office: SDC
Contract #: DASG60-92-C-0060
PI: Sudhir Trivedi, PhD
Title: CdTe:V and CdTe:Ge for Homodyne Optical Detection at 1.06um

Abstract: A light induced phase grating in photorefractive crystals couple the optical fields of the pump and signals beam in a very similar way as a beam splitter combines the signal and local optical fields in a coherent optical communications receiver. The advantages of photorefractive crystals are: 1) the absence of 3db loss in the output intensity of the signal beam unlike in the case of 50/50 beam splitter and, 2) Ease of wave front alignment of the pump and signal beams. Using a InP as a photorefractive crystal these advantages have been demonstrated by Davidson et al [1]. Photorefractive gain in InP is very sensitive to temperature and is reduced due to the electron-hole competition [2] in the crystal. Photorefractive sensitivity of both CdTe:V and CdTe:Ge is better by about a factor of three the photorefractive beam coupling experiments in these crystals indicate absence of electron-hole competition mechanism. Optimizing the photorefractivity in CdTe:V, Ge will improve the homodyne detection at 1.06 micrometer. Moreover, the spin off of this development will be their applications to build optical components like phase conjugations for near IR wavelengths, optical limiters and optical switches.

BUSEK CO., INC.
19 KEARNEY ROAD
NEEDHAM, MA 02194
Phone: (617) 449-3929
Topic#: 92-005 ID#: 92-683
Office: ETDL
Contract #: DASG60-92-C-
PI: V J Hruby
Title: High Energy Cryogenic Varistors

Abstract: High energy (>1kJ/cc) varistors operating at cryogenic temperatures (<77 degrees Kelvin) are being developed at Busek. Power generation, distribution and energy storage at cryogenic temperature is more efficient and requires less massive systems than the room temperature equivalents. These systems, as well as superconducting coils/magnets, require surge/discharge protection devices capable of operating at the same temperatures. Additionally, low voltage cryovaristors may be the enabling technology for protection of high temperature superconductors (HTS) which, when mature, will be used in all electrical systems. Continuous (DC) power dissipation of 2 kW/cc at room temperature was already demonstrated. Development of varistors with higher DC and pulse ratings is currently proceeding via the use of novel ingredients and material processing.

BUSEK CO., INC.
19 KEARNEY ROAD
NEEDHAM, MA 02194
Phone: (617) 449-3929
Topic#: 92-006 ID#: 92-685
Office: NASA
Contract #: PR#490291
PI: V.J. Hruby
Title: Fullerene Hall Thruster Development
Abstract: A Hall thruster (HT) using C60 fullerene as the propellant is currently being developed. The HT is a magnetized neutral plasma electrostatic thruster that has been successfully deployed by the Russians. Efficiencies of 50-70 % at Isp up to 3000 second were achieved, and lifetimes in thousands of hours were demonstrated. The HT performance may be improved by replacing the current propellant of choice (Xe) with C60. With C60, the HT can achieve 90% efficiency without decreasing thrust density which is already ten times larger than in conventional ion thrusters. The effort will start with the design and construction of the C60 feed system and experiments related to C60 vapor generation, flow control, and fragmentation. Later, a prototype HT will be built, and its performance with C60 will be compared with Xe. The final objective is a commercial HT with C60 propellant resulting in a high efficiency, long life, economical electric space propulsion unit.

CAPE COD RESEARCH, INC.
P.O. BOX 600
BUZZARDS BAY, MA 02532
Phone: (508) 759-5911
Topic#: 92-011 ID#: 92-239
Office: AFOSR
Contract #:
PI: Brian G. Dixon
Title: Complex and Stereoregular Nonlinear Optical Materials
Abstract: A novel organic/inorganic composite is described which promises to yield nonlinear optical materials that have extraordinarily high stereo regularities and contain very few defects. The overall approach takes advantage of the highly structured order of special template materials to form previously unknown organic/inorganic composites that promise to have high NLO susceptibilities. The success of the proposed approach will result in novel lamellar organic-inorganic composites with nonlinear of chemical properties that will be useful for a wide range of applications. Eventually, these innovative composite materials will be usable in applications such as switches, modulators, guided wave devices, oscillators and harmonic generators.

CERAMIC COMPOSITES, INC.
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MILLERSVILLE, MD 21108
Phone: (410) 987-3435
Topic#: 92-007 ID#: 92-606
Office: AFWL
Contract #: F33615-92-C-2260
PI: E.L. Paquette
Title: Advanced Low Cost Space Radiator
Abstract: Space based platforms require substantial on-board power systems with a need for waste heat rejection. Prior work performed on such programs as SUPER has led to the design of carbon/carbon radiators with refractory metal tubular heat transfer fluid circuits embedded in the composite. These radiators survive anticipated threats, but are very expensive. Ceramic Composites has developed a concept that allows radiators of the highest thermal conductivity carbon/carbon composites with high thermal efficiency at low manufacturing costs. The cost effective nature of their design and the associated construction techniques makes the radiators potentially attractive for use in commercial satellite systems.

CHRONOS RESEARCH LABORATORIES, INC.
4186 SORRENTO VALLEY BLVD., SUITE H
SAN DIEGO, CA 92121
Phone. (619) 455-8200
Topic#: 92-001 ID#: 92-368
Office: DNA
Contract #: DNA001-92-C-0060
PI: Randall B. Olsen, PhD
Title: High Energy Density Dielectric Materials
Abstract: Radiation tolerant, high operating temperature electronic devices are needed for future space power systems. High energy density capacitors are one of the key elements in most power systems. Improvement of current dielectric capacitors can be realized by incorporating new state of the art polymers designed specifically for the spacecraft environment. Chronos has previously synthesized and measured numerous high dielectric constant polymers for pyroelectric conversion applications. This stuff will center around the design, synthesis, and evaluation of high dielectric constant polymers suitable for use in high frequency energy storage applications.

CIENCIA, INC.
PO BOX 370488
WEST HARTFORD, CT 06137
Phone: (203) 231-8680
Topic#: 92-001 ID#: 92-663
Office: SDC
Contract #: DASG60-92-C-0054
PI: Y.S. Chao, PhD
Title: Polymer Based Acousto Optic Filter
Abstract: Tunable, acousto-optic filters (AOTF) for operation in the UV-VIS-IR spectral ranges are important elements in the design of advanced sensors for target acquisition, and discrimination. Their small size, random-access wavelength selection, rapid scan rates, and all solid-state construction with no moving parts, provide an attractive alternative to monochromators and filter wheels, for many applications such as spectroscopy, analytical chemistry, clinical diagnostics, and on-line sensors for process control. Drawbacks of current AOTFs are (a) made from a single large birefringent crystal which may be difficult to obtain and expensive to manufacture, and (b) for a given design the angular aperture and spectral resolution characteristics are fixed. This work explores the use of non-crystalline polymer materials of variable birefringence for the design and fabrication of novel AOTFs of increased versatility and ruggedness, as well as significantly lower manufacturing costs.

CIENCIA, INC.
PO BOX 370488
WEST HARTFORD, CT 06137
Phone: (203) 231-8680
Topic#: 92-012 ID#: 92-664
Office: SDC
Contract #: DASG60-92-C-0132
PI: Salvador Fernandez, PhD
Title: Vibration Reduction/Suppression in Receptor Sensor Optics
Abstract: Both passive and active tracking optical sensors, such as infrared seekers in hypersonic missiles, or laser pointing systems, require high angular precision. Vibration-induced distortion of optical components creates image distortions, image jitter, and can seriously degrade the performance of the system. The present work investigates the feasibility of employing adaptive optical techniques for the compensation of vibration-induced optical system distortions. Similar vibration-related problems occur in many industrial applications, and it is expected that the methods and hardware compensation system developed in this program would have commercial application beyond the military.

CNS TECHNOLOGY, INC.
81 LINCOLN AVE.
PISCATAWAY, NJ 08854
Phone: (908) 699-0328
Topic#: 92-001 ID#: 92-461
Office: SDC
Contract #: DASG60-92-C-0119
PI: Hui Wang, PhD
Title: Large Power X-Ray Laser for High Energy Beam Weapon
Abstract: The proposed work are (a) to design and develop a new generation large power, high brightness, compact structure and low cost column x-ray source, (b) to use the novel new x-ray source to build a large power x-ray laser for a high energy beam weapon. The proposed x-ray source is based on our patented non-conventional x-ray technology. A prototype column x-ray source will be fabricated and its performance including gain coefficient, spectrum, spatial stability and uniformity will be evaluated. The success of this research will significantly advance x-ray laser technology and promote its applications in many important research areas and industries. These applications include x-ray laser weapon in SDI, x-ray microscope for biomedical research and diagnosis, x-ray lithography for fabrication of sub-micron ultra high density semiconductor device and x-ray radiography and holography in non-destructive evaluation of materials and structures.

COLEMAN RESEARCH CORP.
9302 LEE HIGHWAY, SUITE 800
FAIRFAX, VA 22031
Phone: (703) 934-7800
Topic#: 92-002 ID#: 92-334
Office: AFTL
Contract #: F08630-92-C-0038
PI: Quang M. Lam
Title: Adaptive Attitude Control System for Space-Based Interceptor
Abstract: An adaptive attitude control system for a space-based interceptor will ameliorate the effects of torque disturbances when firing a divert thruster with the line of force offset from its center of mass. The adaptive control algorithm is based on a simplified version of a model reference adaptive control concept. It possesses two features: (i) more robust performance for the interceptor guidance and control system under the influence of dynamic variations without the need of a parameter estimate, and (ii) ease of implementation, which is attractive to the enhancement of the interceptor performance. The adaptive control

law is then configured together with the traditional fixed-gain controller to yield an optimal, reliable, and more robust performance architecture. This architecture can be applied to not only SDIO applications but also to a wider class of nonlinear and linear systems whose parameters are time-varying such as: robotic control, control of flexible space structure process control, and advanced self-repairing flight control systems.

COLEMAN RESEARCH CORP.
5950 LAKEHURST DRIVE
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Phone: (407) 352-3700
Topic#: 92-002 ID#: 92-333
Office: AFTL
Contract #: F08630-92-C-0033
PI: Benjamin Patz

Title: Kinetic Energy Weapon Guidance Utilizing Fuzzy Logic

Abstract: Conventional guidance algorithms for exoatmospheric kinetic energy weapons are based on algorithms developed for endoatmospheric missile systems. With the appropriate assumptions and definitions, the algorithms can be shown to be optimal. Although they perform well under limited circumstances, the algorithms perform poorly in the general case because of inefficient use of imprecise information about the target, inefficient management of fuel resources, and a general lack of robustness. An algorithm which is better matched to the particular requirements of the exoatmospheric KEW guidance problem is needed. Fuzzy logic decision theory is shown to be directly applicable to this problem with the appropriate selection of fuzzy set definitions and membership functions. The objective of this research effort is to develop a guidance algorithm based of fuzzy logic by selecting fuzzy constraint sets, constraint weights, and the fuzzy decision function. This algorithm will then be demonstrated and its performance compared to conventional guidance algorithms through the use of an existing 6DOF simulation. The benefit of the algorithm in terms of reduced fuel utilization, decreased miss distance, increased robustness, and ease with which supplemental constraints can augment performance will be demonstrated.

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Phone: (407) 352-3700
Topic#: 92-010 ID#: 92-332
Office: AFTL
Contract #: F08630-92-C-0034
PI: Benjamin Patz

Title: Time-Dependent Assignment Using a Neural Network

Abstract: The assignment problem is a linear programming problem in which the goal is to determine the assignment of sources to destinations so as to minimize the cost. This arises in numerous areas, including assigning interceptors to threats in battle. Generally, the solution is very time consuming when the number of sources and destinations is large. Also, the problem is difficult when the cost of assignments is dynamically changing. Real-time solutions are needed, especially in a dynamic battle space like the boost-phase intercept of ICBMs using space-based weapons. Conventional solutions on conventional computer architectures are sequential and therefore not well matched to the problem. A dynamic parallel architecture, such as a neural network, can offer significant performance advantages and provide other benefits including increased solution accuracy in the presence of uncertainty of cost information and solution stability as the problem scope changes in real-time. The objective of this research is to design a neural network prototype for solving the time-dependent assignment problem. The performance of this network will be compared to conventional algorithms in solving a set of realistic space-based interceptor assignment problems.

COMBUSTION SCIENCES, INC.
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Topic#: 92-006 ID#: 92-369
Office: NASA
Contract #: NAS326706
PI: John W. Black

Title: Heat-Exchanger for High Specific Impulse Maneuvering

Abstract: Strategic defense missions place a premium on the performance capabilities of onboard propulsion systems. An innovative technique for producing very high impulse at excellent thrust-to-weight ratios is known as laser-powered heat-exchanger propulsion. A remotely stationed high power laser is used to heat a propellent gas within a rocket engine, and the heated gas is exhausted to generate thrust at very high specific impulses. Until now, laser propulsion research has focussed on the use of high-temperature plasmas to convert laser energy into propellant heat. CSI's approach will use a direct-absorption "heat exchanger" as the conversion mechanism, a technique which is far less complex yet offers specific impulse performance

in the range of 500-1000 seconds. Such a propulsion system can increase the payload capacity of on-orbit orbital transfer vehicles, or can enhance the range capability of ground-based interceptors.

CONCEPTUAL SOFTWARE SYSTEMS, INC.
17962 SUN KNOLL DR.
YORBA LINDA, CA 92686
Phone: (714) 996-2935
Topic#: 92-003 ID#: 92-284
Office: SDC
Contract #: DASG60-92-C-0091
PI: Ed P. Andert
Title: Neural Networks to Solve the Closely-Spaced Objects Problem
Abstract: Aggressive training algorithms will allow neural networks to separate closely-spaced objects in target identification for missile defense. Resulting neural networks will show an order-of-magnitude improvement in extracting individual target information from sensor data. This focal plane sensor data processing, performing target identification and decoy discrimination functions as the "eyes and ears" of missile defense systems.The project objective is to demonstrate that neural networks can be focused to accurately extract individual target information from detector outputs of infrared sensors observing multiple point-targets. The technical approach provides accuracy, numerical stability and reduces computation cost by addressing function complexity, network capacity and training algorithm aggressiveness. Reduced computational cost subsequently reduces system power, weight and size. This technology can be further applied to robotics and image processing.

CONDUCTUS, INC.
969 WEST MAUDE AVE
SUNNYVALE, CA 94086
Phone: (408) 746-1099
Topic#: 92-015 ID#: 92-594
Office: AFOSR
Contract #:
PI: Randy Simon
Title: Advanced HTS Superconductor-Normal-Superconductor Devices
Abstract: Superconductors can be used in integrated circuits based on Josephson junction devices that bring performance advantages in speed and low power dissipation. The discovery of high-temperature superconductors (HTS) has created the opportunity for such circuits to function at unprecedented high temperatures. It is likely that very high speed superconducting integrated circuits operating at 30 to 77 K and based on yttrium-barium-copper-oxide (YBCO) will use Josephson junctions of the SNS type, where N is a metallic oxide which is epitaxial and chemically compatible with YBCO. In this project, we will make and study such metallic oxides, first as thin films to determine their physical properties, then as the N layer of SNS junctions both in the form of trilayer sandwich devices and as so-called edge junctions. We will thus be able to choose the optimum material and device structure to be used in HTS digital circuits.

CONDUCTUS, INC.
969 W. MAUDE AVENUE
SUNNYVALE, CA 94086
Phone: (408) 737-6781
Topic#: 92-015 ID#: 92-637
Office: NASA
Contract #: NAS3-92-C-26400
PI: Michael J. Burns, PhD
Title: High Tc Superconductor - Silicon on Sapphire CMOS Hybrid Circuit
Abstract: By exploiting previous work on the growth of YBCO and Josephson junctions on buffered sapphire, Conductus will combine silicon CMOS on sapphire with high temperature superconductors, all on a single chip. Conductus will test the ability of the Si MOS devices to withstand the subsequent YBCO processes. Chips will then be tested to determine the effects of the additional processing on the active Si devices. Finally, Conductus will demonstrate the utility of this hybrid technology by fabricating a simple YBCO/SOS-CMOS circuit incorporating simple YBCO interconnects and active Si devices. The entire project requires no breakthroughs in either YBCO technology or SOS-MOS technology in order to produce the proposed hybrid chips. Such chips may prove extremely valuable for the next generation of supercomputers.

CONTINUOUS MOLDING, INC.
605 FOREST LAKE
PACIFICA, CA 94044
Phone: (415) 355-8521
Topic#: 92-013 ID#: 92-686
Office: SDC
Contract #: DASG60-92-C-0127
PI: Ted Jacobson
Title: Automated Fabrication of Composite Structures without Dedicated Tooling Neural Network Control of Narrow Gore

Layup
Abstract: The project objective is to fabricate high-strength shapes from composite materials without the use of dies, molds or any type of dedicated tooling. In the process, a "forming master" is created from deformable sheet material on a first pass through the molding apparatus. In successive passes, plies of composite materials are overlaid on the master and consolidated by the apparatus. These sequential layering operations may serve to encapsulate wiring, tubing, optical fibers, sensors, actuators and other functional or structural components. The generation of such "integrated structures", without hand labor and without tedious and expensive tooling preparation, is an ultimate objective of the project. Anticipated benefits include rapid modeling, prototyping and eventual mass-manufacture of products, from a wide variety of advanced composite materials, for many applications.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800

Topic#: 92-007
Office: AFTL
Contract #: F29601-92-C-0091
PI: Javier Valenzuela, PhD

ID#: 92-046

Title: Capillary Evaporator for Thermal Management of High Power Density Electronic Components
Abstract: Creare is developing an innovative capillary-based evaporator component for direct cooling of advanced electronic modules and for interfacing with capillary pumped thermal management loops for spacecraft. A reentrant capillary structure design will increase by an order of magnitude the pumping capacity of the capillary surface. Compared with current porous wick evaporators, this evaporator will have four advantages: (1)capillary pumping head 2 to 3 times larger, (2)much lower hydraulic pressure losses in the liquid transport channels, (3)much simpler geometry allowing for easier design and analysis of performance for system applications, and (4) high effective thermal conductance per unit area (50 to 100 W/cm2 degrees Celsius) to handle high power densities. The combination of high pumping capacity and high thermal conductance will result in compact, low weight thermal management systems for cooling electronics on spacecraft. Use of this evaporator in a capillary pumped loop applied to a wide range of satellite applications, including advanced radar satellites of interest to SDIO and Air Force and for EOS satellites. Another commercial application of great potential is the development of a high heat flux cold plate for cooling rack-mounted electronics.

CREARE, INC.
P.O. BOX 71
HANOVER, NH 03755
Phone: (603) 643-3800

Topic#: 92-015
Office: AFWL
Contract #: F33615-92-C-2256
PI: Kent Goeking, PhD

ID#: 92-257

Title: Biaxially Oriented YBCO Thin Films on Non-Lattice Matched Substrate
Abstract: Creare is developing a novel technique for forming biaxially oriented thin and thick films of high temperature superconductor YBa(2)Cu(3)O(x) on non-lattice matched substrates. These films should display high critical current densities because they will avoid the weak link problem that occurs between misaligned grains. Presently, the only effective means of achieving biaxial alignment is to either deposit films onto a limited selection of lattice matched single crystal substrates which are expensive, or by melt texturing techniques which are extremely slow. This project will establish the feasibility of Creare's seeded liquid precursor technology for production of biaxially oriented YBCO films on polycrystalline MgO substrates. Our technique is amenable to either large area thin films or continuous processing for the production of wires and tapes and offers an economical and technical solution to YBCO application limitations.

CRYSTAL ASSOC., INC.
15 INDUSTRIAL PARK
WALDWICK, NJ 07463
Phone: (201) 612-0060

Topic#: 92-011
Office: ONR
Contract #: N00014-92-C-0247
PI: G.M. Loiacono

ID#: 92-007

Title: Crystal Growth in KTiOPO(4)-NaTiOPO(4)
Abstract: Phase I will study tailoring the refractive index ellipsoid of KTP to permit Type II phase matching at wavelengths shorter than 900nm, thereby permitting the SHG of laser diodes and Ti:Al2O3 solid state lasers. The system of solid solutions from mixing KTP with CsTiOPO4 will be studied and crystals grown. The nonlinear optical, mechanical and electrical properties of these crystals will be determined and the data compared with KTP. The benefits will be the identification of a new

nonlinear optical material with large nonlinear properties suitable for SHG of laser diodes and solid state laser operating in the range less than 900nm. Efforts can be concentrated on growth of commercial size crystals and quality refinement. This will permit a domestic source of large, inexpensive nonlinear crystals for military and commercial device applications.

CRYSTAL SYSTEMS, INC.
27 CONGRESS STREET
SALEM, MA 01970
Phone: (508) 745-0088

Topic#: 92-014 ID#: 92-028
Office: SDC
Contract #: DASG60-92-C-0110
PI: Chandra Khattak, PhD

Title: Growth of Cr:LiCaAlF6 (Cr:LiCAF) Crystals for Laser Applications

Abstract: Cr:LiCAF shows potential as an efficient tunable laser with good beam quality at moderate power levels. While efficient laser operation for Cr:LiCAF has been demonstrated in the laboratory, commercialization is impeded because large crystals with low scatter loss are not available. The proposed program is to adapt the Heat Exchanger Method (HEM) for growth of Cr:LiCAF crystals. Since crystal growth by HEM is carried out with low temperature gradients, the scattering losses in Cr:LiCAF due to defects and variation in stoichiometry are minimized. The submerged solid-liquid interface in HEM minimizes the breakdown of the interface due to the nonstiochiometric phase. The nonstoichiometric phase is rejected to the last material to solidify which is near the crucible wall. Crystal growth by HEM is achieved without moving the crucible, the heat zone, or the crystal. After growth annealing of the crystal is achieved in situ, thereby reducing defect density. This feature of HEM also allows controlled cooldown so that large crystals of Cr:LiCAF may be grown.

CRYSTALLUME
125 CONSTITUTION DRIVE
MENLO PARK, CA 94025
Phone: (415) 324-9681

Topic#: 92-003 ID#: 92-647
Office: AFWL
Contract #: F33615-92-C-1071
PI: Maurice Landstrass

Title: Diamond Ultra-Violet Imaging Sensors

Abstract: Diamond Ultra-Violet Imaging Sensors take advantage of diamond's unique combination of high carrier mobility and high radiation tolerance. Diamond is extremely radiation tolerant and has excellent electronic transport properties. DUVS will extend the state-of-the-art of ultra-violet detectors in the areas of total dose detection, fluence range, speed of response, temperature of operation and allow for construction of imaging detectors. Radiation tolerant ultra-violet detectors have a wide range of commercial applications in medical electronics and analytical instruments. Other applications including power station monitors, food irradiation plants, nuclear waste disposal monitoring, and high energy physics programs will also benefit from the potentially low cost of DUVS.

CSA ENGINEERING, INC.
2850 WEST BAYSHORE ROAD
PALO ALTO, CA 94303
Phone: (415) 494-7351

Topic#: 92-012 ID#: 92-732
Office: AFAL
Contract #: F29601-92-C-0085
PI: Eric M. Austin

Title: Smart Hardmounts for Vibration Isolation

Abstract: Dynamic isolation of components and machinery is critical for many SDI and commercial applications. Vibration isolation using soft mounts leads to static misalignment, increased travel requirements, and decreased mount strength, often precluding this approach. The ideal isolator has high static (mount) stiffness, but low stiffness at disturbance frequencies. This SBIR will lead to a family of modern, two-axis "smart hardmounts," mounts with adaptively tuned dynamic compliance characteristics that also possess high static stiffness. These hardmounts will place "notches" in the mount's stiffness at disturbance frequencies, sense changes, and adjust these "notches" to maintain isolation. The "smart hardmounts" will provide solutions to commercial (equipment for making computer chips) and military (cryocoolers and control moment gyros in spacecraft) problems that need both "rigid" mounts and dynamic isolation, but cannot tolerate soft, nonprecision mounting.

CUDO TECHNOLOGIES, LTD.
P.O. BOX 185
LEXINGTON, KY 40584

Topic#: 92-007 ID#: 92-289
Office: AFWL
Contract #: F33615-92-C-2249

Phone: (606) 266-8198 PI: Martin R. Pais, PhD
Title: Spray Cooling of "Tuna-fish-can" Size High Performance Electronic Multi-Chip Modules
Abstract: The project objective is to fabricate high-strength shapes from composite materials without the use of dies, molds, or any type of dedicated tooling. In the process, a "forming master" is created from deformable sheet material on a first pass through the molding apparatus. In successive passes, plies of composite materials are overlaid on the master and consolidated by the apparatus. These sequential layering operations may serve to encapsulate wiring, tubing, optical fibers, sensors, actuators, and other functional or structural components. The generation of such "integrated structures" without hand labor and without tedious and expensive tooling preparation is an ultimate objective of the project. Anticipated benefits include rapid modeling, prototyping, and mass-manufacture of products, from a wide variety of advanced composite materials, for many applications.

