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SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

FY 1993 SBIR

PHASE II AWARD ABSTRACTS

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(1) Q15

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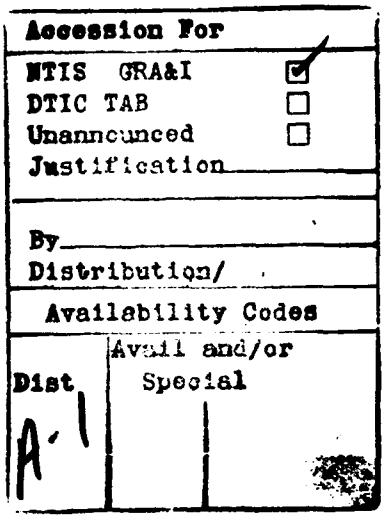

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PREFACE

During Fiscal Year (FY) 1993 the Military Services, the Advanced Research Project Agency (ARPA), the Defense Nuclear Agency (DNA), and the Ballistic Missile Defense Organization (BMDO, formerly SDIO) selected 535 proposals for funding in Phase II of the Small Business Innovation Research (SBIR) Program. These proposals were selected from those submitted by small research and development (R&D) firms awarded Phase I contracts from previous fiscal years solicitations.

In order to make information available on the technical content of the Phase II projects supported by the Department of Defense (DoD) SBIR Program, this report presents the abstracts of those proposals which have resulted in contract awards. Further, the name and address of each firm performing the work is given for those who may desire additional information about the project. 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 SBIR firm directly.

FY 1993 Phase II Program:

FY 1993 Phase II awards were made to firms that had Phase I awards from several past solicitations, but mainly from solicitations FY91.1, FY91.2, FY92.1, and FY92.2. The topic number accompanying each abstract displays the solicitation year of the Phase I. Presentation of the technical abstracts which describe the nature of the funded FY 1993 Phase II SBIR projects is the main purpose of this report. Proprietary information is not provided in these abstracts, therefore technical details may be missing. For this reason, the report supplies the names of individuals (the principal investigator, PI) in the small business firms who may be contacted should more information be needed on a specific project.

	Proposals Received	Phase II Awards
Army	296	123
Navy	250	119
Air Force	272	199
ARPA	179	28
DNA	17	6
BMDO	130	60
	1,144	535

Of the 535 Phase II awards, 94 awards went to minority and disadvantage small businesses.

Phase II abstracts presented in this report are in alphabetical order by firm within each DoD Component. A cross reference by firm appears at the back of this volume.

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INTRODUCTION

On July 22, 1982 the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219). This law is designed to give small high technology firms a greater share of the Federal R&D contract awards. The Act mandates that all Federal Agencies establish an SBIR program if their fiscal year extramural budget for R&D exceeds $100 million. Beginning in FY 1983, DoD began its SBIR Program by setting aside a percentage of its extramural R&D budget for this program. The percentage, set by Congress, began at .1 percent, and has increased over the years to the funding level of 1.5 percent for FY93. The "Small Business Research and Development Enhancement Act of 1993" (P.L. 102-564), signed October 28, 1992, extended the SBIR program through the fiscal year 2000 and expanded the funding level beginning in FY93.

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

The SBIR Program consists of three distinct phases. Under Phase I, DoD Components make awards to small businesses responding to advertised solicitation topics. Typically, a Phase I award is for one half to one man-year effort over a period generally not to exceed 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. All DoD topics address specific R&D needs to improve our defense posture and are designed to produce products for the private sector market. 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. The successful completion of Phase I is a prerequisite for further DoD support in Phase II.

Phase II awards are 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. In addition, proposals which identify a follow-on Phase III funding commitment are given special consideration. Phase II awards typically cover two to five man-years of effort over a period generally not to exceed 24 months, also subject to negotiation. The number of Phase II awards depends upon the success rate of the Phase I effort and the availability of funds. Phase II is the principal research or research and development effort, and requires a more comprehensive proposal which outlines the intended effort in detail.

Phase III is expected to involve private-sector investment and support for any necessary development that will bring an innovation to the marketplace. Also, under Phase III, DoD may award follow-on contracts, not funded by the SBIR Program, for products or processes meeting DoD mission needs.

(7) (SB

ADIABATICS, INC.
3385 COMMERCE DRIVE
COLUMBUS, IN 47201
Phone: (812) 372-5052
Topic#: 91-104 ID#: 91104-02
Office: TACOM
Contract #: DAAE07-93-C-R108
PI: Roy Kamo
Title: Novel Air Gap Insulated Piston
Abstract: Phase I study of an Air Gap Insulated Piston resulted in an air gap piston design for a high temperature engine that could lower the specific heat rejection, the fuel consumption, and the hydrocarbon and particulate emissions. Further heat rejection reductions can be achieved by eliminating cylinder liner cooling and cylinder head insulation. The technical advancement that makes this possible is the air gap hybrid piston concept. The air gap hybrid piston permits the top piston ring in the hot belt region to operate in the dry solid lubricant mode without temperature limitation. Non-aftercooled engine operation, uncooled cylinder liner, and high top ring location become possible with the air gap hybrid piston with consequent reduction in heat rejection, fuel consumption and emissions. An ALGOR thermal analysis and finite element simulation program developed during the Phase I study has shown the integrity of the structural design of the piston, the ultra low engine heat rejection and the viability of the advanced novel air gap piston in the thermal environment of a non-aftercooled and uncooled cylinder liner. Phase II program will bring the novel air gap piston to fruition for commercial and military applications.