CYGNUS IMAGING CORP. Topic#: 92-003 ID#: 92-380
6423 HOLLYHOCK TRAIL Office: AFTL
BRIGHTON, MI 48116 Contract #: F08630-92-C-0046
Phone: (313) 227-6334 PI: Shawn Kelly
Title: Improving Imaging Performance Using a Transparent Spatial Filter
Abstract: Phase I will characterize the performance improvement of an electronic camera fitted with a Transparent Spatial Filter. Such a filter, by band-limiting an input image to match the sampling characteristics of the camera, will remove the output errors associated with undersampling. The resultant higher fidelity image will therefore yield higher performance in subsequent image processing application such as target detection and classification.

DAMASKOS, INC. Topic#: 92-005 ID#: 92-564
PO BOX 469 Office: ETDL
CONCORDVILLE, PA 19331 Contract #: DAAL01-92-C-0253
Phone: (215) 358-0200 PI: William Biter
Title: Microengineered Transformer Material for High Efficiency Power Supplies
Abstract: A smaller, lighter power supply will have an immediate market in both the commercial and military sectors. Higher switching frequencies reduce the size of power supplies but existing transformer core materials are forced to operate at low frequency to avoid losses in the transformer core. This proposal identifies a microengineering approach to form a new core material which eliminates these losses by making a laminated magnetic structure with both the magnetic and insulating strips formed by thin film deposition techniques, allowing the structure to be "microengineered" with specific properties not available by conventional fabrication techniques. The Phase I program will fabricate a transformer which can produce a power supply of unequaled size and performance. Use of a thin film magnetic material in combination with thin film windings on a thin flexible substrate will result in a totally integrated, low profile, highly efficient planar power supply.

DANIEL H. WAGNER ASSOC., INC. Topic#: 92-010 ID#: 92-643
2 EATON ST., SUITE 500 Office: ARO
HAMPTON, VA 23669 Contract #: DAAL03-92-C-0027
Phone: (804) 727-7700 PI: Douglas S. Hulbert, PhD
Title: Nonlinear Filter Modeling Diffusion in Target Heading/Speed
Abstract: To improve automated target tracking and correlation for strategic defense, this proposal models the dynamic behavior of maneuvering vehicles by allowing target heading and speed, or their derivatives, to undergo independent diffusion processes. Current methods for surveillance sensors model diffusion in geographically fixed coordinate systems and fail to exploit course/speed nonlinearities, and known dynamic constraints, over time. A stochastic PDE characterizes the transition density of the process, and is supplanted by a sequence of discrete stochastic difference problems. The discrete problems are solved numerically, and an optimal, nonlinear, point-mass filter combines transition density updates with nongaussian observation updates. Operations count, throughput analysis, and comparison with a related filter indicate the filter's feasibility. Applications include multisensor data fusion, runway incursion prevention, tracking in nonradar sectors, and ship collision avoidance.

DATA FUSION CORP.
7017 S. RICHFIELD STREET
AURORA, CO 80016
Phone: (303) 699-2421
Topic#: 92-003 ID#: 92-439
Office: ONR
Contract #: N00014-92-C-0252
PI: W. Kober, PhD
Title: Distributed Implementation of Track-Before-Detect
Abstract: Data Fusion Corporation and Space Computer Corporation proposes a distributed-sensor version of the track-before-detect method for detecting faint moving objects in noisy, cluttered images. Track-before-detect combines multiple images from a single sensor to detect a moving object's trajectory as a whole, versus detecting single snapshots. Fusion of distributed sensor observations improves detectability and reduces false alarms using consistency checks. Communications bandwidth in the distributed system is kept low by transmitting only detection information, not raw data. The result is higher detection and lower false alarm rates via a feasible system architecture with lower sensor and feasible communication requirements. While intended for SDIO's Brilliant Pebbles and Brilliant Eyes sensors and scenarios, other remote activities will benefit: target recognition, environmental monitoring, and industrial, geophysical, and medical measurements.

DIGITAL OPTICS CORP.
3906 BROWNE'S FERRY ROAD
CHARLOTTE, NC 28269
Phone: (704) 598-0553
Topic#: 92-011 ID#: 92-353
Office: SDC
Contract #: DASG60-92-C-0141
PI: Michael Feldman, PhD
Title: Planar Holographic Optical Interconnects for Multichip Modules
Abstract: PLEX Corporation will demonstrate a highly efficient laser emitting light at 1100nm in the near infrared. Technical issues in laser design will be resolved in Phase I, with a full lasing test experiment in Phase 2. This laser candidate has potentially a 25% electrical efficiency and can, in principle, be scaled to high power levels. Cutting and welding applications are foreseen in the industrial environment, where the sodium mercury excimer could replace the current industry standard, the carbon dioxide laser.

DYNACS ENGINEERING COMPANY, INC.
150 WEST PARK LOOP, SUITE 305
HUNTSVILLE, AL 35806
Phone: (205) 430-3901
Topic#: 92-002 ID#: 92-288
Office: SDC
Contract #: DASG60-92-C-0089
PI: Paul Christian
Title: Fuzzy Logic Control of a Hypervelocity Interceptor
Abstract: A single Fuzzy Logic (FL) design will be able to control an interceptor throughout its entire flight. The robustness of FL controllers will prove to provide adequate control during continuously varying aerodynamic conditions. FL is a completely model-independent linguistic-rule-based control methodology suited for nonlinear, ill-defined, or time variant real world problems. Applications might include: a six degree-of-freedom controller for spacecraft operations; control of an inflight aircraft optimization; train systems; and automotive components. The rule-based control features of FL may make astoundingly successful difference in such applications as guidance, pattern recognition, terrain mapping, vibration suppression, radar tracking controller, throttleable propulsion control, gimbaled seeking positioning, and servo control.

DYNATHERM CORP.
1 BEAVER COURT, P.O. BOX 398
COCKEYSVILLE, MD 21030
Phone: (410) 584-7500
Topic#: 92-007 ID#: 92-221
Office: AFWL
Contract #: F33615-92-C-2253
PI: David A. Wolf
Title: Containment of Lithium Hydride in Alkali Metal Heat Pipes
Abstract: Lithium Hydride is an attractive energy storage material. Its high heat of fusion (2582 kJ/kg) and its melting point (956 K) make it suitable for many applications. The best location for LiH storage capsules is inside a liquid metal heat pipe. The heat pipe facilitates heat transfer into and out of the capsules. The major drawback to using LiH is its high equilibrium hydrogen pressure. Since hydrogen diffuses readily through iron and nickel-based alloys, the expected life time of a heat pipe with a LiH capsule is very low. However, Dynatherm has discovered that the actual hydrogen build-up in a potassium heat pipe with a LiH capsule is much less than predicted. It is postulated that the presence of the alkali metal suppresses hydrogen permeation, probably through the formation of a layer of alkali metal hydride. The objective of Phase I is to verify the initial

observation and to quantify the phenomenon. The ultimate objective is to develop alkali metal heat pipes with internal LiH storage which are not sensitive to hydrogen poisoning. Potential commercial applications are solar powered Stirling engines and cooling systems for the leading edges of hypersonic aircraft.

EDFA CONSULTANTS
46 CARRIAGE LANE, P.O BOX 1668
KINGSTON, RI 02881
Phone: (401) 783-9222

Topic#: 92-011 ID#: 92-443
Office: SDC
Contract #: DASG60-92-C-0059
PI: Steven P. Bastien

Title: Erbium-Doped Fiber Amplifiers at 1550 nm Pumped with 800 nm Laser Diodes

Abstract: We are developing erbium doped fiber amplifiers (EDFAs) for optical communication systems, local area networks, fiber sensors and optical measuring instruments. The EDFA is a new and revolutionary technology that is having a profound effect on the design of lightwave system architectures and other applications. Never has a technology blossomed as fast as the EDFA: it went from a twinkle in the eye to a laboratory curiosity to a practical solution to a commercial product in a 2-3 year time span; a true phenomenon. With an EDFA, the loss in any optical system is no longer a constraint and it can be used as a power amplifier and/or preamplifier to increase loss budget and splitting ratio. We will use semiconductor laser diodes in the 800 nm band as the optical pumps and develop EDFA modules which are much cheaper (<$10K) and more reliable (20) years than modules available today. The EDFA will do the same for fiber optics and photonics what the transistor did for electronics.

EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450

Topic#: 92-011 ID#: 92-712
Office: AFOSR
Contract #: F49620-92-C-0041
PI: Timothy L. Rose

Title: Optically Switchable Conductive Polymers

Abstract: Organic polymers will play a key role in optical processing by spatial light modulation, information storage, and optical bistability. This project will develop the first examples of polymers in which light induces persistent changes in optical absorption, electronic conductivity, and refractive index, all potentially on the time scale of electronic motion. The polymer should also exhibit strong nonlinear optical properties due to its projected high conjugation and donor-acceptor character. They will be less expensive and offer more structural flexibility than inorganic crystal materials. Phase I will evaluate changes in electro-optical properties of derived thiophene monomers when photodoped by exposure to UV radiation. Molecular engineering of the material in Phase II will lead to an optically reversible, two-wavelength system for incorporation into optical processing devices.

EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450

Topic#: 92-015 ID#: 92-713
Office: SDC
Contract #: DASG60-92-C-0102
PI: Martin W. Rupich

Title: Low Temperature Deposition of YBa2Cu3O(7-x) Films on Large Area and Non-planar Substrates

Abstract: Solution based deposition processes represent an extremely attractive method for the inexpensive fabrication of high Tc superconducting films on large area and non-planar surfaces. EIC Laboratories has developed a unique precursor consisting of an extremely soluble Cu-Ba-Y oxoalkalide complex that can be deposited on planar and non-planar surfaces by standard spin and dip coating techniques. The precursor films undergo a facile conversion to the superconducting YBa(2)Cu(3)O(7-x) phase at temperatures as low as 720 degrees Celsius. The process results in c-axis oriented YBa(2)Cu(3)O(7-x) films with Tc's of >90 Kelvin and Jc's of >2 x 10(5) A/cm2 at 77 Kelvin. The fabrication of large area and non-planar films requires optimization of the thermal processing conditions to insure uniform electrical properties over the entire film surface. The process represents a low cost technique for coating cavities, radomes and large area planar substrates with high quality superconducting films.

ELECTRO ENERGY, INC.
19 HILLANDALE RD.
BROOKFIELD, CT 06804

Topic#: 92-005 ID#: 92-336
Office: AFWL
Contract #: F33615-92-C-2258

Phone: (203) 740-1105 PI: Martin Klein
Title: Nickel-Metal Hydride Battery System
Abstract: In Phase I, Electro Energy will design and develop a sealed, electrically rechargeable Nickel-Metal Hydride Battery for Air Force and Space Power Applications. Utilizing the Metal Hydride electrode, which stores hydrogen for reaction, results in a battery that operates at lower pressure and is more compact than gaseous nickel-hydrogen batteries and contains no cadmium which presents toxic and disposal problems.Combining the features of the hydride electrode with improved nickel electrodes and packaging it, it is possible to construct batteries one and one-half to two times better in energy and power density than conventional nickel cadmium and nickel hydrogen batteries. In the Phase I design, single cell experiments and complete battery designs will demonstrate the capabilities of this system. The experimental cells will contain flat single 100 cm2 electrodes of various hydrides, electrode formulations, nickel electrodes of conventional sintered type and improved composite structures. A novel flat plate packaging approach will be evaluated for improved power and energy density. This battery is a viable candidate for military, medical, consumer electronics, and electric vehicle applications.

ELECTRO-OPTEK CORP. Topic#: 92-003 ID#: 92-136
3152 KASHIWA STREET Office: SDC
TORRANCE, CA 90505 Contract #: DASG60-92-C-0142
Phone: (310) 534-3666 PI: William Chan
Title: MMW and LWIR Sensor Fusion in the Same Pixel for Room Temperature Imaging
Abstract: Electro-Optek will develop a sensor-fusion infrared (IR) + millimeterwave (MMW) imaging focal plane array combining electron tunneling and silicon micromachining. A gas encapsulated in a cavity micromachined on Si expands upon absorption of IR radiation, like a Golay detector, causing a deflection of the cavity wall measured by an electron tunneling probe, micromachined on the same SI wafer. MMW antennas, metal-deposited on the back of the cavity wall, connect to readout/mux electronics processed on the back of the micromachined SI wafer. The electron tunneling probe can measure atomic-scale deflections, acting as an extremely sensitive transducer sensing IR well beyond 20 microns. The MMW-horn-shaped cavities have walls coated with a thin layer of Au, of receiving MMWs at 94 GHz and beyond. The same pixel detects IR and MMWs simultaneously, and the FPA provides all-weather, all-battle-condition target detection/recognition from clutter with near immunity to countermeasures.

ELECTRO-OPTEK CORP. Topic#: 92-014 ID#: 92-127
3152 KASHIWA STREET Office: DNA
TORRANCE, CA 90505 Contract #: DNA0001-92-C-0070
Phone: (310) 534-3666 PI: V.K. Raman
Title: Ultra Radiation-Hard, Ultra-Dense, Fast Nonvolatile GaAs Random Access Memory
Abstract: Electro-Optek proposes to develop a radiation-hard, non-volatile random access memory using an epitaxial InSb Hall element fabricated on gallium arsenide (GaAs) in conjunction with a thin-film layer of permalloy. The permalloy layer serves as the non-volatile memory storage medium while the InSb Hall element acts as the high-speed memory readout. The RAM can be built by very large scale integrated-circuit (VLSI) technology. The densely-packed memory cells will be integrated to high electron mobility transistor circuits previously processed on the GaAs. By virtue of InSb's high mobility and extremely fast and low noise HEMT driver, an access time less than 5 nanosecond and a packaging density greater than 1 M bit/cm2 are achievable; these characteristics are superior to those of the state-of-the-art static, non-volatile RAM. Because the magnetization of the permalloy is not affected by high-energy radiation with a semi-insulating substrate, this RAM is ultra-radiation hard.

ELECTRO-OPTEK CORP. Topic#: 92-014 ID#: 92-135
3152 KASHIWA STREET Office: SDC
TORRANCE, CA 90505 Contract #: DASG60-92-C-0080
Phone: (310) 534-3666 PI: V.K. Raman
Title: Radiation Hard Silicon Schottky Barrier LWIR Focal Plane Arrays
Abstract: Electro-Optek proposes to fabricate ultra radiation hard, high-sensitivity, long wavelength infrared focal plane arrays using IrSi3/Si Schottky Barrier (SB) infrared detectors grown by molecular beam epitaxy on silicon-on-insulator substrates. The SB photodiodes of Iridium siliconide/Si, are processed by a special codeposition MBE process with readout electronics on SOI

substrates forming a monolithic array. The reverse bias of the SB diode will be used to tailor the spectral response in the LWIR (9-14 micron). Our overall goal is to develop the SB array with high density, and optimize it for a 40% quantum efficiency, a 1% non-uniformity and a fabrication cost comparable to that of the existing Pt-silicide SB array covering the LWIR. Since the FPAs are built on SOI substrates, the arrays will be ultra-radiation hard. These novel arrays will find applications in FLIRs, space-based interceptors and early warning and surveillance systems.

ELECTROCHEM, INC.
400 W. CUMMINGS PARK
WOBURN, MA 01801
Phone: (617) 932-3383
Topic#: 92-005 ID#: 92-567
Office: AFWL
Contract #: F33615-92-C-2248
PI: Vinod Jalan, PhD
Title: Solid State Galvanic Supercapacitor for Pulse/Sustained Power
Abstract: High energy density supercapacitors may excel in providing pulsed and sustained space power. To develop a solid state galvanic supercapacitor, ElectroChem will prepare very high surface area electrode materials and a fluoropolymer membrane modified for high lithium ion conductivity. Cells will be assembled with particular attention to extension of the ionic/electronic interface for maximum power, and will be tested for charge/discharge properties as a function of temperature, to determine the most promising cell design. The extremely high pseudocapacitance coupled with the high cell voltage will offer a theoretical capacitance three times higher than that of aqueous double-layer devices, while reversible electrode reactions, the absence of metallic lithium, and intrinsically conductive solid polymer electrolytes contribute to safety and high reliability over many cycles.

ELECTROCHEMICAL SYSTEMS, INC.
118 SHERWOOD ROAD
RIDGEWOOD, NJ 07450
Phone: (201) 670-8397
Topic#: 92-014 ID#: 92-252
Office: DNA
Contract #: DNA0001-92-C-0067
PI: Igor V. Kadija
Title: Electroformed High Resolution Thick Metal Film for Hyper-Dense Electronic Packaging
Abstract: 20 microns thick metal film deposits at thin film resolutions will ensure densely integrated MCMs essential to advanced electronic devices such as onboard data and signal processing systems (OBDP). 99.8% dense and 99.8% pure monolithic and environmentally stable copper interconnects in analog applications will remove heat and control impedance with 5-10 times capacity. Two to three times higher chip density in digital MCMs will reduce signal amplitude losses, signal ground bounce and clock distribution variation. As digital clock speeds increase, power and ground line impedance can limit dynamic and static noise margins. Compared to conventional devices, ECSI interconnects will extend this limit two to three times. ECSI's proprietary technology will deliver superior products at high yields at reduced cost.

ELECTROMAGNETIC APPLICATIONS, INC.
64 SUMNER STREET
NEWTON, MA 02159
Phone: (617) 969-4326
Topic#: 92-003 ID#: 92-294
Office:
Contract #: DASG60-92-C-0199
PI: Hoton How
Title: Use of Metallic Patches as Frequency Tunable Antennae
Abstract: Metallic patches deposited on ferrite films can be directly used as frequency tunable antennas. Ferrite patch antennas radiate circularly polarized waves so that 3 dB loss due to polarization mismatch can be avoided when used as receivers. By varying the biasing magnetic field the radiation pattern can be continuously changed. This modulation technique will enhance the signal-to-noise ratio in the transmission of signals by patch antennas. In Phase I, Electromagnetic Applications, Inc. will calculate the radiation patterns for patch antennas consisting of ferrite-dielectric materials. Input impedances as well as transmission bandwidths will also be calculated. In addition, an experimental program in which fabrication and characterization of ferrite patch antennas will be initiated.

EMCORE CORP.
35 ELIZABETH AVE.
SOMERSET, NJ 08873
Topic#: 92-014 ID#: 92-483
Office: ONR
Contract #: N00014-92-C-0120

Phone: (908) 271-9090 PI: Heng Liu, PhD
Title: Atomic Layer Epitaxy of GaN in a Multi-Wafer Rotating Disc Reactor
Abstract: GaN and other III-V nitrides can be used for fabricating visible/UV optoelectronic devices. Sequential exposure of reactants using a commercial microwave Plasma Enhanced Atomic Layer Epitaxy reactor is proposed to grow high quality GaN films. The technique allows two dimensional layer-by-layer growth which reduces nitrogen vacancies commonly observed in the GaN films. PE-ALE also allows deposition at reduced growth temperatures, which can reduce the loss of nitrogen from the solid phase during growth. A movable mechanical barrier is used to divide the chamber into multiple zones. Each zone can supply source gas, purging hydrogen or excited nitrogen. The substrate, which continuously rotates beneath the barrier, is alternately exposed to the individual gases. Each revolution will result in one monolayer of GaN deposition. Since the growth rate of one monolayer per cycle is insensitive to growth parameters, uniform films over a large area can be obtained.

EMCORE CORP. Topic#: 92-014 ID#: 92-484
35 ELIZABETH AVE. Office: ONR
SOMERSET, NJ 08873 Contract #: N00014-92-C-0128
Phone: (908) 272-9090 PI: Peter Norris, PhD
Title: Sequential Growth of Diamond Thin Films in a Rotating Disc Reactor
Abstract: Current difficulties in the growth of diamond thin films lie in their metastable characteristic and the requirements of non-equilibrium heteroepitaxial techniques for the single crystal growth. Sequential exposure of reactants using a microwave hydrogen plasma enhanced Atomic Layer Epitaxy (PE-ALE) reactor is proposed to promote two dimensional nucleation. In particular, use of halocarbon species is proposed to investigate the possibility of self-limiting growth of diamond thin films. We will use a movable mechanical barrier to divide the chamber into multiple zones. The zones supply source gas, exited or purging hydrogen. The substrate, constantly rotating beneath the barrier, is alternately exposed to the individual gases. The success of proof of principle will result in the growth of epitaxial diamond films and a novel process technology.

ENERGY SCIENCE LABORATORIES, INC. Topic#: 92-003 ID#: 92-658
6888 NANCY RIDGE DRIVE Office: AFSTC
SAN DIEGO, CA 92121 Contract #: F33615-92-C-2271
Phone: (619) 552-2034 PI: Michael D. Fennell
Title: Composite Matrix Regenerators for 10K Cryocoolers
Abstract: This project will fabricate and test composite matrix regenerators (CMRs) for use in the temperature regime below 20 K. High capacity rare earth compounds and high conductivity pure metallic components are combined to provide adequate capacity at low temperature with good heat transfer. The innovative channel geometry is conducive to high thermal effectiveness with low viscous losses. A specific goal is to achieve faster thermal response in the regenerator bed than previously achieved with bed rare earth compounds, enabling higher cryocooler frequency, power, and efficiency. Phase I effort will focus on materials development and thermal testing at relevant temperatures. Thermal penetration, pressure drop, and debris generation will be monitored. The potential benefits for multistage Stirling cryocoolers will be assessed with available Stirling modeling codes. Phase II would develop a prototype CMR having rapid response and high thermal effectiveness near 10 K for testing in a mechanical cryocooler.

ENERGY SCIENCE LABORATORIES, INC. Topic#: 92-007 ID#: 92-635
6888 NANCY RIDGE DRIVE Office: AFWL
SAN DIEGO, CA 92121 Contract #: F33615-92-C-2250
Phone: (619) 552-2034 PI: Timothy R. Knowles, PhD
Title: Carbon Fiber Thermal Interface Compound
Abstract: Interfacial thermal resistance is a major contributor to the temperature gradients existing in satellite systems, causing higher temperatures at the electronic heat sources and larger radiators to provide lower reject temperatures. Large thermal resistance accompanies even microscopic interfacial gaps, since heat conduction is interrupted, particularly under the vacuum conditions of space. This project will investigate high conductance interface compounds that use high thermal conductivity vapor-grown carbon fibers for the reduction of interfacial impedance at joints in structures and electronic compounds. Unlike ordinary heat sink compounds that rely on powder additives to lower resistance, the carbon fibers offer continuous conduction

paths that potentially enable orders of magnitude better performance. Phase I will employ electrostatic means of achieving the desired fiber orientation and compliant fibers that connect uneven surfaces forming the interface. Fiber positioning and the interaction of candidate carrier materials will be investigated.

ENTECH, INC.
P.O. BOX 612246, 1015 ROYAL LANE
DALLAS-FT. WORTH, TX 75261
Phone: (214) 456-0900
Topic#: 92-005 ID#: 92-645
Office: NASA
Contract #:
PI: M.J. O'Neill
Title: Line-Focus Fresnel Lens for Space Photovoltaic Concentrator Arrays
Abstract: Since 1986, ENTECH, NASA, and SDIO have pioneered the development of refractive space photovoltaic concentrator systems. We have developed functionally system hardware, including lenses, prismatic cell covers, single- and tandem-junction cells, and small arrays. This hardware has verified world-record performance levels for lenses, cells, and arrays. The present optical element is a small, dome-shaped, point-focus Fresnel lens. This "mini-dome" lens offers outstanding performance, but is relatively expensive to make and needs full two-axis sun-tracking. However, by replacing the mini-dome lens with an innovative line-focus lens, a more-manufacturable, lower-cost, simpler-tracking array can be realized. The Phase I objective is to design, build, and test prototype line-focus Fresnel lenses. Compared to presently used one-sun silicon cell arrays, the new line-focus concentrator array will offer twice the areal power (W/sq.m.), twice the specific power (W/kg), and lower cost.

EPION CORP.
4R ALFRED CIRCLE
BEDFORD, MA 01730
Phone: (617) 275-3703
Topic#: 92-014 ID#: 92-580
Office: DNA
Contract #: DNA001-92-C-0068
PI: Allen Kirkpatrick
Title: Silicon-on-Diamond Structures for SOI Devices
Abstract: Silicon-on-Insulator technology is a basis for fabrication of microelectronic devices with faster performance and better radiation tolerance. By using diamond, with thermal conductivity higher than that of any other materials, as the insulator of the SOI structure, even faster radiation tolerant devices able to operate at much higher power levels will become possible. This program involves experimental evaluation of a concept for fabrication of silion-on-diamond material structures with thin uniform layers of low defect density single crystal silicon on insulating diamond film bases. Quality of the silicon layers for device purposes and prospects for production are to be evaluated.

FEDERAL ELECTRO-OPTICS
3873 CENTRAL
MEMPHIS, TN 38111
Phone: (901) 678-3312
Topic#: 92-003 ID#: 92-734
Office: ONR
Contract #: N00014-92-C-0167
PI: Kevin Dennen
Title: Multi-Aperture Vision System Coupled to Neural Network Processors
Abstract: Nearly every optical system built to date has been modeled after the human eye. Signal processing techniques are also designed to emulate human responses. These human characteristics are imposed upon non-human systems such as missile trackers and robotic vision. Such systems designed to perform simple tasks do not require complex human characteristics, and could be modeled after less sophisticated creatures such as insects. Position determination could be accomplished by coupling a neural network to a multi-aperture vision system. The neural network, acting as the insect visual processor, would use a training set of data with specified inputs and outputs. Once the training set has established the response of the system, the network is considered "trained" and can be programmed to respond in a similar manner to other input function. The insect ommatida, or eyelets, will be constructed using gradient index lenses, fiber optics, and detectors. The system will be "trained" and then stimulated by arbitrary object positions to obtain its response.

FIBER AND SENSOR TECHNOLOGIES
P. O. BOX 11704
BLACKSBURG, VA 24602
Phone: (703) 231-4224
Topic#: 92-012 ID#: 92-452
Office: AFAL
Contract #: F29601-92-C-0087
PI: Kent Murphy

Title: Optical Fiber Sensors for Space Structural Monitoring and Control
Abstract: Existing and future space structures require autonomous onboard structural evaluation and control systems to ensure mission effectiveness. Optical fiber sensors are particularly advantageous within these systems due to such sensors' inherent immunity to electromagnetic interference and ground loops; their excellent resolution, accuracy and dynamic range; their ability to be multiplexed; and their ease of integration into future onboard optical fiber local area networks for communication and light control. Fiber and Sensor Technologies proposes to develop practical and commercially viable optical fiber sensors for use in active structural vibration control and the dynamic quantitative nondestructive evaluation of advanced aerospace materials. F&S principal investigators have demonstrated initial prototypes of innovative optical fiber sensors for each of these applications. They have developed variable-sensitivity spatially distributed optical fiber sensor methods which void the actuator/observer spillover typical of discrete point sensors and the associated instabilities in closed loop systems. F&S proposes to extend this initial research and to develop a commercial product.

FIBER MATERIALS, INC.
5 MORIN STREET
BIDDEFORD, ME 04005
Phone: (207) 282-5911
Topic#: 92-013 ID#: 92-153
Office: AMTL
Contract #:
PI: Shirley Darrah, PhD
Title: High-Strength Piezoceramic Fibers for Smart Adaptive Structures
Abstract: This program on high-strength piezocermaic fibers probes a critical gap in the technology of smart materials which interconvert electrical and mechanical energy. Strong piezoceramic fibers that can function as load bearing members in structures and survive the large mechanical strains encountered in highly stressed engineering components are not developed. It is envisioned that piezoelectric fabric composites will be produced from the fibers. These composites will be bonded to structures like beams and panels to sense and actively damp in-plane strains which cause noise and vibration. Such fibers are badly needed for the active control of noise and vibration in military structures and vehicles, and are also widely applicable to the civil, commercial and industrial fields where similar problems exist.

FIBER MATERIALS, INC.
5 MORRIN STREET
BIDDEFORD, ME 04005
Phone: (207) 282-5911
Topic#: 92-013 ID#: 92-160
Office: SDC
Contract #: DASG60-92-C-0105
PI: Stephen Biddle
Title: Truss Member Fabrication Using In-Situ Thermoplastic Materials
Abstract: To continue the development of low cost carbon composite material, this program is intended to demonstrate the ability to fabricate net shape tubular space truss components using co-braided carbon and thermoplastic (PEEK) yarns. The thermoplastic yarn, when processed through an autoclave cure using high pressure and temperature, will fuse the high modulus carbon fibers together to form a rigid finished component. By incorporating the matrix (PEEK yarn) into the triaxial braiding process, to subsequent impregnation step can be eliminated thus resulting in lower costs. The results of this program will provide an automated demonstration of a reproducible thin-walled structural tube. It will also reveal that thermoplastics can be incorporated into braided structures without expensive processing. In addition, the resulting thermoplastic matrix can be thermally treated to allow for post forming and to facilitate attachment to nodes. Commercially, this product would replace conventional epoxy based structures.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 92-007 ID#: 92-192
Office: AFWL
Contract #: F33615-92-C-2259
PI: Lawrence Domash, PhD
Title: Holographic Controlled Reflectivity/Emissivity
Abstract: The ability to continuously change the thermal reflectivity/emissivity of external spacecraft surfaces at will or automatically through a low voltage holographic film with no moving parts would have considerable performance, reliability, and cost impact on military and commercial spacecraft. Encompassing the external spacecraft surface as part of an active thermal management system will enable more precise space platforms for astronomers, earth observers, and missile defense systems, as well as allow these systems the chameleon-like ability to change their thermal signature at will. Foster-Miller's

program will design, fabricate, and demonstrate a broad band variable hologram in a rugged, thin polyester film that will control surface reflectivity/emissivity over a wide dynamic range. Producibility issues will be addressed with program commercial partner Polaroid, and models will be tested in a space/solar simulation test chamber with aerospace partner Lockheed.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 92-008 ID#: 92-206
Office: AFWL
Contract #: F33615-92-C-5004
PI: Robert Kovar, PhD

Title: Bacteriorhodopsin Films for Sensor Survivability

Abstract: An advanced laser on the battlefield is no ordinary weapon. Nor is it one that is easily defended against. Intense, coherent radiation from lasers can damage delicate sensors, the so-called "eyes of battle" or blind human eyes in a matter of microseconds -- so quickly that targets are destroyed before they know what hit them. An ideal protection for satellite and battlefield optical sensors would be a protective device equipped with lenses that provides clear transmission of image before and after the threat, but respond in subpicoseconds to block intense laser light during attack by frequency agile lasers. Bacteriorhodopsin (BR) is endowed by nature with the properties needed for such lenses. A biotechnology-drive materials, BR has evolved natural methods for transducing light, protecting against photochemical and thermal damage, and rapid recycling. It is therefore the best candidate for laser protection, but has not been applied to laser protection because large, highly oriented optical films of BR are not available. F-M will apply innovative processes to purified BR, such as electric field deposition, isopotential spin-drying, epitaxially-directed film growth and delipidization to produce high clarity and concentration BR films.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 92-011 ID#: 92-188
Office: AFOSR
Contract #:
PI: Parviz Tayebati, PhD

Title: Composite Photorefractive Materials

Abstract: Photorefractive materials are by far the most efficient NLO materials for many of the most dramatic and potentially useful phenomena of nonlinear optics at low powers. Unfortunately, the existing photorefractive materials with large nonlinearities (LiNbO3, KNbO3, and BaTiO3) are far too slow, and those with fast response time (CdTe,GaAs, and Bi12SiO2) have low optical nonlinearity. Development of new organic or inorganic photorefractive materials which are fast and highly nonlinear has been hindered by the necessity for photoconductivity, the electro-optic effect, and partially full deep traps. Foster-Miller's new approach to photorefractive materials will produce materials with fast response time and large nonlinearities. A range of photorefractive materials will be designed using the best photoconductive and electrooptic (polymer) materials for specific applications and wavelengths.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 92-011 ID#: 92-193
Office: AFOSR
Contract #:
PI: Lawrence Domash, PhD

Title: Holographic Multiplexing for 3D Optical Memory

Abstract: Optical 3D data storage research has focussed on developing materials with little consideration given to basic system architecture questions. Basic design choices remain to be made; a key issue is bit versus wavefront recording schemes. These issues can only be resolved by demonstrating real architectures. Foster-Miller's holographic data recording system will be based on 3D optical storage materials using an input/output technique which applies a recently discovered nonlinear optical method. The system will incorporate a device for demultiplexing image data temporally modulated onto laser wavefronts, so as to provide stable wavefronts for holographic recording. An opticallock-in detector based on four-wave mixing will solve this problem by converting image data streams from temporally to spatially multiplexed form. On this basis, a complete holographic volume storage system of up to 1 terabit/cmE3 capacity may be possible.

GENERAL SCIENCES, INC.
2600 MONROE BLVD.
NORRISTOWN, PA 19403
Phone: (215) 666-6080
Topic#: 92-001 ID#: 92-180
Office: SDC
Contract #: DASG60-92-C-0083
PI: Peter D. Zavitsanos, PhD
Title: Metal Vapor Generator for Chemical Lasers
Abstract: General Sciences, Inc. will use a highly exothermic solid state intermetallic reaction as a furnace powered by chemical energy which will vaporize Bismuth metal primarily to its monatomic form. This flow of atomic vapor will be used as a fuel in combustion reactions with fluorine compounds which will form excited states of BiF(A-X) lasing in the visible part of the spectrum (blue). Proof of concept is based on the realized vapor and quantitative measurements of the Bi/Bi2 measurements. A simple portable and scaleable canister like device will be designed for Phase II construction and testing in a Laser Research Facility. In Phase II, a metal vapor generator system capable of generating large quantities of metal atoms will be developed.

GINER, INC.
14 SPRING STREET
WALTHAM, MA 02154
Phone: (617) 899-7270
Topic#: 92-005 ID#: 92-670
Office: AFWL
Contract #: F33615-92-C-2257
PI: A.B. LaConti, PhD
Title: Electrochemical Power System for Burst and Sustained Power Applications
Abstract: Hybrid power sources combining conventional batteries with electrochemical capacitors are being designed toward advanced military, space, and commercial uses. Giner,Inc has developed a high-power density, all-solid proton exchange ionomer-based electrochemical capacitor that represents a potentially more reliable, safer and longer-life alternative burst power source to typical liquid electrolyte electrochemical capacitors. In Phase I, methods are addressed to increase energy density of the all-solid capacitors to 15 kJ/kg by decreasing the particle size and improving the ionomer coating of the alloy noble/transition metal oxide particulates used to fabricate the electrodes. In Phase II, capacitor packaging, scale-up and extension of the unique structure to longer-duration power applications of interest to SDI will be investigated. Possible uses include military (defensive weapons, fast switching devices), CMOS memory backup and load leveling.

GORCA SYSTEMS, INC.
1300 NORTH KINGS HIGHWAY
CHERRY HILL, NJ 08034
Phone: (609) 273-8200
Topic#: 92-010 ID#: 92-271
Office: SDC
Contract #: DASG60-92-C-0123
PI: Walter Helbig
Title: Virtual Memory Redundancy Management for Reliable Multiprocessing
Abstract: Modified computer-to-memory interface architecture and memory management executive software provide substantial increases in multiprocessor system reliability and throughput. The MIL-STD-1750A computer interface has a local cache memory using 8-word pages. The common main memory has fault tolerant data and address buses and fault tolerant data storage, with a page long word length, and hardware are supported Error Detection and Correction. Transferring a full page in a single memory cycle and the architecture achieves virtually 10 times the single computer throughput with 10 computers. The memory management executive uses the unique EDAC system and data scrubbing to guarantee data integrity. Virtual space assignment and two dimensional memory IC sparing are managed in real time to achieve, in a minimum cost way, a Ps of nearly 1 for any length mission. For a 10 year mission Ps>0.99 approximately 40% overhead is needed. Demonstration will be achieved by stimulating the satellite payload and stationkeeping program examples using a modified version of the CDC 444RRR Software Development System hardware model.

GUMBS ASSOC., INC.
11 HARTS LANE
EAST BRUNSWICK, NJ 08816
Phone: (908) 257-9053
Topic#: 92-008 ID#: 92-102
Office: AFOSR
Contract #: F49620-92-C-0040
PI: P. Chandrasekhar, PhD
Title: Passive, Broadband Optical Shutter
Abstract: Broad-band, dynamic (switchable), solid-state, ultrafast (sub-ns) optical shutter activated by a laser or other high intensity radiation source is provided based on novel interfaces of inorganic semiconductor (SC) electrodes with conducting polymers (CPs). The CPs, normally switched electrochemically between opaque and transparent states, are switched via direct

charge transfer from photoexcitation of the SC by a laser or other high intensity radiation source. The SC thus provides both trigger and energy for polymer switching. Preliminary data for SC/CP switching shows sub-ns risetimes and falltimes in the tens of ns, with large OD changes (ca. 2.0 at 532 nm).

HITTMAN MATERIALS & MEDICAL COMPONENTS
9190 RED BRANCH RD.
COLUMBIA, MD 21045
Phone: (410) 730-7800
Topic#: 92-013 ID#: 92-479
Office: ARO
Contract #: DAAL03-92-C-0026
PI: Todd E. Schlesinger, PhD
Title: Composites as Lubricants for Ceramics
Abstract: Development of new solid lubricants is underway. Nanocrystalline lubricant particles embedded in hardcoating material will allow low friction and increased durability of mechanisms in sliding contact. Special attention is being given to materials used in prosthetics including hip implants, where release of wear debris is detrimental. Other uses for low friction nanocomposite coatings include high temperature service or use in vacuum. Nanocomposites formed by unique methods will minimize wear resulting in increased survivability of frictional contacts. Ceramics in contact with ceramics, metals, or polymers will benefit greatly from advanced deposition methods yielding novel microstructures with a synergistic action among the constituent phases. Areas expected to profit from this technology include biomaterials, aerospace applications, and automotive technology including ceramic engines and turbines.

HNC, INC.
5501 OBERLIN DRIVE
SAN DIEGO, CA 92121
Phone: (619) 546-8877
Topic#: 92-016 ID#: 92-688
Office: ARO
Contract #: DAAL03-92-C-0028
PI: Robert Hecht-Nielson
Title: Data Neutronium
Abstract: Just as solid neutronium is the densest form of ordinary matter, data neutronium is the most highly compressed kind of data -- it is pure information. This project is developing a system to compress data such as imagery and speech into data neutronium. This project is developing a system to compress data such as imagery and speech into data neutronium. We are using two new results: a theory relating the tolerable level of reconstruction error to the maximum possible level of compression, as the Cottrell/Munro/Zipser neural network technique (which is capable of achieving maximum compression). Unlike fractal compression (the only other known method theoretically capable of approaching data neutronium density levels), which is computationally impractical, the C/M/Z neural network (which is trained off-line once) is computationally simple, and can carry out both data compression and decompression in real-time using low-cost hardware. Our goal is to achieve compression ratios from 100:1 to 1000:1 for speech and imagery with broadcast quality reconstruction.

HOLZ INDUSTRIES, INC.
4393 VIEWRIDGE AVENUE
SAN DIEGO, CA 92123
Phone: (619) 569-5000
Topic#: 92-014 ID#: 92-356
Office: SDC
Contract #: DASG60-92-C-0079
PI: Joseph Babiarz
Title: Hermetic Housings Incorporating Multiple 50 Ohm Feedthroughs
Abstract: IC packaging technology has not kept the explosive pace of IC electronics technology. The costs associated with inadequate packaging and interconnect technology can be measured both in dollars and in the ability to exploit existing technology. Holz will develop a large scale hermetic housing with multiple 50 ohm feedthroughs to provide a single assembly for several K-band microwave components. The assembly will be constructed using StratEdge technology, a thick/thin film process for fabricating the hermetic multilayer transmission line interface to support frequencies over 20 GHz. Multilayer substrates constructed with StratEdge technology have shown excellent electrical and thermal characteristics at microwave and millimeter-wave frequencies. Initial efforts will concentrate on building an independent 5(ohm feedthrough for direct stripline/antenna interface for an MMIC transceiver module.

IAP RESEARCH, INC.
2763 CULVER AVENUE
DAYTON, OH 45429
Phone: (513) 296-1806
Topic#: 92-013 ID#: 92-518
Office: NSWC
Contract #: N00014-92-C-0141
PI: Bhanu Chelluri, PhD
Title: High Performance Shape Memory Alloy Processing for Actuators
Abstract: IAP will develop a technique to process nickel-titanium to obtain high performance Nitinol shaped memory alloys using dynamic compaction techniques. This approach may result in improved SMA properties such as recoverable stress and strain.

IBIS TECHNOLOGY CORP.
32A CHERRY HILL DRIVE
DANVERS, MA 01923
Phone: (508) 777-4247
Topic#: 92-014 ID#: 92-509
Office: DNA
Contract #: DNA0001-92-C-0069
PI: Wader Krull
Title: In-Situ Particle Removal in Ion Implanters
Abstract: Particles on the wafer surface during oxygen implantation (SIMOX technology) lead to buried oxide isolation failure and thereby limit the yield of rad-hard IC's fabricated on SIMOX. This program will explore the use of inertial and electrostatic forces for the in-situ removal of particles from the wafer surface. Since a major contribution to the total particle count is attributed to the implanter itself, an in-situ method is necessary. A special endstation has been designed and built for the Ibis 1000 implanter which has provisions for taking advantage of the spinning hub inertial forces to remove particles. Also, fixtures have been provided to use the implant ion's charge as well as an electron shower to control the wafer and particle potentials, to facilitate the removal of particles by electrostatic force. The combination of these methods will reduce particles and BOX pinholes by at least 2X from the levels achieved in current production SIMOX material.

IGC ADVANCED SUPERCONDUCTORS, INC.
1875 THOMASTON AVENUE
WATERBURY, CT 06704
Phone: (203) 753-5215
Topic#: 92-015 ID#: 92-450
Office: AFWL
Contract #: F33615-92-C-2254
PI: Leszek Motowidlo, PhD
Title: Advanced 2212 BSCCO Superconductors
Abstract: Phase I work will focus on developing a stabilizer which surrounds the high temperature superconductor, with improved mechanical strength. To date, silver (Ag) has been the preferred stabilizer because it allows oxygen to easily penetrate during heat treatments and does not adversely react with the HTS material, decreasing the superconducting properties. However, the mechanical properties of annealed silver is much lower than that of the HTS ceramic material. This mechanical disparity can cause difficulty in processing and is especially important for successful fabrication of uniform long lengths of high Jc superconducting wire and tape. In addition to high current density and useful characteristics, especially mechanical handleability and strengths, the cost of conductor will be key for many, if not most of the applications for high temperature operation. The fraction of expensive materials, such as silver will have to be reduced in order to provide the economic incentive and advantages provided by lower cost operation at higher temperatures.

IMAGING SCIENCE TECHNOLOGIES
P.O. BOX 8175
CHARLOTTESVILLE, VA 22906
Phone: (804) 296-7000
Topic#: 92-003 ID#: 92-538
Office: SDC
Contract #: DASG60-92-C-0094
PI: David W. Gerdt, PhD
Title: Non-Cryocooled Dual-Band Infrared Imager
Abstract: SDI requires dual band imaging technology. The approach may provide equivalent performance at far lower cost than discrete element IRFPA technologies. The project will develop a dual band IR imager using its photodichronic imaging (PDI) technology. A sensitive 8 to 12 micron imager has been demonstrated. Similarly designed materials have been demonstrated to be sensitive to different IR spectral bands. PDI involves: 1. modulation of photodichronic properties of one molecular group resulting from optical absorption in another, both groups linked in the molecule by pi electronics which determine response time and modulation characteristics; 2. near perfect molecular organization of these materials onto substrates by the Langmuir-Blodgett (L-B) process; and 3. the extreme sensitivity of ellipsometic techniques used to generate images. Dichronic materials act as both sensor and display, directly converting IR or UV images into visible ones. Images can be viewed directly

by the eye, or by means of CCD cameras for missile IR seeker/tracker use. PDI requires no cryocooling, scanning, or electronic signal processing, and is all optical with no moving parts.

IMPLANT SCIENCES CORP.
107 AUDUBON RD., 5 CORPORATE PL.
WAKEFIELD, MA 01880
Phone: (617) 246-0700
Topic#: 92-014 ID#: 92-591
Office: ARO
Contract #: DAAL03-92-C-0030
PI: Stephen N. Bunker
Title: Single Crystal Diamond Films
Abstract: Diamond films are important for radiation tolerant devices. However, fabrication of single crystal films has proven to be much more difficult than polycrystalline deposits. A novel deposition process is proposed which can be used to deposit diamond on a seed crystal. The technique permits patterned deposits in island and offers the potential of a new method for attempting to dope diamond semiconductors. Diamond films offer the highest radiation resistance of any semiconductor material and are thus important for military and space applications. The problems of fabrication of single crystal diamond films have not yet been solved. If this work is successful, a major materials limitation will have been resolved.

INNOVA LABORATORIES, INC.
PO BOX 85608
SAN DIEGO, CA 92186
Phone: (619) 455-4688
Topic#: 92-003 ID#: 92-632
Office: AFTL
Contract #: F08630-92-C-0030
PI: George Webb
Title: Non-Contact Array Readout
Abstract: Innova Laboratories will develop an optical voltage measurement device for read-out of cryogenic infrared sensor arrays using a non-contact technique allowing data to be read-out by optically addressing a capacitive sensor. Because the read-out means does not contact the array, heat input to the array from conductive signal paths is minimized. Pixels are addressable randomly, allowing data to be read either serially or in parallel data streams. The technique offers ultimate read times than a microsecond and operation at a wide range of temperatures and frequencies. Commercial uses include: spectroscopic characterization of materials, high frequency radiation detectors, mixers, and logic elements in computers.

INNOVATIVE CHEMICAL TECHNOLOGIES CORP.
916 PLEASANT STREET #12
NORWOOD, MA 02062
Phone: (617) 769-6064
Topic#: 92-014 ID#: 92-181
Office: ONR
Contract #:
PI: Shantha Sarangapani, PhD
Title: Synthesis and Characterization of Wide Direct Bandgap Material BeCn2
Abstract: The use of thin film diamond in semiconductor electronic devices has been hampered by the lack of suitable substrates for growth of single crystal diamond films. Recently, it has been proposed that a new hypothetical semiconductor material, BeCN2, could be expected to exhibit close lattice matching to the structure of diamond. While BeCN2 might itself be an important semiconductor material, it might also be able to support the growth of single crystal diamond films. Under this project, an indepth literature study is to be performed to assess the best methods and conditions for the synthesis of BeCN2. Preliminary experiments of BeCN2 formation using two techniques are planned.

INTEGRATED APPLIED PHYSICS, INC.
PO BOX 70166
PASADENA, CA 91117
Phone: (617) 489-1818
Topic#: 92-005 ID#: 92-617
Office: ONR
Contract #: N00014-92-C-0112
PI: Nicholas Reinhardt
Title: Rapid Start BLT Switches for Anti-Missile Radar Systems
Abstract: Anti-missile radars require high voltage pulse-power switching at high average powers on the order of 100 kilowatts. Physically large, slow-to-warm-up switch tubes have been needed to handle the necessary peak currents. Integrated Applied Physics' BLT-250, a miniaturized hydrogen thyratron employing a novel, fast-warm-up "super-emissive" cathode, can switch many 10s of kiloamperes of peak current in a small (2 1/2" diameter) envelope, making the device a strong candidate to replace heavy, bulky, conventional thyratrons, provided that ways can be found to spread and remove the many kilowatts of heat

dissipation now concentrated in the miniaturized devices. In this program, novel methods for removing heat from miniature power tubes will be investigated. Success in removing highly concentrated average-power heat dissipation from the BLT will make practical smaller, lighter,faster-responding, and more powerful radar modulators, laser drivers, and other pulse power equipment.

INTERPHASES RESEARCH
722 RUSHING CREEK PLACE
THOUSAND OAKS, CA 91360
Phone: (805) 492-9814
Topic#: 92-005 ID#: 92-117
Office: NASA
Contract #: NAS3-92-C-26707
PI: Shalini Menezes, PhD
Title: Thin-Film Photovoltaic Cell
Abstract: The optimal photovoltaic properties of CuInSe2 are exploited in a new cell configuration: n-CuInSe2/CuIn2Se3I/p-CuISe3. The cell components and structure are being assessed and adapted for a high energy density power system that is environmentally safe, low cost, low maintenance, reliable, lightweight, efficient and radiation tolerant. The new cell obviates the prevailing concerns associated with the p-CuInSe2/n-CdS cell while retaining the thin-film attributes of the radiation-hard CuInSe2. Non-hazardous and compatible constituents, low interface-state density and better mechanical stability are envisioned to produce a highly efficient photovoltaic device that can safely withstand space environments. Applications range from powering consumer products, communication satellites, and remote locations to utility and space power systems.

IONWERKS
2215 ADDISON
HOUSTON, TX 77030
Phone: (713) 522-9880
Topic#: 92-014 ID#: 92-212
Office: ONR
Contract #: N00014-92-C-0161
PI: J. Albert Schultz
Title: Monitoring Epitaxial Layer Growth
Abstract: When making a structure like AlGaAs or SiGe by heteroexpitaxial growth techniques, it would be nice to know when one atomic layer is completed so that the next can be started. The quality of the device depends on accurate control of the thickness and purity of each layer. Currently, no way exists to detect both layer growth and atomic composition during expitaxial processing of electronic and optoelectronic materials. Our proposed method allows detection of layer growth and atomic composition and would give data complementary to RHEED (reflection high energy electron diffraction) which is commonly used to sense the completion of each epilayer (but gives no composition data). We will accomplish this in real time with no instrumental obstruction of the vapor fluxes to the growing film. In addition, we can perform our experiment at pressure of a few mTorr which allows monitoring and control of films grown by LPCVD (low pressure chemical vapor deposition).

IRVINE SENSORS CORP.
3001 REDHILL AVE, BLDG. 3, SUITE 208
COSTA MESA, CA 92626
Phone: (714) 549-8211
Topic#: 92-003 ID#: 92-067
Office: SDC
Contract #: DASG60-92-C-0116
PI: John C. Carson
Title: Multi-Spectral Smart Retina
Abstract: Multi-Spectral Smart Retina (MSSR) is a 512x512 array of mercury cadmium telluride detectors backside illuminated through an active silicon substrate. The substrate contains switching circuits to multiplex groups of sixteen detectors onto a common read-out pad. The substrate has deposited on it a checkerboard spectral filter to provide a unique waveband for each of the sixteen detectors. As a result, the 512x512 array can be read out using a 128x128 channel parallel processor. When it is either scanned, a 512x512 image is produced in each of sixteen colors. Coupling of massively parallel signal processing to the MSSR for purposes of automatic target recognition, aimpoint determination, camouflage penetration, and countermeasure avoidance is enabled without requiring a separate processing channel for each detector element. Initial commercial applications will include security systems followed by high definition television with integrated digital data compression.

J.B.S. TECHNOLOGIES, INC.
631 KENDALE LANE
THOUSAND OAKS, CA 91360
Phone: (805) 496-0144
Topic#: 92-003 ID#: 92-040
Office: ONR
Contract #: N00014-92-C-0257
PI: Jeffrey B. Shellan, PhD
Title: Multispectral Clutter Suppression Sensor for Detecting Dim Targets From Space
Abstract: A major area of current interest in the field of clutter suppression for enhanced target detection is based on exploiting differences in the spectral content of the target and its background. J.B.S. proposes a scheme that reduces Earth background clutter and increases the target signal for high altitude targets viewed from space. The approach will be modeled using target spectral data from missile plumes and high flying aircraft. The most detailed Earth background spectral data available, based on measurements from the Airborne Imaging Spectrometer (AIS) and the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) will be used to demonstrate the superiority of the proposed concept over standard spectral matched filter approaches.

JET PROCESS CORP.
25 SCIENCE PARK
NEW HAVEN, CT 06511
Phone: (203) 786-5130
Topic#: 92-011 ID#: 92-656
Office: SDC
Contract #: DASG60-92-C-0066
PI: Bret L. Halpern, PhD
Title: Jet Vapor Deposition of Semiconductor-Cluster-Embedded Thin Films
Abstract: Modern aerospace designs push performance of conventional metallic structural materials to the absolute limits of their physical properties. Advanced high performance aerospace structures will need new fiber reinforced composite materials which are stronger, lighter and more durable. Cost-effective manufacturing of composites has yet to be achieved, limiting realization of these performance benefits. Jet Process Corporation's new, low-cost, clean, safe, pollution-free, JET VAPOR DEPOSITION JVD) PROCESS for fiber coating promises significantly reduced costs and improved quality of fiber reinforced composites. JVD uses supersonic, low pressure inert gas jets to efficiently transport metal vapor for concentrated deposition of metal and metal-oxide and silicon-carbide ceramic fibers and multifilament fiber tows. Jet Process Corporation will team with major aerospace and materials companies to carry out this R&D project and to commercialize the results for aerospace and automotive markets.

JET PROCESS CORP.
25 SCIENCE PARK
NEW HAVEN, CT 06511
Phone: (203) 786-5130
Topic#: 92-013 ID#: 92-554
Office: NSWC
Contract #: N60921-92-C-0119
PI: Bret L. Halpern, PhD
Title: Jet Vapor Coating of Ceramic Structural Fibers
Abstract: Demand for high speed transmission and processing of information is soaring. Optical fibers are the workhorse for high speed, high-volume data transmission. Current electronic systems cannot receive, switch, process and retransmit data at comparable volume and speed. The recognized solution for the future is "all optical" circuitry. These circuits require "nonlinear" optical materials and integrated photonic devices not yet available. To meet this need, Jet Process Corp will use its new, clean, safe, pollution-free JET VAPOR DEPOSITION (JVD) process for low cost manufacture of important new classes of "nonlinear" optical materials: "nanoscopic" semiconductor "clusters", a few dozen atoms wide, are "embedded" in optical quality, micron-scale ceramic thin films. Integrated photonic circuits and devices will be made from these nonlinear materials. Jet Process and collaborators will develop these photonic materials and nonlinear devices for computer and telecommunications equipment markets. IBM expects optical switches to attain a large share of a forecasted $30 billion market.

KULITE SEMICONDUCTOR PRODUCTS, INC.
ONE WILLOW TREE ROAD
LEONIA, NJ 07605
Phone: (201) 461-0900
Topic#: 92-014 ID#: 92-249
Office: ARO
Contract #: DAAL03-92-C-0043
PI: Anthony Kurtz
Title: Silicon Carbide Microsensor with Piezoresistive Diamond Sensing Elements
Abstract: Currently, there exist no pressure sensors which are able to withstand operating temperatures in excess of 500 degrees Celsius. Such pressure measurements are critical for proper control of operating parameters in aeronautical propulsion systems, rockets and materials processing. Silicon pressure transducers, which have found extensive use in the aerospace industry, are

inoperative above 600 degrees Celsius due to the unstable mechanical properties of silicon at those temperatures, and are unable to monitor pressure in the hot sections of aircraft engines. We, at Kulite, have initiated a program to develop ultra-high temperature pressure transducers using high temperature semiconductors, namely SiC and Diamond, as sensing elements. The program involves characterization of the materials, development of processing methods and most importantly, the demonstration of a prototype sensor capable of operation at temperatures up to 800 degrees Celsius. These transducers will revolutionize aerospace measurement capability by facilitating proper engine monitoring, enhanced fuel efficiency, and safety.

LASERGENICS CORP.
P.O. BOX 611330
SAN JOSE, CA 95161
Phone: (408) 433-0161
Topic#: 92-011 ID#: 92-340
Office: SDC
Contract #: DASG60-92-C-0088
PI: Richard Schlecht, PhD
Title: Holographic Storage Using BaTiO3 Fibers
Abstract: LaserGenic's research addresses the need for materials for optical storage of information that solve limitations presently found in bulk photorefractive crystals. The structure of a monocrystal fiber increases the amount of information that can be stored by means of channeling the radiation along the fiber. Recently discovered storage properties of Fe:LiNbO3 fibers represent advances in this direction, because LiNbO3 has a longer index grating lifetime and a doubled figure of merit over other better known materials. Using the laser-heated pedestal-growth technique, LaserGenics will grow single crystal fibers of iron doped LiTaO3 because it is a material that has been studied extensively and its properties are well known. Fiber growth and test will ultimately lead to a working holographic storage system.

LASERGENICS CORP.
P.O. BOX 611330
SAN JOSE, CA 95161
Phone: (408) 433-0161
Topic#: 92-014 ID#: 92-337
Office: SDC
Contract #: DASG60-92-C-0103
PI: Richard Schlecht, PhD
Title: Diode Pumped NYAB Green Laser
Abstract: Solid state minilaser sources are receiving increased attention because of the wide variety of space applications they could open up. LaserGenics will investigate the self-frequency-doubling crystal NYAB. This material could lead to a compact high power green laser that could be ideal for topographic mapping, as it can be readily Q-switched, is more efficient at high peak powers, and the 532 nm wavelength has a high detectivity. The only commercially available miniature solid state green laser is the diode pumped Nd:YAG laser with intracavity frequency doubling KTP as the nonlinear optical material; however, these systems are complicated. Previous LaserGenic experiments have demonstrated a self-frequency-doubled NYAB laser with 35 mW of green output. This project will further improve the laser, measure its output characteristics, and develop a high power Q-switched device.

LASKER TECHNOLOGY COMPANY
170 BUTLER COURT
CLAREMONT, CA 91711
Phone: (714) 626-8035
Topic#: 92-002 ID#: 92-273
Office: SDC
Contract #: DASG60-92-C-0099
PI: George Lasker, PhD
Title: Ring Wing Interceptor Concept
Abstract: Below a 100,000 foot altitude, ballistic missile decoys do not pose an intercept problem, but high maneuver acceleration does. Low cost light weight interceptors require optical target tracking sensors and need to achieve accelerations twice as high as those of the ballistic missile. This requires a very high interceptor velocity which in turn results in unacceptable optical sensor window heating and design complexity. Phase I effort will establish feasibility for unique "RING WING INTERCEPTOR" (RWI) which is simple, light, uses an optical sensor, obviates the problem of window heating and achieves the required maneuver acceleration. The RWI has a tube shape, uses a side looking sensor window and maneuvers by means of both lateral and axial velocity controls. RWI's high lifting surfaces allow it to achieve twice the maneuver acceleration of a conical reentry vehicle which has twice the velocity. The effort will also identify and prioritize high risk technologies.

LINARES MANAGEMENT ASSOC., INC.
P.O. BOX 336, 41 GREEN LANE
SHERBORN, MA 01770
Phone: (508) 653-5458
Topic#: 92-014 ID#: 92-321
Office: SDC
Contract #: DASG60-92-C-0070
PI: Robert C. Linares
Title: Heterostructures of Diamond and Wide Bandgap Semiconductors
Abstract: Heterostructures of diamond and other wide bandgap semiconductors are expected to result in diamond films with high carrier concentrations and high mobility. Such structures should overcome the poor transport properties of currently made semiconducting diamond and allow device designers to take advantage of the high breakdown voltage, radiation resistance and high thermal conductivity of diamond, to enable fabrication of high speed and high power devices. Engineered structures of single crystal films of diamond and other wide band gap semiconductors will enable devices to be built which are customized for specific applications.

M.S. SAPUPPO & ASSOC.
7 REGIS ROAD
ANDOVER, MA 01810
Phone: (508) 475-0658
Topic#: 92-002 ID#: 92-652
Office: AFTL
Contract #: F08630-92-C-0023
PI: M.S. Sapuppo
Title: Application of Modern Lithographic Fabrication Processes to the Design of a Miniature Spinning Wheel Gyro
Abstract: M.S. Sapuppo & Associates will examine VLSI microfabrication technology to make traditional spinning wheel gyros. Unique wheel designs will be studied to manufacture complete miniature gyros. Unique wheel designs will be studied to manufacture complete miniature gyros. The simplicity of this design bypasses operator skill/contamination sensitive procedures which make current gyros costly. The marriage of modern processing to traditional principles makes possible subsequent technology demonstration prototypes, which in turn, shall reveal performance to size advantages and savings in cost. Performance estimates range from earth rate to 1 nautical mile/hr. Batch fabrication cost goals are targeted at under $500.00. Gyro power less than 1 watt and sensor package with compatible accelerometers as small as 1 cubic inch. This technology makes possible a family of instruments for military, commercial, and medical uses such as vehicle and control, videocameras. TV/VCR remote control mobile computer pointers, personal strapdown guidance, head and hand position sensing and microliter pumps. US and foreign patents are in progress.

MAINSTREAM ENGINEERING CORP.
200 YELLOW PL.
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 92-007 ID#: 92-534
Office: AFWL
Contract #: F33615-92-C-2255
PI: Robert P. Scaringe
Title: Transient Demonstration of a Pulse-Power Electronic Cooling
Abstract: This research will develop an innovative and effective technique for the removal of heat from high heat flux electronic components. The cooling fluid is passed through micro-channels engraved in chip substrate which acts as an evaporator in a heat pump loop. The flow in micro-channels is controlled automatically by a TXV to provide subcooled nucleate boiling with no dry out in the channels. This results in a very large heat transfer coefficient and consequently low and isothermal temperature for the electronic components. Fundamental heat transfer measurements for both steady-state and transient two-phase flow in micro-channels will be performed for different combinations of operating pressure, passage size and configuration, fluid flow rate, and fluid properties. The effort will experimentally demonstrate that the proposed pulsed-power electronic cooling system has significant benefits in terms of reduced weight, increased reliability, rapid response, increased heat flux in excess of 2x10(6) W/m(2)),and increased operational flexibility when compared to alternative rapid-transient electronic cooling designs.

MARTIN GOFFMAN ASSOC.
3 DELLVIEW DR.
EDISON, NJ 08820
Phone: (908) 549-5433
Topic#: 92-014 ID#: 92-489
Office: ARO
Contract #: DAAL03-92-C-0037
PI: W. Robert Sinclair, PhD
Title: Ultra-Small Silicon Particles for Above-Band-Gap Luminescence
Abstract: Silicon particles of minuscule dimension, so-called "quantum particles," will luminesce intensely when exposed to ultraviolet light. Using proprietary procedures, electrodes will be applied to these ultra-small quantum particles so that they may

be made to electroluminesce. The process voltages will be compatible with the voltages for transistor circuitry. This work offers the promise of joining displays with integrated circuits on the same silicon wafer. Significant reductions of size, weight, and cost will be found with this monolithic silicon structure which contains both the electronic circuitry and display. Aside from its value to the military, commercial application areas include computer displays.

MATERIALS & ELECTROCHEMICAL RESEARCH
7960 S. KOLB ROAD
TUCSON, AZ 85706
Phone: (602) 574-1980
Topic#: 92-015 ID#: 92-306
Office: SDC
Contract #: DASG60-92-C-0087
PI: T.A. Miller, PhD
Title: Ambient-Atmosphere-Compatible Superconducting Fullerene
Abstract: One of the most interesting aspects of the new carbon allotropes, the fullerenes, is their versatile electronic properties, which range from insulating to superconducting depending on the type and level of admixtured elements. The record fulleride transition temperatures have been steadily rising and is 45K at this writing. Fullerenes even have advantages over the ceramic superconductors because of their simple chemistry,isotropic conduction, and potential for infrared sensitivity. The main obstacle to the electronic usefulness of the fullerides is their chemical incompatibility with the ambient atmosphere. MER's outlines an approach in which several methods of producing doped fullerides are evaluated. The techniques investigated include 1) incorporating dopants inside the fullerene cage during creation using MER's production equipment, 2) using alternate, more stable interstitial dopants, and 3) using protective overlayers on alkali doped thin films which will isolate the atmosphere sensitive alkali atoms form the air.

MAYER APPLIED RESEARCH, INC.
1417 DICKEN DRIVE
ANN ARBOR, MI 48103
Phone: (313) 662-3841
Topic#: 92-004 ID#: 92-445
Office: NRL
Contract #: N0014-92-C-2152
PI: Frederick Mayer
Title: Hydron Reactions in Metals
Abstract: Hydrons are charge-neutral, unstable particles formed from an electron and hydrogen isotope nucleus. Recent theoretical work by our company has suggested that certain selected nuclides, in low concentrations, may undergo hydron-mediated nuclear reactions that may be responsible for some of the anomalous experimental observations in heavy-water, electrolytic cells. We propose to design and build small experimental cells that have been appropriately modified to include known amounts of selected nuclides. Baseline and comparison experiments will be performed to test for enhanced nuclear activity in the presence of the selected nuclides. In addition, further theoretical analysis will be performed to suggest alternative reactions with possible significance to energy release from hydrogen-isotope loaded metals.

MDS COMPANY
6114 LA SALLE AVE, SUITE 339
OAKLAND, CA 94611
Phone: (510) 530-8276
Topic#: 92-001 ID#: 92-020
Office: ONR
Contract #: N00014-92-C-0218
PI: Patrick Ferguson
Title: One GW - S-Band Relativistic Klystron Amplifier
Abstract: MDS is developing a 1.5 GW relativistic klystron amplifier operating at 3.5 GHz with 60% efficiency at a minimum pulse width of 1 microsecond which yields 1.5 kilojoules of energy per pulse. The pulse repetition frequency is 500 Hz giving an average RF output power of 750 kW. We will employ an electron gun with a thermionic cathode operating at 1.1 megavolts with a beam current of 2300 A. The RF wave-electron interaction circuit consists of a four cavity bunching circuit with a high efficiency four cavity extended interaction circuit. The klystron will exhibit long life and with a all-brazed ruggedize construction, will be field deployable. We offer this RF pulse power source for high power radar, long-range electronic warfare, directed energy, future high gradient particle colliders, and for high gradient accelerators for industrial and medical use.

METROLASER
18006 SKYPARK CIRCLE #108
IRVINE, CA 92714
Topic#: 92-003 ID#: 92-087
Office: SDC
Contract #: DASG60-92-C-0082

Phone: (714) 553-0688 PI: James D. Trolinger, PhD
Title: Light, Compact, Holographic Window for Exo-Atmospheric Seekers
Abstract: Key optical components for an innovative, infrared/visible seeker design for a hypervelocity exo-atmospheric homing interceptor are being developed. The principle innovation involves the use of specially designed optical windows integrated with holographic optical elements (HOEs) and binary optical elements (BOEs) to provide a light weight, small volume, zoom capable, imaging system which takes advantage of the color separating properties of HOEs to improve the efficiency of the sensor and to enhance discrimination of targets, background, clutter and decoys. Holographic windows would replace large and heavy optics currently used in seekers. They will provide the capability of zooming at the target, correcting for shocks and other aero-optics aberrations, and chromatic aberrations. These windows may be combined and dispersed within a radar antenna to form a compact, dual mode seeker. These holographic optical elements could represent the next generation window for both exo- and endo-atmospheric seekers.

MIDWEST RESEARCH TECHNOLOGIES, INC. Topic#: 92-013 ID#: 92-286
180 NORTH BISHOPS WAY Office: NSWC
BROOKFIELD, WI 53005 Contract #: N60921-92-C-0130
Phone: (414) 821-5250 PI: Norman A. Draeger, PhD
Title: Flexible Atomic Oxygen Resistant Coating for Polyamide and Carbon/Carbon Composite Surfaces
Abstract: Oxide coatings previously developed to protect polyamide and carbon/carbon composites in low earth orbit are brittle and crack upon flexing. Adding small amounts of polytetrafluoroethylene (PTFE) increases coating flexibility but reduces atomic oxygen (AO) resistance and mechanical durability. Coatings developed in this project will use inorganics with potentially greater flexibility (such as sheet/layer structures). Organics used are physically tougher and optically superior (lower absorption/emittance, a/e) compared to PTFE. Deposition conditions will limit defect (pinhole) density and maximize adhesion and uniformity. Goals for coated materials, repeated bending around a 1 mm mandrel, are greater or equal to 0.6 and good resistance to thermal cycling, UV radiation and particle impact.

MSNW, INC. Topic#: 92-007 ID#: 92-290
P.O. BOX 865 Office: NSWC
SAN MARCOS, CA 92079 Contract #: N60921-92-C-0101
Phone: (215) 940-0262 PI: Kent Buesking
Title: Lightweight High Temperature Thermal Radiators
Abstract: Graphite/glass composites offer lightweight, highly conductive, survivable radiators that can improve the maximum temperature and energy efficiency of space nuclear power systems. MSNW will develop a preliminary radiator design, fabricate subcomponent materials, and experimentally determine critical material properties. The preliminary design will include thermal comparisons with other materials, analysis of the heat transfer of the heat pipe/fin interface, and analysis of thermal stresses. Analytical studies will use composite micromechanics, closed form heat transfer and stress analysis, and finite element models. Fabrication and testing, to be done by United Technologies Research Center, will include hot pressing of high conductivity graphite/glass subcomponents and measurement of thermal conductivities, thermal expansions, and tensile properties.

MULTILAYER OPTICS AND X-RAY TECHNOLOGY Topic#: 92-001 ID#: 92-442
7070 UNIVERSITY STATION Office: NRL
PROVO, UT 84602 Contract #: In Procurement
Phone: (801) 377-5512 PI: Alexander M. Panin, PhD
Title: Capillary Discharge X-Ray Laser Driver
Abstract: A compact x-ray laser driver with a high repetition rate is the subject of this phase I project. Most existing x-ray laser drivers are huge (1000s of square feet of floor space), expensive ($10,000,000+), have a low repetition rate (1/hr), are complex and require several PhDs to keep them working. Thus applications of present x-ray lasers are limited. In contrast, the proposed laser will occupy only a few square feet of floor space, will be light weight, and will have a high repetition rate several pulses/minute). If successful, the proposed laser will have application in space, in biology, in surface analysis, in medicine, x-ray lithography, x-ray holography, x-ray microscopy, atomic spectroscopy, metrology, etc. The driver is based on a capillary plasma discharge. A computer model that calculates ion level's populations in plasma will be developed. Strong laser transitions

will be identified and calculated. A preliminary design will be based on calculations. This design will be used for phase II experiments and prototypes.

MXR, INC.
P.O. BOX 370
DEXTER, MI 48130
Phone: (313) 426-2803
Topic#: 92-003 ID#: 92-390
Office: AFRL
Contract #: F3060-92-C-0182
PI: Phillippe Bado
Title: Solid-State, Femtosecond Sources
Abstract: The Phase I goal is to build energy-efficient, compact femtosecond optical sources, and demonstrate diode-pumped lasers that can generate femtosecond pulses via self-modelocking. Only readily available 750-nm diode lasers will be used as pump source. Existing subpicosecond sources are complex devices requiring large, heavy, power-inefficient Argon-ion lasers, Nd:YAG, or similar lasers as primary pump sources. There is an existing need for compact ultrafast sources that can be used outside the R&D laboratory setting. Our compact sources will be used for: 3D acquisition; collision avoidance; imaging scattering media (including tomography of the human body); electronic devices testing (electro-optical sampling); and high-power switching.

NEW LIGHT INDUSTRIES, LTD.
3610 S. HARRISON ROAD
SPOKANE, WA 99024
Phone: (509) 456-8321
Topic#: 92-005 ID#: 92-054
Office: AFWL
Contract #: F33615-92-C-2269
PI: Stephen P. McGrew
Title: Low-Mass Spectrum Separating Concentrator for Photovoltaic Power
Abstract: The concentrator separates sunlight into a focused spectrum, allowing photovoltaic conversion efficiencies of 50% or more through the use of several types of solar cells. The project involves generation and high-fidelity replication of surface relief diffractive structures with sub-micron dimensions. NLI's patented replication technology can be used to manufacture low cost, high quality diffractive optical elements for use in imaging devices, optoelectronics, integrated optics, optical fiber multiplexers, laser beam scanners, and optical computers.

NIELSEN ENGINEERING & RESEARCH, INC.
510 CLYDE AVENUE
MOUNTAIN VIEW, CA 94043
Phone: (415) 968-9457
Topic#: 92-002 ID#: 92-295
Office: ARO
Contract #: DAAL03-92-C-0015
PI: Robert E. Childs
Title: Reducing Turbulent Flow Aero-Optical Distortion
Abstract: High-speed endo-atmospheric interceptors need cooling to protect the body and homing sensors from hot external flow. The windows for infrared seekers are cooled with some form of wall jet(s), but turbulence generated in the mixing layer between the cooling jet(s) and the external flow distorts the image the seeker receives. Large eddy simulation (LES), in which time-accurate numerical solutions of the 3D Navier-Stokes equations are used to compute the mean flow and large scales of turbulence, will be validated for predictions of aero-optical distortion; used to obtain information about turbulence which will guide development of turbulence control methods; and used to demonstrate the feasibility of these methods. Based on the present understanding of turbulence in high speed shear layers, several control methods may be effective. Successful completion of Phase I and II work will yield: methods of controlling aero-optical distortion for specific configurations; verification of these methods' effectiveness; and software for predicting the turbulent distortion and evaluating control methods in general configurations.

NIMBLE COMPUTER CORP.
16231 MEADOW RIDGE WAY
ENCINO, CA 91436
Phone: (818) 501-4956
Topic#: 92-010 ID#: 92-539
Office: SDC
Contract #: DASG60-92-C-0133
PI: Henry Baker, PhD
Title: Superposable Signalling Protocols for a Locally-Connected Scalable Parallel Computer
Abstract: Scalable parallel computer architectures will require communications networks which are also scalable. The simplest,

most scalable communication architecture involves only nearest neighbor and next nearest neighbor interconnection; however, it is not known to what extent such a network will prove a bottleneck for general purpose computing. Nimble proposes to develop a communications protocol for such a locally connected scalable processor which obeys an analog of the "superposition" principle of wave propagation in a linear medium. Such a superposable communications protocol should permit point-to-point interference-free communications, scale with the size of the processor, and degrade gracefully in latency and bandwidth with increasing congestion. A superposable messaging protocol should also make better use of the available computational resources than a fixed partitioning of the resources into computation and communication components.

NONVOLATILE ELECTRONICS, INC.
15800 INDUSTRIAL PARK BLVD., SUITE 110
PLYMOUTH, MN 55441
Phone: (612) 550-0913

Topic#: 92-014 ID#: 92-183
Office: SDC
Contract #: DASG60-92-C-0073
PI: James M. Daughton

Title: Controlled Anti-Ferromagnetic Coupling in Giant Magnetoresistance Materials

Abstract: The measurement of infrared spectra can develop the composition and temperature of a target object. It can also determine the concentration of gases along a measurement path, or the size of particles or thin films. An excellent way to rapidly obtain spectra is with a Fourier Transform Infrared (FT-IR) spectrometer which allows detection of all regions of the spectrum simultaneously. What's new is a unique FT-IR sensor which is fast, small, totally vibration tolerant, and permanently aligned. The new FT-IR is based on a novel dynamically balanced interferometer which reduces the affect of external vibrations by over a factor of 100. The Phase I is a joint venture between Advanced Fuel Research, Inc. and On-Line Technologies, Inc formed to commercialize FT-IR technology. Government market: identifying hostile missiles, enemy aircraft, and ground targets from satellites or aircraft or poison gases on the battlefield. Commercial market: environmental and process monitoring.

NONVOLATILE ELECTRONICS, INC.
12800 INDUSTRIAL PARK BLVD., SUITE 110
PLYMOUTH, MN 55441
Phone: (612) 550-0913

Topic#: 92-014 ID#: 92-203
Office: ONR
Contract #: N00014-92-C-0160
PI: Kurt E. Spears

Title: Nanometer Magnetoresistive Random Access Memory

Abstract: New cell concepts using better magnetoresistive material will make Magnetoresistive Random Access Memory (MRAM) denser for the same lithography than other semiconductor solid state memories such as DRAM, EEPROM, and flash, while retaining the advantages of both nonvolatility (saving data with no power) and durability (with infinite write- and read-cycling). Area densities of ten thousand million bits/cm2 will be achieved using 0.05 micron E-beam lithography. With these new cells, it may be possible to replace the present three level hierarchy (main, disk buffer, and disk memories) in computers with a single MRAM, radically improving system performance, size and weight, reliability, and cost. In Phase I the memory cell will be designed and simulated, and initial process definition completed. In Phase II, the cells will be demonstrated.

OPTIVISION, INC.
4009 MIRANDA AVENUE
PALO ALTO, CA 94304
Phone: (415) 855-0224

Topic#: 92-011 ID#: 92-113
Office: SDC
Contract #: DASG60-92-C-0064
PI: Behzad Moslehi, PhD

Title: Ultra Fast Fiber-Optic Modulator/Switch

Abstract: Optivision, Inc. will design, demonstrate, and evaluate a method of externally modulating light in a waveguide, utilizing the surface plasmon polariton (SPP), a high-intensity two-dimensional electromagnetic wave tightly confined to a metal-dielectric interface, by coupling with quantized charge oscillations. The proposed SPP modulator device is in contact with a waveguide and consists of: 1.) a thin dielectric buffer layer; 2.) a thin metal film of a few hundred atomic layers; 3.) an electroptic material; and 4.) the outer electrode. A prototype modulator will be designed and fabricated on a single-mode fiber using a thin-film deposition technique. When the electrically-controllable refractive index of the EO layer is made equal to the effective guided mode index, complete transfer of the waveguide light to SPPs occurs through evanescent wave coupling, so that modulation is achieved by changes in the applied voltage. Unlike conventional devices, as SPP device can be rugged and low cost, broadband, operating at very high frequencies in the 850nm, 1300nm, and 1550nm wavelength windows with low insertion losses and no back reflections. The high sensitivity of SPP excitation means that such a modulator can operate at very low

voltages. The feasibility of two-dimensional configurations will also be studied.

OPTRON SYSTEMS, INC.
3 PRESTON COURT
BEDFORD, MA 01730
Phone: (617) 275-3100
Topic#: 92-011 ID#: 92-610
Office: NSWC
Contract #: N60921-92-C-0118
PI: Todd Tsakiris
Title: CTP-Based Electrically-Addressed VLSI Liquid Crystal SLM
Abstract: Phase I will develop a very high-contrast VLSI-addressed liquid crystal spatial light modulator for opto-electronic computing that uses a charge transfer plate to transfer modulation voltages from the VLSI circuit, while providing an optically flat substrate for liquid crystal fabrication. The Phase I will demonstrate: 1) flip-chip solder bump-bonding of MOSIS-fabricated VLSI circuitry onto CTPs; 2) assembly of a complete device consisting of a VLSI/CTP/LC sandwich; and 3) testing and characterization of these electrically-addressed devices. The advantages of this approach over the current non-CTP technology include: 1) higher contrast ratios, since the CTP is optically flat and a second liquid-crystal alignment layer can be deposited on it; 2) larger and more densely-packed arrays offering significantly increased parallelism at lower cost; 3) excellent spatial uniformity and the elimination of unwanted fixed pattern noise since the CTP provides an optically flat and smooth dielectric mirror surface for the liquid crystal cell; and 4) high optical readout efficiency because of the use of a highly reflective dielectric mirror surface on the CTP, and because the LC modulating element is optically isolated from the underlying driving circuitry. Commercial applications include parallel bistable optical memories, reconfigurable optical interconnects, visual displays, or, using more complex VLSI circuitry, "smart pixel" image processors or neural network circuit element.

ORTEL CORP.
2015 WEST CHESTNUT STREET
ALHAMBRA, CA 91803
Phone: (818) 281-3636
Topic#: 92-014 ID#: 92-166
Office: SDC
Contract #: DASG60-92-C-0072
PI: Jeffrey Ungar, PhD
Title: Laser Diodes Using InGaP Confining Layers
Abstract: Laser diodes which incorporate chemically reactive aluminum based materials in their structures are prone to have poor reliability when operated at high output powers because of facet oxidation. The presence of aluminum also makes it difficult to fabricate high performance laser diodes using more than one epitaxial growth step because of oxidation that takes place upon exposure to the atmosphere. By replacing the claddings with layers of Indium Gallium Phosphide grown on Gallium Arsenide substrates, lasers entirely free of aluminum can be fabricated. We will fabricate simple aluminum free laser structures and perform high temperature accelerated aging tests to compare them with similar lasers containing aluminum. High power, reliable laser diodes fabricated with multiple epitaxial growths could revolutionize fields such as satellite communications and optical computer interconnections.

PAGE AUTOMATED TELECOM. SYSTEMS, INC.
ROUTE 2, BOX 188
LA HONDA, CA 94020
Phone: (415) 857-9655
Topic#: 92-012 ID#: 92-585
Office: AFAL
Contract #: F29601-92-C-0088
PI: Stephen Rowe
Title: Robust Sensor System for Space Structures
Abstract: A new fiber-optics communication and sensing structure, Smart Skin Array Technology (SSAT) shows promise for enabling robust, integrated data buses and sensing systems for space structures. The project consists of experimentation to demonstrate characteristics of SSAT that promote data bus survivability, including embedment within conventional composite layers and sandwiching between laminate layers. Also, the project will demonstrate the integration of the data bus structure with fiber optic techniques for monitoring fatigue, strain and temperature. Interest in robust fiber-optic communication and sensing systems is widespread, particularly for aerospace, medical and robotic applications. Many of these applications are likely to occur in hazardous environments where the survivability enhancement techniques described in this proposal would be of great commercial interest. Integration of data bus and sensor structures with a common fiber-optic based technology offers a significant system cost opportunity.

PARASOFT CORP.
2500 E. FOOTHILL BLVD., SUITE 205
PASADENA, CA 91107
Phone: (818) 792-9941
Topic#: 92-010 ID#: 92-111
Office: SDC
Contract #: DASG60-92-C-0065
PI: Jon Flower
Title: Automatic Creation of Parallel Programs from Ada
Abstract: Parallel programs can be written in Ada in many ways. Both the original Ada standard and the newer Ada/9X standard include specifications for parallel and distributed computing. Another possibility would be to use nonstandard subroutine libraries which implement alternative parallel programming models. However, in all of these cases, humans are requited to create, debug, and maintain the parallel application. ParaSoft seeks to automate this process by using technology proven successful in parallelizing both C and Fortran programs. The complexities of the Ada language and the desire to conform in some manner to the evolving Ada standards require that effort be made to understand the various ways in which Ada programs can be parallelized and the parallelization tools be capable of generating customized Ada code.

PHASEX CORP.
287 EMERSON RD.
LEXINGTON, MA 02173
Phone: (508) 794-8686
Topic#: 92-013 ID#: 92-466
Office: NSWC
Contract #: N60921-92-C-0140
PI: Michael P. Coffey
Title: Silicon Carbide-Silicon Carbide Composites
Abstract: Ceramic composites of silicon carbide fibers in a silicon carbide matrix are currently produced via CVD infiltration (CVI), but the requisite high temperature for CVI can partially degrade the fibers. Infiltrating a SiC precursor polymer into a fiber preform and subsequently converting the polymer at low temperature (<900 C) to SiC can form a composite with improved mechanical properties. A supercritical fluid (SCF) solvent exhibiting high transport properties and no surface tension limitation is used to infiltrate and deposit the polymer uniformly in a SiC fiber preform or tape; the precursor is pyrolyzed to monolithic SiC with no adverse interaction on the fiber surface, thereby achieving full advantage of the SiC fibers in the composite. Improved mechanical properties will be measured and compared with conventionally produced silicon carbide composites. The program is another example of the application of the company's technology to achieving improved performance of materials such as carbon/carbon composites, high performance polymers, space lubricants, and energetic materials.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 530-1416
Topic#: 92-001 ID#: 92-343
Office: SDC
Contract #: DASG60-92-C-0076
PI: Gajendra Savant, PhD
Title: Volume Holographic Generation of Diffraction-Free Directed Energy Beam
Abstract: Physical Optics Corporation (POC) proposes a novel approach to directed energy systems based on high efficiency holographic generation of diffraction-free beams. Diffraction-free beams are not subject to transverse spreading (diffraction), in sharp contrast with the currently used Gaussian-profile directed energy beams which undergo significant spreading along the propagation direction. POC's approach is to first generate the diffraction-free beam with the conventional slit-lens method, and then record the interference pattern of the diffraction-free beam and a Gaussian beam as a volume phase hologram using POC's proprietary volume holographic technology. When such a volume hologram is illuminated by a Gaussian beam from a directed energy laser, it converts most of the incident light into a diffraction-free beam. Using POC's volume holographic technology, the conversion efficiency can potentially reach 99%, significantly better than existing methods. If the proposed research is successful, the practical use of diffraction-free beams can become possible. Such beams provide energy transport efficiency several orders of magnitude higher than Gaussian beams, and can give rise to a new generation of directed energy systems featuring ultrahigh energy transport efficiency, low energy budget, lower cost beam control equipment, and real-time capability.

PHYSICAL OPTICS CORP.
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TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 92-003 ID#: 92-487
Office: NSWC
Contract #: N60921-92-C-0120
PI: Eva Strzelecki
Title: Voltage Controlled Wide Angular Range Optical Beam Steering Device

Abstract: The proposed beam steering technique merges high efficiency wide bandwidth diffraction gratings with liquid crystal cells. The angular dispersion properties of the gratings can be utilized and enhanced when they are combined with a layer of a medium with large refractive index modulation. The initial calculation predicts that an optical beam can be modulated by up to 10 degrees in a simple voltage controlled device. Though slower than acoustooptic beam deflectors, the proposed device offers greater versatility in its angular deflection, significantly smaller power consumption, and less bulky packaging at a lower cost. These properties will permit its wide spread use in laser radar and communication.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 530-1416
Topic#: 92-011 ID#: 92-060
Office: SDC
Contract #: DASG60-92-C-0062
PI: Ray T. Chen, PhD

Title: Dispersion-Free Traveling Wave Plasmon/Polymer Waveguide Modulator

Abstract: Physical Optics Corporation (POC) proposes a traveling wave plasmon/polymer waveguide modulator. Conventional EO modulators suffer from small modulation bandwidths (usually much less than 100 GHz) due to the large walk-off between the propagation of the microwaves and optical waves. Additionally, the small index modulation associated with linear electrooptic coefficients requires a long electrode length (mm to cm). The proposed plasmon waveguide modulator, in conjunction with an EO polymer, provides a modulation scheme that has a small interaction length (about 100 um). No dispersion between the optical waves and the microwaves is expected. Employment of a collinear microstrip line generates a much better overlap integral between the optical and microwave signals, and power consumption is reduced in comparison with conventional coplanar electrode structures used for LiNbO3 and GaAs EO modulators. The optical bandwidth is greatly enhanced by adjusting the input coupling angle and the bouncing angle of the substrate-guided wave, which has a continuous guiding spectrum as long as the total internal reflection (TIR) criterion is satisfied. A plasmon waveguide modulator will be demonstrated in Phase I. The microstrip line suitable for transmitting a 100 GHz signal will also be tested.

PHYSICAL OPTICS CORP.
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TORRANCE, CA 90501
Phone: (310) 530-1416
Topic#: 92-011 ID#: 92-061
Office: AFTL
Contract #: F08630-92-C-0045
PI: Ray T. Chen, PhD

Title: Active Optical Backplane for Three-Dimensional Optoelectronic Computing

Abstract: Current high temperature performance computing systems are limited by interconnection speeds rather than by their processing elements. In the interconnection hierarchy, backplane interconnections impose the most serious speed limitations on 3-D optoelectronic computing systems. Physical Optics Corp proposes an Active Optical Backplane (AOB) which will upgrade the architecture of 3-D optoelectronic computing systems and produce much higher modulation speeds (to 1000 Gbit/sec) among processing elements. When compared with existing electronic backplanes (EB) and Passive Optical Backplanes, the AOB has the same advantage of system compatibility as EBs while keeping the modulation speed projected for POBs. Unlike POBs, the proposed AOB performs both modulation and demodulation on the backplane itself. As a result, the electronic packaging issue is automatically solved without modifying existing connectors from card boards to the backplane. Among all backplane buses investigated, Futurebus+ has the widest data bit width (up to 128 bits), and highest user acceptability. Futurebus+ will be incorporated into this program. Phase I will demonstrate a AOB with on-board modulation and demodulation, with physical layers and protocol in Phase II.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 92-011 ID#: 92-499
Office: ONR
Contract #: N00014-92-C-0149
PI: Andrew Kostrzewski, PhD

Title: Highly Parallel Opto-Electronic Digital Multiprocessor

Abstract: We will develop entirely new class of electrooptic analog-to-digital (A/D) converters and modulators. Preliminary experiments on electrooptic materials have demonstrated such conversion/modulation. The A/D converter/modulator consists of an integrated optic channel waveguide with device end faces polished and coated with high reflectivity mirrors. The resultant transmission response of the device can be tuned through the electrooptic effect. Several advantages of the A/D

converter/modulator are its multi-valued logical capability, electronically reconfigurable logical weights, and high speed operation (~GHz). Additional advantages include elimination of the use of sampling optical pulse, provision of long distance digital optical signal transmission capability, high SNR, high dynamic range and thermal stability. The reconfigurable multiwavelength coding can be used to realize highly secure optical communication for military an commercial purposes.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
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Phone: (310) 320-3088
Topic#: 92-011 ID#: 92-500
Office: ONR
Contract #: N00014-92-C-0175
PI: Freddie Lin, PhD
Title: Electrooptic Modulator Structure with a Very High Bandwidth
Abstract: New modulator structures are required in order to make a significant improvement in the development of very high speed electrooptic modulators. The biggest problem with conventional modulator designs is the lack of a "perfect" electrooptic material, one having both a large index modulation (Delta n) and a very high bandwidth. We are currently investigating a novel waveguide grating coupler modulator structure concept which goes around this problem. This modulator is based on electrooptically varying the phase-matching coupling condition, which is very stringent, so that a very small change in the refractive index determines whether or not the unguided free space beam is coupled into the fundamental waveguide mode. This unique electrooptic modulator configuration has theoretical modulation bandwidths of up to 1600 GHz, with a small driving voltage (under 30 V).

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 92-011 ID#: 92-501
Office: AFOSR
Contract #:
PI: Michael Wang
Title: N X N Integrated Channel Waveguide Optical Crossbars for Large Scale High Speed Non-Blocking Data Switching
Abstract: The ability to switch data flows between channels quickly, massively, and without blocking usable channels in the process will form the centerpiece of every future computing or communications system. In this project we explore a new concept in high-speed large-scale optical crossbar switching devices, utilizing evanescent-wave couplings between single-mode channel waveguides and electrooptic tunable ring resonators. The wavelength selective switching between the input and the output channel can be achieved by controlled tuning voltages applied to these ring waveguide switches. The proposed crossbar can realize N x N switchings with only 2N switches, and is reconfigurable to any switching pattern, including two-way non-blocking switching and active wavelength division multiplexing and demultiplexing. Additional advantages include large array data switching, high speed (GHz), and the capability for monolithic integration with other integrated optoelectronic components.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
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Phone: (310) 530-1416
Topic#: 92-014 ID#: 92-345
Office: SDC
Contract #: DASG60-92-C-0071
PI: Ray Chen, PhD
Title: Microlaser Array Using Ion-Doped Polymer Waveguide Resonators
Abstract: Physical Optics Corporation (POC) proposes a drastically new ion-doped graded index (GRIN) polymer waveguide laser. Due to the GRIN property, such a waveguide laser can be fabricated on any substrate of interest. The existence of ion-doped waveguide lasers on various amorphous glass substrates and single crystal LiNbO3 implies that metastable states do exist for an array of host microstructures. The O-H-group quenchers, which jeopardize the lifetime of metastable states, can be eliminated through the dehydration process after the ions, such as Er+++ and Nd+++, have been implemented. Single-mode waveguides provide better gain due to their high optical energy confinement. A stable waveguide resonator is provided by recording a narrow-band holographic rejection filter which also functions as the single longitudinal-mode selector. Longitudinal pumping significantly reduces the size and therefore the cost of the microlaser array. Long interaction length of longitudinal pumping ensures a high absorption rate of the photons generated from the semiconductor pumping laser. Finally, the problem of excited state absorption (ESA) can be eliminated by detuning the pumping wavelength away from the center of the ground-state absorption feature. The feasibility of the proposed Er+++ and Nd+++-doped GRIN polymer waveguide

lasers will be demonstrated in Phase I.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
ANDOVER, MA 01810
Phone: (508) 689-0003
Topic#: 92-003 ID#: 92-383
Office: AFRL
Contract #: F30602-92-C-0100
PI: William J. Marinelli
Title: Infrared Imaging Spectroradiometer
Abstract: Physical Sciences will develop an imaging infrared spectroradiometer based on the use of single order Fabry-Perot interferometry. An IR focal plane array views the center of the interference pattern, which contains the image of the object at the transmission wavelength. Piezoelectric transducers, synchronized with the framing rate of the array, move the interferometer mirrors to change the transmission wavelength. This capability allows for rapid and adaptive changes in sensor bandpass and wavelength selection. Full spectral coverage from 1.35 um to the LWIR is provided at a possible spectral resolution of 2% of the transmission wavelength. The concept offers spectral resolution and sensitivity comparable to IR circular variable filter based systems, with the advantages of great mechanical simplicity and ruggedness, a common optical train and pixel registration at all wavelengths, higher spectral fidelity, and high framing rates.

PHYSITRON, INC.
3325 TRIANA BLVD., SUITE A
HUNTSVILLE, AL 35805
Phone: (205) 534-4844
Topic#: 92-001 ID#: 92-108
Office: SDC
Contract #: DASG60-92-C-0096
PI: David B. O'Hara
Title: Broad Bandwidth Beam Benders and Short Focal Length Aperture Optics
Abstract: Although there have been many advances in optics for low energy x-rays, (< =20keV), all optics for x-rays suffer from combinations of small effective apertures, excessively long goal lengths, small bandwidth, or the inability to bend the x-rays through large angles. Physitron proposes to design, fabricate and test x-ray bending, focusing and collimating optics which will have large effective apertures, short focal lengths in focusing systems, large transmission bandwidths,and the ability to bend even 8-10 keV x-rays through large angles with high transmission efficiency. These optics will be fabricated from laminar microchannel sheets stacked to form the large aperture. Microchannel of this type have been made possible by recent Physitron work in neutron optics. Microchannel optics of this type are distinct from those using capillary fibers because they allow better control of x-ray transmission, larger apertures, and much easier fabrication. These optics will have applications in x-ray lasers and other high energy-directed energy systems, x-ray lithographic systems, and underground nuclear testing, aboveground nuclear testing, synchron radiation sources, plasma diagnostics for fusion, materials science applications, and uses in scientific instruments such as x-ray diffractometry and x-ray spectrometry.

PICOTRONIX, INC.
2553 BUNKERHILL
ANN ARBOR, MI 48105
Phone: (313) 763-4881
Topic#: 92-011 ID#: 92-592
Office: ARO
Contract #: DAAL03-92-C-0035
PI: Steven Williamson
Title: Solid-State Optical Temporal Analyzer with Picosecond Resolution and Picowatt Sensitivity
Abstract: Picotronix Inc. will integrate the world's fastest photodetector with an equally fast optoelectronic sampling gate to develop the "Solid State Optical Temporal Analyzer with Picosecond Resolution and Picowatt Sensitivity." The combination of 1-ps response, 1-pW/Hz sensitivity, and 100 dB dynamic range obtained simultaneously in a 1 cm-size, robust, all-solid-state detector represents a major leap forward in the measurement of high speed optical signals. It will be sensitive to 1 nm (2 keV x-rays) through 1600 nm radiation. Applications include: compact optical ranging for micron-resolution 3-D imaging; automobile sensors; and novel ultrafast scientific instrumentation. The technique of time-gated imaging of a dispersed picosecond optical pulse as it emerges from a scattering medium will be demonstrated. The ability to image a 1-mm size object buried within a scattering medium will have a profound impact of early, x-ray-free detection of breast tumors.

POWDER TECHNOLOGY, INC.
300 BLUE SMOKE CT., W.
FORT WORTH, TX 76105
Phone: (817) 535-8911
Topic#: 92-013 ID#: 92-410
Office: NRL
Contract #:
PI: Grady Sheek
Title: Fluidized Bed Coated Powders
Abstract: Powder Tech's technique facilitates the creation of a structural, metal matrix composite with previously unsurpassed strength-to-density ratios at elevated operating temperatures, and may be the single most important find to traditional powder metallurgy ever. This technique involves the coating of SiC powders with aluminum matrices by a computer controlled fluidized bed CVD process followed by their subsequent consolidation. Such composites can replace titanium for high temperature applications up to 900 F. This process is not limited SiC/Al and depending on the starting and deposited materials, the use temperature can be greatly increased and tailored to most environments. Implications of this work include stabilized ceramics, structural ceramics with room temperature ductility, particulate reinforced composites for high temperature engine and airframe components, kinetic armor penetrators, etc.

PRODUCTIVITY SOLUTIONS
30 EAST STREET
NEWPORT, RI 02840
Phone: (401) 847-8875
Topic#: 92-010 ID#: 92-208
Office: SDC
Contract #: DASG60-92-C-0125
PI: John E. Stockenberg, PhD
Title: Dynamic Integration Architecture for High Availability Embedded Networks
Abstract: Incremental system/software integration and the maintenance and evolution of embedded systems are not well supported by current tools. This is particularly true of high availability systems that can't be shut down to use off-line integration approaches. We have developed a software architecture that associates dynamic integration command statements with the code of the current and new components. While the system is executing, these commands are interpreted to effect the required module updates. This formal, rigorous language allows a dynamic integration strategy to be tailored to the specific needs of each modification. Unlike proposed alternatives, our technique works with existing languages, architectures and SW designs. In addition to updating critical, continuously running systems--a capability that is currently unavailable--our approach provides a formal HW/SW integration tool that allows reuse, review and verification of tasks that account for over 1/3 of system cost.

PROPULSION RESEARCH, INC.
4511 DALY DRIVE
CHANTILLY, VA 22021
Phone: (703) 968-0200
Topic#: 92-002 ID#: 92-094
Office: SDC
Contract #: DASG60-92-C-0077
PI: Carl W. Anderson
Title: Miniature High-Performance Ferro-Magnetic Actuator Research
Abstract: Certain ferro-magnetic (F/M) materials expand and/or contract in the presence of an electrical current or field. This program proposes basic and applied research to use this material property as the working medium to achieve quantum improvements in the performance of miniature actuators. Using this exciting new solid state technology, it appears possible to create ultra-fast response, high force, miniature actuation devices that will have minimum power consumption, are suitable for a variety of high-tech defense and commercial applications, and represent the ultimate in simplicity with essentially no moving parts. Micro second response times and highly precise displacements from tenths of microns up to one millimeter are thought possible with the proper mechanical implementation and electronics. This F/M actuation technology has thousands of military and commercial applications possible.

RADIATION SCIENCE, INC.
P.O. BOX 293
BELMONT, MA 02178
Phone: (617) 621-7076
Topic#: 92-003 ID#: 92-329
Office: HDL
Contract #:
PI: Allen S. Krieger
Title: Broad Band Hard X-Ray Receiver for Interactive Discrimination
Abstract: Reflection of high energy X-rays from multilayer coatings raises the possibility of building a focussing hard X-ray telescope for interactive discrimination by X-ray spectroscopy. The objective of this project is to evaluate the feasibility of using graded period multilayer coatings to build a broad band hard X-ray concentrator. An optimal multilayer coating design will be

generated. A graded multilayer will be procured and its hard X-ray reflection characteristics will be evaluated. Because most hard X-ray sources produce continuous spectra, a broad band hard X-ray reflector can produce a net gain in X-ray energy per unit area. Thus, broad band reflectors should be useful as hard X-ray concentrators in synchrotron radiation instrumentation, medical technology, and perhaps, NDE and security instrumentation.

RASOR ASSOC., INC.
253 HUMBOLDT CT.
SUNNYVALE, CA 94089
Phone: (408) 734-1622

Topic#: 92-004 ID#: 92-725
Office: AFWL
Contract #: F33615-92-C-2264
PI: John B. McVey

Title: Thermionic Energy Conversion Efficiencies Using Low Emissivity Materials

Abstract: In thermionic power systems, thermal radiation heat transfer between the hot emitter and cold collector constitutes a parasitic heat loss which reduces conversion and system efficiencies. After observing that the radiant heat depends linearly on the effective emissivity of the electrode pair, a method of reducing this parasitic heat loss was developed. For the typical case of tungsten emitter and niobium collector, this effective emissivity is 0.17 to 0.20. Some materials such as copper and sodium have total emissivities less than 0.10 for the typical range of collector temperatures used in space power applications. Coating the collector with such a material could potentially reduce the effective pair emissivity significantly. Phase I will: identify low emissivity materials which would be compatible with a converter environment; establish requirements to maintain low-emissivity surfaces by controlling emitter evaporation; and measure, in a vacuum, the radiant heat transfer in a thermionic convertor structure incorporating a low-emissivity collector surface. Estimates will be made of the impact on system performance in proposed system concepts. Phase 2, will address issues raised in fabrication and performance stability and will build and test a converter prototype.

RESEARCH OPPORTUNITIES, INC.
2200 AMAPOLA COURT, SUITE 101
TORRANCE, CA 90501
Phone: (310) 533-5149

Topic#: 92-007 ID#: 92-218
Office: NSWC
Contract #: N60921-92-C-0100
PI: William C. Riley

Title: Carbon-Carbon Composite for Space Radiators

Abstract: The program objective is to fabricate and test carbon-carbon panels for spacecraft radiators with a thermal conductivity above 700 W/mK. Innovations required to meet this objective are: (1) 1100 W/mK K1100X graphite fiber, (2) unique weaving techniques that will provide a nearly unidirectional preform with adequate mechanical strength for handling and launch loads, and (3)careful impregnation of pitch A240 into the preform, possibly supplemented with CVD. The matrix should orient itself to the graphite fibers with an apparent growth of the fiber diameter. Maximum density is vital with a goal of 1.85 g/cc. Through flattening of the fiber tow, it is expected that thickness in the range of 10 mils can be obtained. Evaluation consist of non-destructive thermal conductivity measurements and mechanical property measurements. Phase II activities will include composite scale-up, proof of thermal and mechanical property reproducibility, and a design data base will be developed.

REVEO, INC.
200 SAW MILL RIVER ROAD
HAWTHORNE, NY 10532
Phone: (914) 741-2006

Topic#: 92-011 ID#: 92-258
Office: ONR
Contract #: N00014-92-C-0148
PI: Sadeg Faris

Title: Multi-Layer Optical Mass Storage

Abstract: Numerous problems in science and engineering require powerful computers with Tera-FLOP speeds which will demand the concurrent availability of mass storage media with T-Byte capacities and data rates exceeding 1 Giga-bit/sec. A new read-write optical storage technology that meets the requirements to enable many processors to work in parallel where data can be stored in three dimensions and retrieved very fast is being introduced by Reveo, Inc. This technology, which will enable the development of materials for optical storage and data retrieval methods without cross-talk between channels, is based on the cholesteric liquid crystal polymer property of selective reflection at a characteristic wavelength. Each layer in a multi-CLC-layer storage medium has a different characteristic wavelength, making it possible to randomly select any layer for reading and writing. It is projected that a 16 T-Byte erasable mass storage system with a data rate of 1.6 T-Bit/sec can be built using Reveo's breakthrough technology. In Phase I, a 5-layer storage system will be designed and the feasibility of random layer addressing

demonstrated. Phase II will build and demonstrate the new technology, with product development and commercialization in Phase III.

ROCKY RESEARCH
P.O. BOX 61800
BOULDER CITY, NV 89006
Phone: (702) 293-0851
Topic#: 92-007 ID#: 92-140
Office: AFWL
Contract #: F33615-92-C-2251
PI: Uwe Rockenfeller, PhD
Title: Solid State Chemistry Cooling Devices
Abstract: Miniature adsorption refrigeration systems capable of cooling as low as -60 degrees Fahrenheit without fans for heat rejection are being developed. When used with computers and electronics packages, advantages include 40% higher processing speed with key chips operating at low temperature, better reliability with hermetically sealed chassis and no hot spots, and low noise by elimination of fans. Other applications include a microwave-oven-sized consumer quick-freeze appliance, portable freezers, and boat and RV refrigerators. Because solid adsorbents are used, the refrigeration systems require no moving parts except on valve, giving high reliability. Complex compound adsorbents provide high cooling power per unit mass, high efficiency, and low cooling temperatures. They perform where thermoelectrics and vapor compression cannot. Manufacturing cost is estimated at less than $40 for 50W of cooling at -40 degrees Fahrenheit. Sorbers specifically optimized for a miniature electronics cooling device will be developed in Phase I. A complete operating prototype will be built in Phase II.

SANDIA SYSTEMS, INC.
13423 DESERT HILLS, NE
ALBEQUERQUE, NM 87111
Phone: (505) 294-1040
Topic#: 92-001 ID#: 92-689
Office: SDC
Contract #: DASG60-92-C-0139
PI: Scott Wilson, PhD
Title: Rapid Fabrication of Precise SiC Mirror Substrates
Abstract: Sandia Systems, Inc. will apply novel processing techniques to demonstrate an improved fabrication process for SiC optical elements. We will combine the CVD of SiC replication process and ion beam figuring process to demonstrate fabrication of high quality optical elements. The CVD SiC would have no subsurface damage layer, and this would alleviate many of the materials problems associated with processing the material. Demonstration of this proposed integrated processing arrangement would provide a methodology to rapidly fabricate complex SiC elements which have improved optical properties, yet at a significantly reduced cost.

SARCOS RESEARCH CORP.
261 E. 300 SOUTH, SUITE 150
SALT LAKE CITY, UT 84111
Phone: (801) 531-0559
Topic#: 92-003 ID#: 92-120
Office: SDC
Contract #: DASG60-92-C-0124
PI: Ian McCammon, PhD
Title: Micro Disk Systems for Inertial Sensing and Optical Beam Control
Abstract: Sarcos is currently developing a technology that can lead to low-cost millimeter-scale gyroscopes, multi axis inertial sensors, and very compact laser scanning devices. This technology, called Micro Disk Systems (MDS), is based on levitating a small disk above a VLSI substrate using electrostatic fields. AC stabilization of the fields ensures that the disk position remains suitable, and field-based sensors measure the spatial position of the disk. In a previous contract, we constructed a proof of principle prototype and demonstrated the feasibility of MDS technology. In Phase I, we will design an evaluation system that will address two immediate applications of this technology: 1)inertial sensors (a few millimeters on a side) that determine acceleration magnitude and direction, and 2) a very small laser scanner which can steer an incoming beam. Phase II will focus on construction and testing of the evaluation system, and Phase III will emphasize commercial development.

SATCON TECHNOLOGY CORP.
12 EMILY ST.
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Phone: (617) 761-0540
Topic#: 92-012 ID#: 92-121
Office: SDC
Contract #: DASG60-9-C-0203
PI: Richard L. Hockney
Title: Ultra High-Precision Tunneling Tip Force Transducer

Abstract: SatCon Technology Corporation will develop an ultra high precision force transducer based on the electron-tunneling effect. Precision force transducers have wide application in all manner of physical control systems as feedback sensors. In addition to being central to the operation of precision instruments such as gyros and accelerometers, they find wide application in active vibration control, active mounts, precision machining, and precision pointing systems. SatCon's design eliminates deficiencies of conventional transducers in these applications and will allow orders-of-magnitude improvement in performance over state-of-the-art devices. The design uses the electron-tunneling effect to make extremely sensitive position measurements which are used in conjunction with closed loop rebalance and estimation techniques to provide high accuracy force estimates. Benefits include low cost, wide bandwidth, high sensitivity, small envelope, and low power consumption. Phase I will include definition of the sensor interface electronics, and development of the processing algorithm for the signals. Detailed Phase I engineering designs will allow fabrication and testing of sensors in Phase II, in addition to implementing the signal processing algorithm with a Digital Signal Processor.

SCHMIDT INSTRUMENTS, INC.
2476 BOLSOVER, SUITE 234
HOUSTON, TX 77005
Phone: (713) 529-9040

Topic#: 92-014 ID#: 92-566
Office: ONR
Contract #: N00014-92-C-0142
PI: Mark S. Hammond, PhD

Title: Diamond Growth Using Liquid Phase Chemistry

Abstract: Diamond exhibits physical properties that make it an ideal material from which to construct electronic devices. A major obstacle to the use of diamond as a naturally insulating thermal management material is the lack of a method for growing large area thin films of diamond at low temperature on other materials, such as finished integrated circuits. All existing high deposition rate diamond film growth techniques to date are prohibitively expensive for making diamond a general electronic or packaging material. In this program, Schmidt will establish diamond crystallization from the liquid phase to deposit broad area, low temperature diamond films for electronic materials. The proposed proprietary technique will provide an extreme nonequilibrium environment on a microscopic scale for the nucleation of diamond, using liquid phase chemistry techniques. The proposed technique, involving extremely simple techniques, will likely be immediately accessible to inexpensive and uncomplicated industrial scale-up and provide fast, low temperature single crystal diamond growth.

SCHMIDT INSTRUMENTS, INC.
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Topic#: 92-014 ID#: 92-513
Office: ONR
Contract #: N00014-92-C-0116
PI: Mark S. Hammond, PhD

Title: Diamond Thin Film Growth Using Seeded Supersonic Beams

Abstract: Diamond exhibits physical properties that make it an ideal material from which to construct electronic devices for high temperature, high frequency and/or high radiation applications. A major obstacle to the mass production of diamond electronics is the lack of a method for growing large area single crystal thin films of diamond on other materials. All reliable high deposition rate diamond growth techniques to date require elevated temperatures, severely limiting the choice of substrate materials. Schmidt will explore the use of seeded supersonic beams to deposit diamond heteroepitaxially on silicon. The kinetic energy imparted to feedstock gas molecules via supersonic expansion in a lighter carrier gas can be accurately controlled and will serve to activate the feedstock during surface-molecule collisions while the substrate remains at ambient temperature. Several variations of this scheme that will vary total energy delivered to the growth surface and concentration of molecular hydrogen will also be explored.

SCHMIDT INSTRUMENTS, INC.
2476 BOLSOVER, SUITE 234
HOUSTON, TX 77005
Phone: (713) 529-9040

Topic#: 92-014 ID#: 92-514
Office: SDC
Contract #: DASG60-92-C-0135
PI: Howard K. Schmidt, PhD

Title: Nanoscale Particles and Structuring

Abstract: The physical and chemical properties of ultrasmall particles (in the range of 1 to 10 nm) differ greatly from those of bulk solids. For example, the melting point of 3 nm CdS has been reduced by almost a factor of five from bulk CdS. Bandgaps may be increased along with various activation energies. Structuring of solids in the same range has already made a splash in

electron device potential, such as the reported luminescence in porous silicon. Schmidt proposes to realize devices using small size (on the nanoscale) and structuring. Most important, the methods described will be compatible with current electronic materials fabrication technology.

SCIENCE & ENGINEERING SERVICES, INC.
4040 BLACKBURN LANE, SUITE 105
BURTONSVILLE, MD 20866
Phone: (301) 989-1896
Topic#: 92-003 ID#: 92-253
Office: SDC
Contract #: DASG60-92-C-0108
PI: Hyo Sang Lee
Title: Frequency-Agile Intermediate Power Diode-Pumped Solid State Laser
Abstract: Frequency agile, intermediate power laser is being developed for diffractive beam steering and remote laser induced emission spectroscopy from spaceborne platforms. The system is an efficient compact, tunable, solid-state laser designed by combining the advent of high power laser diode arrays, with the unique characteristics of the new laser crystal, Cr:LiSAF. The laser which has a tuning range extending from 780 to 1010 nm will be Q-switched at up to 1 kHz repetition rate and frequency doubled using a second harmonic generator crystal to generate short pulses with 1 mJ/pulse energy, and tunable in the 390-500 nm range. The laser system is a logical extension of the conventional solid-state lasers with substantial improvements of efficiency, size, weight, and repetition rate.

SCIENCE RESEARCH LABORATORY, INC.
15 WARD ST.
SOMERVILLE, MA 02143
Phone: (617) 547-1122
Topic#: 92-001 ID#: 92-506
Office: SDC
Contract #: DASG60-92-C-0107
PI: Allen Flusberg, PhD
Title: Self-Seeded Raman Shifter for Single-Band Operation of a XeF Laser
Abstract: Xenon fluoride is the best excimer laser for atmospheric propagation, since its wavelength is the least absorbed in the atmosphere. To date, all efficient xenon fluoride lasers have their energy divided between 2 bands, 351 and 353 micrometer. One can increase the laser efficiency by heating the XeF to 425 degrees Kelvin, but this spreads the energy more evenly between the two bands. The 2-nm bandwidth is too large for coherent imaging techniques that DoD is trying to apply. By Raman shifting the 351 to the 353 band. Science Research Laboratory will collapse the bandwidth and make the coherence length the long enough for the most exacting imaging techniques while maintaining the high efficiency. Phase I will identify appropriate Raman media and Phase II will demonstrate the bandwidth collapse. In Phase III, Science Research Laboratory will retrofit existing XeF lasers to apply them to lithography.

SCIENCE RESEARCH LABORATORY, INC.
15 WARD STREET
SOMERVILLE, MA 02143
Phone: (617) 547-1122
Topic#: 92-006 ID#: 92-255
Office: NASA
Contract #: NAS326710
PI: Xing Chen, PhD
Title: High Repetition Rate Electrodeless Thruster
Abstract: Potential advantages of pulsed electrodeless inductive thrusters over other types of electric thrusters include an ultra-low erosion rate, long lifetime, and capability of operating over a wide range of power levels. Performance of present inductive thrusters is hindered by the lack of reliable, efficient pulsed-power technology. Science Research Laboratory has developed novel all-solid-state pulsed drivers that have greater than 10(E)11 shot life and can operate at repetition rates of 10(3 pps and higher. The pulsed drivers can generate the pulse waveform required for rapid gas breakdown, efficient plasma acceleration, and recovery of the reflected electrical energy. This new driver technology will lead to a 100-1000 times increase in thruster total impulse, a factor of 10 reduction in specific weight, and more than 50% increase in energy efficiency. Successful development of the all-solid-state inductive thruster will result in a thruster technology that is lightweight, efficient, capable of achieving 10(E)8 - 10(E)9 N-sec total impulse, and scalable to megawatt average power levels.

SECURE COMPUTING TECHNOLOGY CORP.
1210 WEST COUNTY ROAD E, SUITE 100
ARDEN HILLS, MN 55112
Topic#: 92-010 ID#: 92-341
Office: SDC
Contract #: DASG60-92-C-0058

Phone: (612) 482-7443 PI: Richard O'Brien
Title: Methodology for Assuring Trusted Software
Abstract: The goal of this project is to develop a methodology and supporting tools for automating much of the difficult task of showing that the source code for a large software system correctly implements its critical requirements. A module level specification format and two tools, a module level flowtool and a code summary tool, will be developed. The approach supplements the software development tasks of design/code walkthroughs and testing when a higher level of assurance is required. It differs from formal methods in that it is less formal and relies on designer/analysts to help check the correspondence. In Phase I, the requirements will be developed for the specification format and tools, which will be implemented in Phase II. Once developed, the methodology and tools will provide a believable and cost-effective means for documenting the high level specification to code correspondence. They will also be useful for maintaining assurance documents and for reverse engineering large systems.

SENSOR SYSTEMS GROUP, INC. Topic#: 92-003 ID#: 92-531
150 BEAR HILL ROAD Office: SDC
WALTHAM, MA 02154 Contract #: DASG60-92-C-0097
Phone: (617) 890-0204 PI: Holger Luther, PhD
Title: Low Cost Line of Sight Position/Stabilization Control System
Abstract: Optical surveillance systems need real-time inertial line of sight (LOS) positioning and stabilization control to track the absolute position of targets within view. LOS position can be controlled in real time with an inertially stabilized pseudostar optical reference at the sensor's entrance aperture. The gyros that stabilize the pseudostar provide the LOS direction relative to inertial space when initialized against known stars. This concept decouples the sensor from its platform. The LOS position and control unit is comprised of a collimated light and three gyros on a hinged platform controlled by a servo system using two of the on-board gyros. The system must be compact, light weight, and have arc second angular resolution. Issues that will be addressed in Phase I include: gyro selection, system bandwidth, LOS slew rate, platform flexure, and servo system design.

SENSORS UNLIMITED, INC. Topic#: 92-003 ID#: 92-010
51 CHERRYBROOK DRIVE Office: ARO
PRINCETON, NJ 08540 Contract #: DAAL03-92-C-0040
Phone: (609) 466-4661 PI: Gregory Olsen, PhD
Title: Room-Temperature Near-Infrared Camera
Abstract: Sensors Unlimited will develop an infrared camera that sees in the dark, yet costs less than $10,000 and requires no cooling. Present-day cameras for the near-infrared spectrum (wavelength range 1-3 microns) require liquid nitrogen cooling which makes them bulky and expensive. Our novel camera will be based on an array of 128 X 128 detector pixels of indium gallium arsenide (InGaAs), which has high sensitivity and operates at room temperature, bonded to a hybrid silicon multiplexer "readout. A camera designed to "see" out to 1.7 microns will be demonstrated in Phase I. The Phase II effort will incorporate any advances made in multiplexer design and/or monolithic detector/amplifier "integrated circuits" that might be developed in other Sensors Unlimited R&D programs, and the latest InGaAs material for the 1-3um spectrum. Applications for the camera include remote sensing (satellite imaging), pollution monitoring, and night vision.

SENSORS UNLIMITED, INC. Topic#: 92-014 ID#: 92-009
51 CHERRYBROOK DRIVE Office: ARO
PRINCETON, NJ 08540 Contract #: DAAL03-92-C-0039
Phone: (609) 466-4661 PI: Gregory Olsen, PhD
Title: Indium Gallium Arsenide Charge-Coupled Device for 1-3 Micrometer Imaging
Abstract: Sensors Unlimited will develop a unique "CCD"-type light detector that "sees in the dark." CCDs are the "chips" used in hand held "cam-corders" and are made from silicon which is sensitive to visible light. These new indium gallium arsenide CCDs will be sensitive to infrared (1-3 micrometer wavelength) radiation and offer the same benefits (low cost, high sensitivity, room-temperature operation) to the infrared world as silicon CCDs offer to the visible world. The InGaAs CCD would find itself in a room-temperature near-infrared camera that sells for just a few thousand dollars, yet offers unmatched performance in pollution monitoring (i.e. laser radar to detect gases), satellite imaging to monitor water content of crops, and

thermal imaging of the earth.

SENSORS UNLIMITED, INC.
51 CHERRYBROOK DR.
PRINCETON, NJ 08540
Phone: (609) 952-1188
Topic#: 92-014 ID#: 92-508
Office: ONR
Contract #: N00014-92-C-0183
PI: Gregory H. Olsen, PhD
Title: Avalanche Photodiode for the 1.5-2.2 Micron Spectrum
Abstract: Sensors Unlimited will develop an "amplifier" device for near-infrared (1.5-2.1 micron) light signals. "APDs" operate by accelerating electrons (generated by incoming light signals) via a high electric field (voltage) and crashing them into the semiconductor crystal, thereby releasing additional electrons which in turn get accelerated and generate even more electrons. This "avalanche" or "multiplication" effect enables gains of ten or more to be achieved, thus reducing the need for external amplification -- which introduces unwanted electronic noise. This device will be used with LIDAR -- laser radar systems -- and windshear detection systems.

SHERMAN M. SELTZER
2786 HURRICANE ROAD
NEW MARKET, AL 35761
Phone: (205) 379-3428
Topic#: 92-012 ID#: 92-267
Office: AFAL
Contract #: F29601-92-C-0086
PI: Sherman Seltzer
Title: Low Cost Space Structure Pointing Experiment
Abstract: Previous approaches for assessing spacecraft pointing and rapid retargeting have been considered but have been quite expensive. The proposed approach would investigate whether significant elements of STP can be demonstrated by an experiment composed of a few representative critical "sparse" elements, incorporated in a small satellite to be launched from a Shuttle Hitchhiker bus. Use of sparse elements will minimize the complexity, weight, and cost of the experiment, while the Hitchhiker approach will substantially reduce launch costs. Specifically, it is proposed to assess the feasibility of being able to accurately emulate a Directed Energy Weapon spacecraft using a spatially correct satellite composed of sparse optical components. After orbital insertion, these components would be deployed out of the spacecraft to the correct relative distances. They would then represent a spacecraft-borne optical system that can be pointed and repointed to the required accuracy. Using these critical "sparse" elements from a representative full-scale DEW concept, combined with portrayals of accurate representative structural dynamics, it is proposed that the experiment can provide scalable large structure data. It would lend itself to demonstrating Pointing and Rapid Retargeting and to investigating and demonstrating structural dynamics associated with large deformable mirrors.

SIOUX MANUFACTURING CORP.
P.O. BOX 400
FORT TOTTEN, ND 58335
Phone: (701) 766-4211
Topic#: 92-013 ID#: 92-211
Office: SDC
Contract #: DASG60-92-C-0106
PI: Dana T. Grow
Title: Carbon-Carbon Composites Fabrication
Abstract: Sioux Manufacturing Corporation will develop a novel processing method for carbon-carbon composites manufacture with reduced processing time and costs. Current carbon deposition processes are unacceptably slow and expensive. The new feature of our process is the deposition of iron oxide onto the carbon filters to catalyze the deposition of carbon from methane. Laboratory tests have shown that this unique catalyst doubles the rate of deposition of carbon. Phase I will confirm that the catalytic effect will extend from short term laboratory tests to the deposition of sufficient carbon to form a complete composite material. Phase II will develop optimal process conditions. Applications include: hypersonic flight vehicles, airframe thermal protection materials, rocket nozzles and nosecones, and aircraft brakes.

SPACE EXPLORATION ASSOC.
141 WEST ZENIA AVE., PO BOX 579
CEDARVILLE, OH 45314
Phone: (513) 766-2020
Topic#: 92-004 ID#: 92-399
Office: SDC
Contract #: DASG60-92-C-0137
PI: Elliot B. Kennel

Title: Joining Carbon Composite Fins to Titanium Heat Pipes
Abstract: Everybody knows that composites have high strength, low density, and great thermal properties. They would be great for a number of applications such as fins for spacecraft radiators. So why aren't they used more on spacecraft thermal systems? One reason is joining technology. Although many methods such as brazing and adhesives have been developed for joining composites to metals, these methods are generally inadequate for high temperature operation, surviving launch vibration and thermal cycling and all the other "gotta-haves" required by spacecraft designers. Space Exploration Associates, teamed with BeamAlloy Corp., propose a radical new method for joining dissimilar materials. The idea is to bombard composite surfaces with metal ions, forming a super-adherent metal layer, which is bonded at the atomic level. Then the metals can be joined by application of pressure and temperature to make a nice, neat, nearly indestructible bond. The key is the use of special 500,000 volt accelerates to inject atoms directly into the atomic lattice of the host material. Preliminary experiments have resulted in bonds for nickel to carbon carbon, gold to molybdenum and even a combination of gold to rubber. Try that with a conventional brazing method. Applications range include radiator fins, turbine blades and even golf clubs.

SPACE EXPLORATION ASSOC.
141 WEST ZENIA AVE., PO BOX 579
CEDARVILLE, OH 45314
Phone: (513) 766-2020
Topic#: 92-006 ID#: 92-404
Office: AFWL
Contract #: F33615-92-C-2261
PI: Elliot B. Kennel
Title: Single Cell Carbide Fueled Thermionic Fuel Element
Abstract: If you can't beat them, join them. Such is the philosophy of Space Exploration Associates, who hired the top talent in Russian and the new Republic of Georgia to develop advanced thermionic converters for SDIO. Unlike other highly publicized exchanged with the Russians, this work will be done in the US and no hardware will cross international lines. The metallurgical wizards from the East have concocted new refractory metal alloys which promise extended operation at high temperatures. These can be combined with exotic nuclear fuel materials based on uranium carbide, resulting in higher power and more compactness. Space Exploration Associates does not plan on building nuclear reactors in the Ohio cornfields anytime soon; therefore, they will be working with US contractors such as Rockwell, General Atomics, Babcock & Wilcox and Space Power Inc., to ensure that they have full access to the technology. The Republic of Georgia's Arnold Kalandarashvili, generally regarded as the world top expert in cesium supplies for thermionic converters, will join the Space Exploration Associates staff in July to help out.

SPACE POWER, INC.
621 RIVER OAKS PARKWAY
SAN JOSE, CA 95134
Phone: (408) 434-9500
Topic#: 92-006 ID#: 92-735
Office: NASA
Contract #: NAS326700
PI: See-pok Wong
Title: Power Conditioning Unit for Russian Stationary Plasma Thruster
Abstract: A Russian designed Stationary Plasma Thruster (SPT) has demonstrated 1600 second specific impulse, 50% efficiency, 3500 hours and 3000 start/stop cycle of space operation. This performance has recently been confirmed by a US scientific team. The Russian has flown more than 50 of the SPT thrusters. Recently, this technology is available to the US users. Despite the advancement of the thruster design, Russian electronics are trailing behind the west, especially the American electronic technology. The Russian designed Power Conditioning Unit for the SPT is not likely to meet the US expectations and space hardware qualification. Furthermore, the Russian flight PCU weighs over 30kg, three times the US targeted weight. Space Power Inc will use the rugged MOSFET with fast intrinsic diode, high frequency switching, and proprietary low mass, high efficiency PCU design expertise to develop a PCU for the SPT that will weigh less than 10 kg and has over 90% efficiency.

SPACE POWER, INC.
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SAN JOSE, CA 95134
Phone: (408) 434-9500
Topic#: 92-014 ID#: 92-702
Office: ARO
Contract #: DAAL03-92-C-0029
PI: John Lawless
Title: cBN Insulator for TFE Trilayer
Abstract: An improved insulator material is proposed for use in space nuclear reactors. This material is for the insulator of the trilayer of a thermionic fuel element (TFE). This insulator must withstand rigorous conditions of long life at high temperature under exposure to nuclear radiation. Previous work has studied alumina, YAG, and diamond as possible RFE insulator materials.

cBN is similar to diamond in many ways: high thermal conductivity, refractory, and large bandgap for high electrical resistivity. This material can potentially enable longer life in space nuclear reactors. Like diamond, cBN has been expensive to produce in bulk. However, recent experiments have shown that cBN can be readily deposited in thin film coatings. This is accomplished through a laser ablation deposition process. Laser deposition using long wavelength lasers (Nd: YAG operating in fundamental or second harmonics) have only produced BN films of hexagonal crystal structure. But laser deposition using excimer lasers operating in the UV show good promise. Work in the excimer laser deposition of boron nitride films on SI indicated that the resulting BN films of cubic zincblende structure. Regions of films also exhibit technique in cBN film preparation. BN films will be prepared by excimer laser deposition. The films will be characterized by scanning electron microscopy, raman spectroscopy, and x-ray diffraction. The effect of laser wavelength on the CN film crystal formation will be studied.

SPARTA, INC.
23041 AVENIDA DE LA CARLOTA, SUITE 400
LAGUNA HILLS, CA 92653
Phone: (617) 863-1060
Topic#: 92-011 ID#: 92-316
Office: ONR
Contract #:
PI: Steven Lis
Title: Continuously Tunable External Cavity Diode Laser
Abstract: Sparta, Inc. will develop a low cost continuously tunable all solid state external cavity diode laser. The continuous tuning over a wide range of wavelengths is permitted by the introduction of an etalon to cancel the residual cavity modes of the laser diode. This effort will verify the proof-of-concept and establish design requirements for a fully operational unit in Phase II. Applications include: coherent detection, optical communications, and spectrally diverse optical computing. Such a device would dramatically enhance communication capacity of optical fibers. In optical computing, this device would expand the capacity of frequency selective optical mass storage technologies by several orders of magnitude.

SPECTRAL SCIENCES, INC.
99 SOUTH BEDFORD STREET, #7
BURLINGTON, MA 01803
Phone: (617) 273-4770
Topic#: 92-003 ID#: 92-729
Office: ARO
Contract #: DAAL03-92-C-0042
PI: Michael E. Gersh, PhD
Title: Cameron Ultraviolet Radiation Contrast Enhancement Sensor (CURCES)
Abstract: Ballistic missile location often relies on rocket plume infrared radiation. However, ultraviolet (UV) radiation detection offers hardware system advantages. CO Cameron UV radiation is attractive for detecting high altitude plumes -- it is intense and is present for both solid and liquid propellent. The CURCES concept uses a Fabry Perot etalon filter to discriminate against bright daytime atmospheric backgrounds, which can obscure plume signatures. By modulating the wavelengths of the etalon filter peaks, the plume radiation can be absorbed periodically, while the background radiation remains largely unaffected. The target will be therefore enhanced to background contrast as the background signal is suppressed relative to the plume signature.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 92-003 ID#: 92-242
Office: ONR
Contract #:
PI: H. Paul Maruska, PhD
Title: Laser Beam Steering with SIMOX Waveguide
Abstract: The ability to rapidly and randomly steer a laser beam is critical to the success of free-space satellite-based laser radar systems for missile defense and target tracking. By extending SIMOX waveguide technology, Spire will demonstrate multi-dimensional, all-electronic laser beam steering. Parallel arrays of electronically phase-modulated waveguide structures will be fabricated, configured to spatially dissect an incident coherent planar waveform, and used to rotate the output light beam through constructive interference effects in the field. A two-dimensional array of phase-control channels would allow scanning the beam over the entire image plane. Initial efforts will focus on fabrication and test of a two channel, vertically situated set of waveguides featuring two buried SiO2 layers. Integration of two sets of guides into a two dimensional structure will allow rapid agile steering.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 92-003 ID#: 92-451
Office: SDC
Contract #: DASG60-92-C-0122
PI: Stanley Vernon

Title: High-Sensitivity, Low-Noise Visible Imaging of YAG-Laser-Illuminated Scenes

Abstract: Somebody's taking a bead on your satellite and you're blissfully unaware? Not if Spire can help it! This little group of entrepreneurs proposes a new infrared-detector sensitive to the 1.06 micron YAG-laser light used by just about everyone for target designation and ranging. Sure, GaAs photocathodes work fine for detection and imaging,but they're blind to YAG light. The answer is to use an InGaAs negative-electron-affinity transmission-mode structure lattice-matched to InP. Spire claims this combination will yield good quantum efficiency in the 0.9 to 1.6 micron range, won't require active cooling, and can be used in imaging devices. Varo Inc, a leading supplier of night-vision systems, thinks Spire is on to something; they're pitching in to test and commercialize the concept.

SPIRE CORP.
ONE PATRIOTS PARK
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Phone: (617) 275-6000

Topic#: 92-003 ID#: 92-503
Office: AFTL
Contract #: F08630-92-C-0043
PI: Robert G. Wolfson, PhD

Title: Two-color, Bias Selectable, HgCdTe IR Detector by MOCVD

Abstract: Seeing in the dark or looking through haze is easy if you know how; Spire Corporation has invented infrared "eyes" which peer through two atmospheric windows simultaneously, spotting both hot (vehicles) and warm (people) targets at the same time. It takes two separate detectors to do this now but, using metalorganic chemical vapor deposition, the company will develop single packages to do the job. Because they will be simpler, cheaper, and smaller than conventional focal plane arrays, Spire thinks its dual-band mosaics will make night time snooping practical for everyone!

SPIRE CORP.
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Phone: (617) 275-6000

Topic#: 92-004 ID#: 92-240
Office: SDC
Contract #: DASG6O-92-C-0109
PI: Edward Burke

Title: Radioisotope-Powered Voltaic Cells

Abstract: Spire's program will develop a high energy density, long life power source for space applications such as Brilliant Pebbles and Brilliant Eyes. The essential element of the proposed device consists of a radioisotope powered indium phosphide voltaic cell that can achieve an energy density over ten thousand times greater than that of chemical batteries. In past attempts to develop radioisotope powered voltaic cells, the power attained was severely limited by radiation damage to the silicon semiconductor material used in the cells. This limitation has been removed by the recently discovered radiation damage resistance and annealing properties of indium phosphide. High energy beta and alpha emitters can now achieve high power and long life, and the use of alpha emitters can eliminate external radiation. Spire's voltaic cells represent a power source for remote or inaccessible locations such as space, ocean depths, arctic or mountainous regions, as well as for implantable power sources for cardiac pacemakers, insulin pumps, and ventricular assist devices.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 92-005 ID#: 92-164
Office: DNA
Contract #: DNA001-92-C-0059
PI: Anton C. Greenwald, PhD

Title: High Energy Density Capacitors

Abstract: A capacitor storing a thousand times more energy than is possible today is the carrot offered by this Spire Corporation proposal. To get there, Spire will exploit its ability to grow exotic thin-film dielectric layers by metalorganic chemical vapor deposition (MOCVD). Everything has to go just right, but if it does, large-area one-micron thick films with kilovolt holdoff will result; that's tens of millions of volts per centimeter! Spire claims MOCVD is eminently practical because, at 2 microns per minute, it will grow metallized, multilayer structures economically whereas other thin-film processes won't. Big weight savings on spaceborne platforms are foreseen. Since the energy stored in Spire-built ultra-capacitors will approach that of

electrochemical systems, Spire's capacitors may even supplant batteries as high-power, short-term energy sources in aerospace and all-electric vehicles.

SPIRE CORP.
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Topic#: 92-007 ID#: 92-297
Office: AFWL
Contract #: F33615-92-C-2252
PI: Charles C. Blatchley, PhD

Title: Improved Heat Removal by Microscopic Surface Texturing of Capillaries

Abstract: Future space power and propulsion systems will be hot, hotter than materials can stand. They'll need active cooling for the toughest spots, either heat pipes (with recoverable coolant) or fuel channels. In general, heat transfer in these devices improves as capillary sizes shrink, but they cannot be arbitrary reduced without eventually causing blockages and catastrophic hot spots. Instead, Spire proposes to keep the larger passages but micro-texture inner surfaces by ion beams to increase surface area, similar to using internal vanes. For really hot applications, this will also increase thermal emissivity, something ordinary capillaries cannot do. Feature sizes much smaller than optical wavelengths make micro-textured metals broadband light absorbers, nearly perfect blackbodies that radiate more effectively than plain metal surfaces. The extra radiational heat transfer could really make a difference. Texture blackening will improve active cooling or nucleate boiling in hypersonic aircraft, fast computers, high power x-ray sources, adiabatic or Stirling engines, and other advanced systems.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 92-011 ID#: 92-301
Office: ONR
Contract #: N00014-92-C-0150
PI: H. Paul Maruska

Title: Multi-Quantum Well Lateral-Field-Effect Electro-Refraction

Abstract: Band gap resonant optical non-linearities in III-V compound semiconductor materials provide the basis for novel components, allowing advances in optical signal processing. Of particular interest are temporal and spatial light modulators, which find applications in optical interconnects, optical computing, and logic circuits. Spire will characterize an advanced GaAs multi-quantum well structure which will exhibit the Lateral-Electric-Field-Induced-Refraction (LEFIR) effect. The lightwave propagates transverse to the stack of grown layers, while the electric field, applied laterally due to the removal of a two-dimensional electron gas supplied by planar doping, induces changes in the refractive index of the active region containing the quantum wells. The transmissive modes are shifted in wavelength when the effective refractive index of the active region is altered by the applied field, modulating intensity. Without mirrors, the device can shift the phase of incident light. EFIR modulators can be extended into two-dimensional arrays with applications as spatial light modulators.

SPIRE CORP.
ONE PATRIOTS PARK
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Phone: (617) 275-6000

Topic#: 92-011 ID#: 92-302
Office: SDC
Contract #: DASG60-92-C-0078
PI: Stanley Vernon

Title: GaAs-Ge Alloys for Optical Processing at 1.3-1.5 microns

Abstract: Fast electronics talking to optical circuits built right on the same chip are everybody's goal; problem is, it's not so easy to get there with infrared optics. Spire proposes a clever way around this, doubly clever because it's based on well known materials and methods combined in new ways. Starting with GaAs, an excellent choice for high-speed electronics but an infrared dead-head, by mixing in a little Ge, Spire will create a new alloy which is optically alive and fits perfectly on GaAs substrates. Infrared emitters and detectors can be built in the alloy, fast electronics in the GaAs. If this works, Spire argues, it's lower cost and higher reliability will knock existing infrared technologies right out of the market for fiber optic communications.

SPIRE CORP.
ONE PATRIOTS PARK
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Phone: (617) 275-6000

Topic#: 92-014 ID#: 92-157
Office: AFOSR
Contract #:
PI: Anton C. Greenwald, PhD

Title: Ion Doped Quantum Well Lasers
Abstract: Diode lasers are great, but not temperature stable. Keeping the frequency constant, essential for communications, requires exotic (read expensive) heavy cooling systems. Investigators at Spire think they have a better way: build a laser diode whose frequency is naturally stable, as in ionic lasers such as neodymium doped YAG. Spire reasons that adding erbium to the quantum well of conventional AlGaAs lasers will stabilize the output at 1548nm, up from the common 800 to 900nm range and well matched to fibers. Spire knows how to make quantum well lasers and offers them as a finished product. Addition of erbium doping is another matter. It requires discovering a source gas compatible with existing metalorganic chemical vapor deposition and learning how to use it. That's what this research program proposes to do.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 92-014 ID#: 92-217
Office: ONR
Contract #: N00014-92-C-0113
PI: Stanley M. Vernon
Title: GaAs-Ge Alloys for High-Speed Transistors
Abstract: If you need high-speed, high-power transistor today, you'll probably opt for an HBT (heterojunction bipolar transistor). And you'll have to put up with its limitations, some of which are due to dopants moving from their proper place in the structure. But Spire thinks it can improve the growth process by building HBTs which use an inherently p+ GaAs-Ge alloy, getting around the problem of dopants creeping out of the base region during materials deposition. What's more, by replacing hard-to-make aluminum-containing compounds with GaAs-Ge, Spire can make HBTs better and cheaper. Best of all, by choosing the right alloy, HBTs can be grown directly on GaAs wafers, then integrated with other electronic and optoelectronic devices. The payoff, say Spire's commercialization-minded engineers, will come when their HBTs show up in the micro- and millimeter wave amplifiers powering radar and mobile communication systems.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 92-014 ID#: 92-237
Office: AFOSR
Contract #:
PI: Stanley Vernon
Title: Growth of Boron Phosphide for High Temperature Electronic Devices
Abstract: Invent a material good for transistors running at 2000 degrees Fahrenheit and the world will beat a path to your door. That's what the Spire Corporation hopes will happen; Spire proposes to take advantage of boron phosphide's potential as a high-temperature, wide-bandgap electronic material. Thin-film boron phosphide isn't easy to grow; the Japanese have been trying for years. Spire thinks the answer is low-pressure chemical vapor deposition. Low pressure will keep gas molecules far enough apart to stop "snow" from forming but will still permit rapid crystal growth, important because 300 micron thick free-standing wafers are the program's goal. Always looking to the marketplace, Spire sees itself as becoming the first on-shore supplier of crystalline boron phosphide.

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2201 WEST CAMPBELL PARK DRIVE
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Phone: (312) 421-1819
Topic#: 92-006 ID#: 92-541
Office: ONR
Contract #: N00014-92-C-0113
PI: Robert Moriarty
Title: Azacubanes for High Energy Propulsion
Abstract: Cubanes are high energy materials which can be used as propellants. The high energy propellant azacubane could be used either as a pure material or as a fuel additive. Azacubane is a nitrogen derivative of cubane and has more favorable properties. The basic reason for the high energy content of cubane is the distortion of carbon-carbon bonds which comprise its structure. Azacubane incorporates this element of strain energy but because of the presence of one or more nitrogen atoms, this new material has totally different chemical and physical properties. Chemical synthesis will be used to make azacubanes in quantities sufficient for preliminary evaluation. Also synthetic routes will be investigated for the purpose of scaling up the synthesis with a view towards future manufacture. The end goal is to develop an economical synthesis for these powerful and exciting materials.

STRUCTURED MATERIALS INDUSTRIES, INC.
240 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102
Phone: (201) 471-3589

Topic#: 92-014 ID#: 92-213
Office: SDC
Contract #: DASG60-92-C-0084
PI: S.I. Kim

Title: Light Emitting Thin Films Containing Germanium Quantum Nanocrystals

Abstract: The recent observation of light emission from porous silicon and from germanium nanocrystals in a silicon dioxide matrix has given a great boost to the field of quantum confined structures. It has been suggested that the formation of quantum wires in porous silicon is responsible for the observed emission. The confinement effects in quantum nanocrystals are even more pronounced. In preliminary measurements, SMI has noticed photoluminescence emission (600-900 nm) from silicon Si/SiO2. Ge as smaller effective hole and electron masses and a larger dielectric constant than Si, and as such should exhibit a greater blue shift for a given nanocrystal size. These films may be ideal for the observation and development of confinement effects in germanium quantum nanocrystals. The germanium particles are surrounded by wide bandgap silicon dioxide, which forms an ideal potential barrier. SMI will develop a deposition and processing technology to form, control, and study germanium nanocrystals for luminescence. Later work will investigate electroluminescence by AC excitation.

SUPERCONDUCTOR TECHNOLOGIES, INC.
460 WARD DRIVE, SUITE F
SANTA BARBARA, CA 93111
Phone: (805) 683-7646

Topic#: 92-015 ID#: 92-275
Office: NRL
Contract #:.N0014-92-C-2155
PI: Michael Eddy

Title: T(1)BaCaCuO Thin Films on MgO Substrates for High Frequency Microwave

Abstract: The preparation of epitaxial T1BaCaCuO films has been demonstrated on only a small number of substrates (LaA1O3 and SrTiO3). At present, LaA1O3 is the only substrate that produces films suitable for microwave applications. However, there are limitations to its use, particularly at high frequency. The two most apparent problems are the high dielectric constant (24.5) and twinning. A near term alternative which can address these problems is MgO. The program proposed is to develop TBCCO films of MgO, which represents the only large area, low dielectric constant, twin-free substrate available at this time. TBCCO films have the highest operating temperature of any films currently available (>100K). If successful, this technology would replace some of the TBCCO material currently grown on LaA1O3 for microwave components at high frequencies and where frequency setability is a key issue.

SUPERCONDUCTOR TECHNOLOGIES, INC.
460 WARD DR., SUITE F
SANTA BARBARA, CA 93111
Phone: (805) 683-7646

Topic#: 92-015 ID#: 92-372
Office: AFRL
Contract #:
PI: Roger J. Forse

Title: Active HTS Switch for Microwave Circuits

Abstract: Superconductor Technologies Inc. has grown a fully oriented A-axis film and plans to characterize the film and build several candidate switch topologies for it. An A-axis film has the characteristics of directional anisotropy where the critical current parallel to the crystal planes is higher than that perpendicular to it. An attempt will be made to build a switch where its non-linear critical current characteristics will be used to modulate current in a plane orthogonal to the primary direction. This has the promise of modulating a large current with a smaller one, i.e., gain. This phenomenon will also be measured to see if it is useful as an RF switch, where a small DC current orthogonal to the preferred direction can modulate the RF current.

TACAN CORP.
2330 FARADAY AVENUE
CARLSBAD, CA 92008
Phone: (619) 438-1010

Topic#: 92-003 ID#: 92-393
Office: SDC
Contract #: DASG60-92-C-0117
PI: Michael M. Salour

Title: Wideband Electromagnetic Pulse to Optical Pulse Train Convertor

Abstract: Ultrawideband radar with short duration pulses (10 ps-10 ns) is a candidate for new sensor systems. This approach may provide improved capabilities for target detection and identification through examination of target resonance characteristics. Detection and processing of short duration, ultrawideband pulses that have random time intervals between pulses require new approaches to receiver design. Analog-to-digital conversion of ultrawideband signals for processing of resonance features is a

major challenge for the development of this technology. TACAN Corporation proposes a new approach that converts single electromagnetic pulses into optical pulse trains that preserve the signal waveform for analog-to-digital conversion and facilitates signal processing. This approach uses a fiber-optic-coupled antenna and other fiber-optic components to build a circulating delay line and repeater, and allows analog-to-conversion for accurately recording the short duration return waveform. Applications include military sensors, remote inspection of structures, environmental sensing, and geophysical surveying.

TAKOM COMPANY
805 W. DUARTE ROAD, SUITE 102
ARCADIA, CA 91007
Phone: (818) 574-8782
Topic#: 92-008 ID#: 92-694
Office: SDC
Contract #: DASG60-92-C-0153
PI: Albert Stiegman, PhD
Title: Surface Modification of Materials to Achieve Ultralow Reflectivity
Abstract: Strategic space borne assets may be targeted by laser designators operating in the visible or infrared region of the spectrum. Critical components, especially those containing highly reflective optical surfaces, may become obvious targets by reflecting light from laser designators or from sunlight. Applying appropriate coatings to the optical surfaces suppresses reflectivity by light scattering and absorption, but these applied coatings tend to interfere with the optical properties of the component. Takom will develop a technique using ion beam surface modification to produce ultralow reflectivity optical components without affecting essential optical properties of the parent material. With proper choice of exposure parameters, this process will generate a surface topology such that the material on the scale of the wavelength of light appears to have a smoothly changing mass density. Therefore, a smoothly graded refractive index through a surface layer will result in a significant reduction in reflectivity.

TECHNO-SCIENCES, INC.
7833 WALKER DR., SUITE 620
GREENBELT, MD 20770
Phone: (301) 345-0375
Topic#: 92-010 ID#: 92-486
Office: ARO
Contract #: DAALO3-92-C-0025
PI: Charles Fletcher
Title: Realtime Control of Multiple Sensor Systems
Abstract: Project will develop methods for the optimal management of sensor systems. As a specific application, we consider the nonlinear filtering of a vector diffusion process, with several noisy vector observations. Any number of sensors can be utilized in the signal processing performanced by the nonlinear filter. The problem considered is the optimal selection of a schedule of these sensors from the available set, so as to optimally estimate a function of the state at the final time. We will design algorithms for the solution to produce optimal sensor schedules. In Phase I we shall consider a limited number of sensors designed to intercept radar signals. Benefits will include realtime, feedback control procedures for sensor management, and data fusion. Algorithms for management of complex systems of sensors will find commercial application in large scale industrial processes, especially for quality control and fault detection.

TECHNO-SCIENCES, INC.
7833 WALKER DR., SUITE 620
GREENBELT, MD 20770
Phone: (301) 345-0375
Topic#: 92-012 ID#: 92-485
Office: AFAL
Contract #: F29601-92-C-0089
PI: William H. Bennett
Title: Ground Based Evaluation of Control Structure Interaction for Space Structures with Adaptive Controllers
Abstract: Control Structure Interaction in space structures can involve parasitic dynamics which can limit system performance and reliability for autonomous, long duration missions. Next generation spacecraft will rely on multiple actuators and sensors interacting with advanced lightweight structures to affect autonomous and highly agile response to maneuver commands for tracking, pointing, and articulation of payload system apertures. Ground based testing will play an important role in the development of such systems. Techno-Sciences will test and evaluate incipient nonlinear Control Structure Interaction dynamics. Test procedure protocol will be based on modern analysis of nonlinear dynamics focused on the observation that mode-locking, an inherently nonlinear dynamic phenomenon, is readily detectable in ground based testing and is useful in prediction and analysis of system failure modes resulting from incipient nonlinear CSI.

TETRA CORP.
3701 HAWKINS ST., NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-8623
Topic#: 92-005 ID#: 92-150
Office: ONR
Contract #: N00014-92-C-0244
PI: William M. Moeny, PhD
Title: High Voltage Liquid Dielectric Repetitive Opening Switch
Abstract: This program is to develop repetitive opening switches capable of switching average currents of kiloamps at voltages of hundreds of kV to MV's using a new class of liquid dielectrics. This family of liquids has very high drift velocity and low conduction losses for electrons within a particular energy band. The liquid is not subjected to ionization, it simply acts as a conductor of electricity or as an insulator. It has a much higher dielectric strength than gases or semiconductors of similar size. This technology is not related to a liquid spark gap because the liquid is not broken down during conduction. The repetition rate potential of the switch appears to be very good with 10's of kHz perhaps being achievable. This switch will have primary commercial applications to current interruption devices for commercial electric power utilities, for controlling repetitive medical accelerators, and for controlling x-ray lithography units. Defense applications include high voltage control for large electron beam guns for lasers and control of injectors for repetitive particle beam accelerators.

THERMACORE, INC.
780 EDEN ROAD
LANCASTER, PA 17601
Phone: (717) 569-6551
Topic#: 92-007 ID#: 92-706
Office: AFWL
Contract #: F33615-92-C-2263
PI: Kevin Horner-Richardson
Title: Heat Pipe Emitters for Thermionic Fuel Elements
Abstract: Isothermalizing a Thermionic Fuel Element (TFE) may increase efficiency from 8.78% to 10.8%. Phase I will design an isothermal heat pipe for the thin emitter wall of a long TFE. Recently demonstrated two-phase flow in sintered power metal wick structures will be used to achieve isothermal conditions in heat pipes. Hardware will be tested to demonstrate the principle. A successful design will also permit out-of-core thermionic reactors whereby a heat pipe delivers heat from the core to the thermionic unit, circumventing current problems of fuel swelling, neutron damage and life expectancy and allowing simplification of future designs.

TIGTEK, INC.
26609 MENOMINEE PLACE
RANCHO PALOS VERD, CA 90274
Phone: (213) 373-5265
Topic#: 92-001 ID#: 92-379
Office: SDC
Contract #: DASG60-92-C-0075
PI: John H. Chang, PhD
Title: Solar-Pumped Liquid Lasers
Abstract: Phase I will examine rare-earth salts dissolved in suitable liquids to generate high power laser beams in space. Such lasers would be immune to the catastrophic thermal fracture problems which limit the power capability of solid-state lasers. Also techniques to directly solar-pump these lasers will be studied. Phase I work will include: 1) selection of rare-earth or other trivalent metal ions and suitable solvents for laser operation; 2) study of laser process when pumped by solar radiation in space to estimate the overall laser efficiency and power capability; 3) conceptual design of a space-deployed solar concentrator for laser pumping; and 4) conceptual design of the laser system, including liquid flow and cooling system, size, weight and power requirements. A test plan will validate a prototype demonstration in Phase II using simulated solar pumping.

TORANAGA TECHNOLOGIES, INC.
2236 RUTHERFORD ROAD, SUITE 123
CARLSBAD, CA 92008
Phone: (619) 931-7096
Topic#: 92-014 ID#: 92-195
Office: AFWL
Contract #: F33615-92-C-2266
PI: Kevin Christiam
Title: High Strength Soldering Compounds Produced from Gas Atomized Powered Metal Alloys
Abstract: Sn-Pb solder alloys used now to solder electronics fail from fatigue cracking. Attempts involving new binary and ternary alloys have increased strengths less than 10% over current solders. No substitute exists with higher mechanical strength yet melting below 210 degrees Celsius, compatible with electronics. Company proposes using novel gas atomized powders to join electronic componentry. Powders will be fabricated which effectively "melt" and fuse well below their known melt temperature. Through low temperature fusion of high temperature alloy powders, gains in solder joint strength exceeding 400%

are anticipated. The objective is creation of a new solder substitute which exhibits superior strength though processed below 210 degrees Celsius to replace solder in electronic joints. The proposal also anticipates a lead free solder replacement and eliminating solders of different melting temperatures in step soldering.

TPL, INC.
3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668

Topic#: 92-005 ID#: 92-386
Office: SDC
Contract #: DASG60-92-C-0114
PI: Richard Brotzman, PhD

Title: High Energy Density Storage Polymers for Capacitive Stores

Abstract: The development of capacitor stores are dependent upon advances in low loss, high energy/high power density storage materials. A unique polymer material is proposed as a high energy density storage material. The molecular structure of the polymer will be engineered to achieve a high, nonlinear dielectric constant and a high, nonlinear dielectric strength. Predicted properties are a dielectric constant greater than 30 and a voltage breakdown strength greater than 3 MV/cm, resulting in an energy storage density greater than 10 MJ/m3. The dielectric molecular engineering concepts that will be employed have been demonstrated on a first generation material that has a dielectric constant of 16 and a dielectric breakdown strength of 1.24 MV/cm. The dielectric material will be processable with no residual stresses, will wet other capacitor components and can be fabricated into unique morphologies. The polymer will be synthesized, fabricated into films and characterized. Designs for advanced capacitors will be presented.

TPL, INC.
3574 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668

Topic#: 92-012 ID#: 92-387
Office: AFAL
Contract #: F29601-92-C-0095
PI: Timothy Tiernan

Title: Miniature, Ultrasensitive, Solid State Sensor for Atomic Oxygen

Abstract: An extremely sensitive, low power, high durability solid state atomic oxygen sensor system with the potential for cost effective fabrication is proposed. It should lead to 1) improved understanding of the levels of atomic oxygen encountered during space missions; 2) quantification of the effects of atomic oxygen on a variety of materials in the space environment; 3) a warning mechanism for potential damage to structural components signaling the need for preventative maintenance and 4) possible weight savings as a result of a lessened need for intentional overdesign. The technology developed should result in the basis for a family of miniature, solid state chemical sensors with ppb sensitivities.

TPL, INC.
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ALBUQUERQUE, NM 87109
Phone: (505) 345-5668

Topic#: 92-013 ID#: 92-385
Office: SDC
Contract #: DASG60-92-C-0112
PI: Richard W. Brotzman, PhD

Title: Surface Treatment for Graphite Fiber Composites

Abstract: High performance graphite/resin composites have not realized their potential because they have poor interface-dependent mechanical properties that degrade by as much as 65% under hot-wet conditions. An RF-plasma/wet-chemistry fiber surface treatment is proposed to establish covalent bonding between the graphite fiber/resin matrix interface. The plasma process will establish reactive moieties on the relatively inert crystallite basal plane of the graphite fiber. The wet-chemical treatment will covalently bond the resin matrix to the reactive plasma-generated moieties thus forming the interfacial covalent bond. The covalently bonded interfaces will improve interface-dependent mechanical properties by at least 50% and prevent degradation of these properties under hot-wet conditions. Prior work that established interfacial covalent bonds in OCF S-2 glass/polysulfone composites demonstrated that interface-dependent mechanical properties degraded by less than 8% during 106 degree C-9 RH aging conditions. Basal plane reactivity treatments will be conducted in a spectrometer-controlled plasma research reactor facility. Titration, IGC, surface energetics and ESCA techniques will characterize the graphite surface. Processes will be developed for wet-chemical bonding. Peel tests of two-ply laminates subjected to hot-wet aging will provide proof of increased interfacial adhesion.

TRISTAN TECHNOLOGIES, INC.
11408 SORRENTO VALLEY ROAD, #204
SAN DIEGO, CA 92121
Phone: (619) 587-6032

Topic#: 92-015 ID#: 92-711
Office: AFOSR
Contract #:
PI: Duane Crum, PhD

Title: Microwave Frequency Sources and Filters Based on Superconducting Photonic Band Gap Structures

Abstract: Tristan will study a new class of very high Q superconducting structures based on a Photonic Band Gap (PBG) resonator. These structures are physically very different from superconducting cavities or pattered stripline structures, and have unique properties which may overcome many present limitations instate-of-the-art microwave devices. In conjunction with suitable amplifiers, PBG resonators have a variety of microwave applications, including exceptionally high speed AFC loops, ultra-stable oscillators with low phase noise close to the carrier, and precise frequency standards. Such devices are desirable for improving performance in many applications including radar and state-of the-art communication systems. In order to achieve the full potential of these devices, we will extend this work to cryogenic systems incorporating superconducting cavities. In Phase I, a cryogenic system which can incorporate both high and low Tc devices will be built. We expect to achieve Q > 10E5 at 77K using presently available high Tc thin films and Q > 10E8 using low Tc materials. Recent work with room temperature PBG resonators at X band can create a true mono-frequency, narrow band oscillator. Numerical simulations to cover K and V bands and by analyzing possible modulation techniques will be performed.

TRS CERAMICS, INC.
2820 EAST COLLEGE AVE., SUITE J
STATE COLLEGE, PA 16801
Phone: (814) 238-7485

Topic#: 92-012 ID#: 92-042
Office: AFAL
Contract #: F29601-92-C-0090
PI: Joseph Fielding, Jr.

Title: Piezoelectric Sensors and Low Voltage Actuators for Active Control in Space Structures

Abstract: Piezoelectric ceramic sensors and multilayer actuators with enhanced performance are required for applications in health monitoring and active vibration control in space structures. The technology of producing highly reactive submicron perovskite (ABO3) materials known as "reactive calcination" is proposed. Enhanced performance due to processing at temperature < 200 degrees Celsius below that of conventional methods, results in fine-grain microstructures (less than or greater than 1 micrometer) with minimal microstructural property dependency. The ability to fabricate ultra-fine grain piezoelectric materials is essential in the fabrication of miniature sensors, e.g. shear or lateral and especially for low voltage multilayer actuators capable of operational voltages less than or greater than 25 volts. In addition, the inherently low processing temperatures offers the potential of low cost 70Ag:30Pd internal electrodes in contrast to platinum. Fabrication and evaluation of Navy Types I and II PZT-based piezoelectric sensors and low power actuators will provide further evidence of the level of performance achievable through enhanced processing.

TRS CERAMICS, INC.
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STATE COLLEGE, PA 16801
Phone: (814) 238-7485

Topic#: 92-014 ID#: 92-228
Office: ONR
Contract #: N00014-92-C-0141
PI: Joseph Fielding, Jr.

Title: Substrate Applications in Electronic Packaging

Abstract: Substrate materials for high performance packaging in microelectronics require thermal expansion matching to Si and GaAs chips, low dielectric constants, and processing temperatures compatible with thick film technology. Other requirements may include integrated packages incorporating a level of intelligence or multi-functionality ("smart" materials); or high temperature packaging incorporating wide bandgap semiconductors including SiC and diamond. TRS will research ceramic substrate materials in the NaZr2P3O12 (NZP) -based family of materials. This compositionally diverse family offers the ability of thermal expansion tailoring from positive through negative values. Based on the selection of low polarization cations and NZP's open structure and high molar volume, ultra-low dielectric constants may result. Further tailoring of key packaging parameters will be demonstrated through the use of glass-ceramic composite concepts. Ultimately, specific tailoring will allow novel integrated packaging.

UES, INC.
4401 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-6900
Topic#: 92-013 ID#: 92-695
Office: AFWL
Contract #: F33615-92-C-5005
PI: Rabi Bhattacharya, PhD

Title: Ion Beam Processed Fullerene Coatings for Tribological Applications

Abstract: The discovery of a totally new form of carbon, CE60, known as fullerene, has sparked tremendous interest for various applications including that as a solid lubricant. Within the soccer ball shaped fullerene molecule, the bonding between carbon atoms are very strong, and the molecule has considerable structural stability. The intermolecular bonding is weak and is due to van der Waals attraction. Based on this background information, it is easy to imagine that these loosely bonded balls can roll and slip when placed between two sliding surfaces thus providing solid lubrication. UES Inc, proposed to develop thin coatings of these materials using physical vapor deposition and bond the coating with a surface using very high energy (~MeV) ion beams. The evaluation of physical and tribological properties of these coatings will determine their future applications as a solid lubricant.

ULTRAMET
12173 MONTAGUE STREET
PACOIMA, CA 91331
Phone: (818) 899-0236
Topic#: 92-004 ID#: 92-446
Office: AFSTC
Contract #: F29601-92-C-0096
PI: Robert Tuffias, PhD

Title: Enabling Materials Technology for Nuclear Propulsion

Abstract: Few materials exist that possess useful properties in hydrogen at 2750K and are compatible with the environment of a nuclear reactor. Bulk fabrication and processing of those that do exist, the ceramics niobium carbide (NbC) and zirconium carbide (ZrC), have not yet reached the maturity required for application to nuclear reactors. The versatility of chemical vapor deposition (CVD), however, permits these materials to be fabricated in a unique geometric configuration to produce tailorable thermal and mechanical properties. Ultramet will fabricate structural and insulating materials that overcome the limitations of state-of-the-art materials currently baselined for nuclear propulsion devices. To maximize the possibility of success, Ultramet has teamed with Babcock & Wilcox, the leader in particle bed reactor (PBR) technology.

WARE TECHNICAL SERVICES, INC.
42 LORRAINE ROAD
WESTWOOD, MA 02090
Phone: (617) 320-0291
Topic#: 92-014 ID#: 92-035
Office: ARO
Contract #: DAAL03-92-C-0034
PI: Rowland Ware

Title: LEC Growth of Bulk In(1-x)Ga(x)As

Abstract: This program will develop a method of growing bulk ternary compound semiconductors of uniform composition. The target material of In(1-x)Ga(x)As was chosen because of its immediate use in the growth and fabrication of very high speed HEMT devices. The method should be applicable to other ternary compounds, giving a new field of "substrate engineering" to complement the "bandgap engineering" at present applied by epitaxy. The availability of substrates lattice matched to active layers will reduce strain and improve performance in devices such as II-VI lasers, solar cells, and HBTs.

XEMET, INC.
15257 N.E. 90TH STREET
REDMON, WA 98052
Phone: (206) 881-2797
Topic#: 92-001 ID#: 92-013
Office: SDC
Contract #: DASG60-92-C-0118
PI: Richard Minch

Title: Smart Mirror Technology

Abstract: The output mirror is the most important optical component in determining laser beam quality. The mirror of an industrial laser is therefore the critical component of a high value system in a large market. XEMET's technology creates mirrors that not only resist thermal distortion by removing several KW/sq-cm., but also detects distortion and acts to off-set it in real time, holding the mirror shape invariant under very high pulsed loading. In addition to reducing the errors of the optical train the mirrors will be very resistant to catastrophic damage. The technology is completely passive and does not require support equipment and does not introduce jitter as do other approaches.

XEMET, INC.
15257 N.E. 90TH STREET
REDMOND, WA 98052
Phone: (206) 881-2797
Topic#: 92-007 ID#: 92-023
Office: SDC
Contract #: DASG60-92-C-0081
PI: Richard Minch
Title: High-Power Laser Diode Arrays
Abstract: Removing heat critically limits the application of high power laser diode stacked arrays to many high-value-added commercial markets where they would have commanding competitive advantages, including solid state and gas laser pumping; communications; laser welding; heat treating; alloying; high speed printing and various medical uses XEMET's technology will remove on the order of 5 KW per square centimeter, with a temperature drop of 1 to 2 degrees C. per KW. XEMET's approach avoids the plumbing, pumping, sealing, clogging and the erosion problems of microchannel cooling. It removes 10 to 100 times the heat flux of diamond and avoids the CTE problems of diamond. Additional benefits are higher laser duty cycles, better reliability, longer life and improved optical performance.

XEMET, INC.
15257 N.E. 90TH ST.
REDMOND, WA 98052
Phone: (206) 881-2797
Topic#: 92-007 ID#: 92-100
Office: SDC
Contract #: DASG60-92-C-0081
PI: Richard B. Minch
Title: Very High Thermal Conductivity Micro-Filaments
Abstract: Electronic cooling, micro-chip cooling and advanced materials all suffer from thermal limitations. XEMET micro-filaments used individually or embedded into matrix materials will create new families of products focused on these high-value-added markets. For electronic applications a single XEMET micro-filament 50 microns in diameter is capable of carrying 10 to 20 watts. Embedded into a matrix, they will remove 4 TO 10 times the heat loads limiting wafer scale applications. Formed into MMC's for high temperature advanced materials applications, they will carry in excess of 100 watts each, allowing structural materials to operate in environments which exceed their melting point.

XSIRIUS SUPERCONDUCTIVITY, INC.
1110 NORTH GLEBE RD., SUITE 620
ARLINGTON, VA 22201
Phone: (703) 522-8601
Topic#: 92-015 ID#: 92-109
Office: SDC
Contract #: DASG60-92-C-0090
PI: S.C. Han
Title: Scanning Submillimeter Laser Reflectometer for Precision Surface Resistance Measurements
Abstract: Superconductors, materials that carry electrical current without any resistance, can make electronic circuits more efficient and communications between remote locations easier. In the past two years, the materials developments of superconductors have progressed so much that the quality of the materials can no longer be measured even with the most sophisticated techniques. Xsirius Superconductivity, Inc is developing a new measurement technique using lasers to scan the surface of the superconductors to measure the quality. This new measurement technique improves detection sensitivity by 100 times. This technique will be useful for developing superconducting materials for use in computer chips, communication systems, and particle accelerators.

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SDIO Topic#: 92-001
- CHRONOS RESEARCH LABORATORIES, INC.
- CIENCIA, INC.
- CNS TECHNOLOGY, INC.
- GENERAL SCIENCES, INC.
- MDS COMPANY
- MULTILAYER OPTICS AND X-RAY TECH.
- PHYSICAL OPTICS CORP.
- PHYSITRON, INC.
- SANDIA SYSTEMS, INC.
- SCIENCE RESEARCH LABORATORY, INC.
- TIGTEK, INC.
- XEMET, INC.

SDIO Topic#: 92-002
- ADVANCED PROJECTS RESEARCH, INC.
- APA OPTICS, INC.
- COLEMAN RESEARCH CORP.
- COLEMAN RESEARCH CORP.
- DYNACS ENGINEERING COMPANY, INC.
- LASKER TECHNOLOGY COMPANY
- M.S. SAPUPPO & ASSOC.
- NIELSEN ENGINEERING & RESEARCH, INC.
- PROPULSION RESEARCH, INC.

SDIO Topic#: 92-003
- ADVANCED FUEL RESEARCH, INC.
- ADVANCED FUEL RESEARCH, INC.
- ADVANCED SCIENTIFIC CONCEPTS, INC.
- ADVANCED SCIENTIFIC CONCEPTS, INC.
- ADVANCED TECHNOLOGY MATERIALS, INC.
- ANRO ENGINEERING, INC.
- ASTROPOWER, INC.
- BLACK FOREST ENGINEERING, INC.
- BRIMROSE CORP. OF AMERICA
- CONCEPTUAL SOFTWARE SYSTEMS, INC.
- CRYSTALLUME
- CYGNUS IMAGING CORP.
- DATA FUSION CORP.
- ELECTRO-OPTEK CORP.
- ELECTROMAGNETIC APPLICATIONS, INC.
- ENERGY SCIENCE LABORATORIES, INC.
- FEDERAL ELECTRO-OPTICS
- IMAGING SCIENCE TECHNOLOGIES
- INNOVA LABORATORIES, INC.
- IRVINE SENSORS CORP.
- J.B.S. TECHNOLOGIES, INC.
- METROLASER
- MXR, INC.
- PHYSICAL OPTICS CORP.
- PHYSICAL SCIENCES, INC.
- RADIATION SCIENCE, INC.
- SARCOS RESEARCH CORP.
- SCIENCE & ENGINEERING SERVICES, INC.
- SENSOR SYSTEMS GROUP, INC.
- SENSORS UNLIMITED, INC.
- SPECTRAL SCIENCES, INC.
- SPIRE CORP.
- SPIRE CORP.
- SPIRE CORP.
- TACAN CORP.

SDIO Topic#: 92-004
- ADVANCED ENERGY TECHNOLOGY, INC.
- MAYER APPLIED RESEARCH, INC.
- RASOR ASSOC., INC.
- SPACE EXPLORATION ASSOC.
- SPIRE CORP.
- ULTRAMET

SDIO Topic#: 92-005
- ASTROPOWER, INC.
- BUSEK CO., INC.
- DAMASKOS, INC.
- ELECTRO ENERGY, INC.
- ELECTROCHEM, INC.
- ENTECH, INC.
- GINER, INC.
- INTEGRATED APPLIED PHYSICS, INC.
- INTERPHASES RESEARCH
- NEW LIGHT INDUSTRIES, LTD.
- SPIRE CORP.
- TETRA CORP.
- TPI., INC.

SDIO Topic#: 92-006
- APPLIED PULSE POWER, INC.
- BUSEK CO., INC.
- COMBUSTION SCIENCES, INC.
- SCIENCE RESEARCH LABORATORY, INC.
- SPACE EXPLORATION ASSOC.
- SPACE POWER, INC.
- STEROIDS, LTD.

SDIO Topic#: 92-007
- CERAMIC COMPOSITES, INC.
- CREARE, INC.
- CUDO TECHNOLOGIES, LTD.
- DYNATHERM CORP.
- ENERGY SCIENCE LABORATORIES, INC.
- FOSTER-MILLER, INC.
- MAINSTREAM ENGINEERING CORP.
- MSNW, INC.
- RESEARCH OPPORTUNITIES, INC.
- ROCKY RESEARCH
- SPIRE CORP.

THERMACORE, INC.
XEMET, INC.
XEMET, INC.

SDIO Topic#: 92-008
FOSTER-MILLER, INC.
GUMBS ASSOC., INC.
TAKOM COMPANY

SDIO Topic#: 92-010
ACT RESEARCH CORP.
COLEMAN RESEARCH CORP.
DANIEL H. WAGNER ASSOC., INC.
GORCA SYSTEMS, INC.
NIMBLE COMPUTER CORP.
PARASOFT CORP.
PRODUCTIVITY SOLUTIONS
SECURE COMPUTING TECHNOLOGY CORP.
TECHNO-SCIENCES, INC.

SDIO Topic#: 92-011
CAPE COD RESEARCH, INC.
CRYSTAL ASSOC., INC.
DIGITAL OPTICS CORP.
EDFA CONSULTANTS
EIC LABORATORIES, INC.
FOSTER-MILLER, INC.
FOSTER-MILLER, INC.
JET PROCESS CORP.
LASERGENICS CORP.
OPTIVISION, INC.
OPTRON SYSTEMS, INC.
PHYSICAL OPTICS CORP.
PHYSICAL OPTICS CORP.
PHYSICAL OPTICS CORP.
PHYSICAL OPTICS CORP.
PHYSICAL OPTICS CORP.
PICOTRONIX, INC.
REVEO, INC.
SPARTA, INC.
SPIRE CORP.
SPIRE CORP.

SDIO Topic#: 92-012
AMERICAN GNC CORP.
CIENCIA, INC.
CSA ENGINEERING, INC.
FIBER AND SENSOR TECHNOLOGIES
PAGE AUTOMATED TELECOM. SYSTEMS, INC.
SATCON TECHNOLOGY CORP.
SHERMAN M. SELTZER
TECHNO-SCIENCES, INC.
TPL, INC.
TRS CERAMICS, INC.

SDIO Topic#: 92-013
CONTINUOUS MOLDING, INC.
FIBER MATERIALS, INC.
FIBER MATERIALS, INC.
HITTMAN MATERIALS & MEDICAL COMPONENTS
IAP RESEARCH, INC.
JET PROCESS CORP.
MIDWEST RESEARCH TECHNOLOGIES, INC.
PHASEX CORP.
POWDER TECHNOLOGY, INC.
SIOUX MANUFACTURING CORP.
TPL, INC.
UES, INC.

SDIO Topic#: 92-014
ADVANCED PHOTONIX, INC.
ADVANCED TECHNOLOGY MATERIALS, INC.
ADVANCED TECHNOLOGY MATERIALS, INC.
AMERICAN RESEARCH CORP. OF VIRGINIA
APA OPTICS, INC.
ASTRALUX
ASTRALUX
ASTROPOWER, INC.
ASTROPOWER, INC.
BELTRAN, INC.
CRYSTAL SYSTEMS, INC.
ELECTRO-OPTEK CORP.
ELECTRO-OPTEK CORP.
ELECTROCHEMICAL SYSTEMS, INC.
EMCORE CORP.
EMCORE CORP.
EPION CORP.
HOLZ INDUSTRIES, INC.
IBIS TECHNOLOGY CORP.
IMPLANT SCIENCES CORP.
INNOVATIVE CHEMICAL TECHNOLOGIES CORP.
IONWERKS
KULITE SEMICONDUCTOR PRODUCTS, INC.
LASERGENICS CORP.
LINARES MANAGEMENT ASSOC., INC.
MARTIN GOFFMAN ASSOC.
NONVOLATILE ELECTRONICS, INC.
NONVOLATILE ELECTRONICS, INC.
ORTEL CORP.
PHYSICAL OPTICS CORP.
SCHMIDT INSTRUMENTS, INC.
SCHMIDT INSTRUMENTS, INC.
SCHMIDT INSTRUMENTS, INC.
SENSORS UNLIMITED, INC.
SENSORS UNLIMITED, INC.

SPACE POWER, INC.
SPIRE CORP.
SPIRE CORP.
SPIRE CORP.
STRUCTURED MATERIALS INDUSTRIES, INC.
TORANAGA TECHNOLOGIES, INC.
TRS CERAMICS, INC.
WARE TECHNICAL SERVICES, INC.

SDIO Topic#: 92-015
ADVANCED FUEL RESEARCH, INC.
ADVANCED TECHNOLOGY MATERIALS, INC.
ADVANCED TECHNOLOGY MATERIALS, INC.
CONDUCTUS, INC
CONDUCTUS, INC.
CREARE, INC.
EIC LABORATORIES, INC.
IGC ADVANCED SUPERCONDUCTORS, INC.
MATERIALS & ELECTROCHEMICAL RESEARCH
SUPERCONDUCTOR TECHNOLOGIES, INC.
SUPERCONDUCTOR TECHNOLOGIES, INC.
TRISTAN TECHNOLOGIES, INC.
XSIRIUS SUPERCONDUCTIVITY, INC.

SDIO Topic#: 92-016
ADVANCED TECHNOLOGY MATERIALS, INC.
HNC, INC.