ADVANCED ENGINEERING
P.O. BOX 1630
ALPINE, CA 91903
Phone: (619) 445-5748
Topic#: 91-081 ID#: 91MIC-060
Office: MICOM
Contract #: DAAHO1-93-C-R218
PI: Robie Faulkner
Title: Thrust Augmentation System for a Low Cost Expendable Turbojet Engine
Abstract: The technical objective of this Phase II program is to develop a flight weight augmentation system which will double the thrust of an expendable low cost turbojet engine.

ADVANCED TECHNOLOGY & RESEARCH, INC.
14900 SWEITZER LANE
LAUREL, MD 20707
Phone: (301) 369-2141
Topic#: 90-465 ID#: 90ARD-026
Office: ARDEC
Contract #: DAAA21-93-C-0063
PI: Dr. Anthony J. Barbera
Title: Navigation of an Intelligent Vision Based Mobile Robot
Abstract: The major effort of this research is to create a generic sensory interactive control architecture for autonomous vehicles. There are two primary components in real-time control. One component collects data from the environment through sensors, then processes it into a useful format; the other component analyzes this processed sensory data in the context of the task to control timing and amount of actuator movement. This proposed concept offers a control system solution that is an innovative coordination between a knowledge based component for autonomous vehicle control with multiple sensory devices that report on a complex, non-linear, real world environment. This control can be efficiently implemented on common, low-cost commercial processors. The first element of the system is the Real-time Control System (RCS). RCS will handle task decomposition sequencing, aspects of world modeling, planning and task knowledge based reasoning and control. The sensory processing element will be developed using artificial intelligence algorithms and learning algorithms associated with knowledge based sensory processing and neural networks. Coordinated interaction between vehicle control and sensory processing elements where the executing control task sets the context for the appropriate level of sensory processing at the present instant to allow for a robust, incremental approach to the goal state is the unique aspect of this project.

AEGIS RESEARCH CORP.
6703 ODYSSEY DRIVE, SUITE 302
HUNTSVILLE, AL 35806
Phone: (205) 922-0802
Topic#: 91-084 ID#: 91MIC-089
Office: MICOM
Contract #: DAAHO1-93-C-R189
PI: D. Brett Beasley
Title: Infrared Laser Diode Based Infrared Projector
Abstract: The objective of this SBIR effort is the development of a dynamic infrared (IR) scene projector, based on IR laser diode technology, for use in HWIL simulations of IR missile systems. The goals of this Phase II effort is the upgrade of the single-channel projector demonstrated during Phase I to a multi-channel projector for testing missile systems with focal plane

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array sensors. AEgis's design offers the potential for an IR projection system with very high frame rates and sufficient dynamic range to simulate most targets and countermeasures of interest. This document presents AEgis Research's proposal for the Phase II effort. The proposal details a design for the Phase II projector and the tasks involved in the work plan. The result of this Phase II effort will be an operational, bench-mounted, dynamic IR scene projector for testing missile systems with focal plane array sensors.

AMERICAN GNC CORP.
9131 MASON AVE
CHATSWORTH, CA 91311
Phone: (818) 407-0092
Topic#: 90-458 ID#: 90ARD-019
Office: ARDEC
Contract #: DAAA21-91-C-0042
PI: Ching-Fang Lin
Title: High Precision, Robust, Adaptive Weapon Control System Design
Abstract: Future combat armored vehicles, air-defense artillery, and attack helicopters are required to perform precise points in the presence of unpredictable terrain motions, unmodeled flexible dynamics, unmeasurable disturbances, and nonlinear/time-varying effects to mission effectiveness. However, due to the interactions of firing disturbance and gun flexible dynamics, the improvements in the accuracy and speed of gun-turret control systems have been limited. Recently, newly developed robust, nonlinear, and adaptive control design algorithms have provided an opportunity for the design of high precision pointing systems. To develop, demonstrate and validate advanced control algorithms for robust, high bandwidth, high precision, low cost pointing and stabilization systems, the advanced weapon tracking test-bed (AWTB) has been designed at the Army Research, Development and Engineering Center (ARDEC) to provide a realistic simulation of turret guns in a laboratory environment. The objective of this proposal is to provide the Army with a robust, nonlinear, adaptive, and digital fire control system and design capability so as to demonstrate its effectiveness on the test-bed. The deliverables include: (1) a well maintained and supported control system design, development, rapid prototyping environment that facilitates all future control related design tasks, (2) a high precision integrated nonlinear-adaptive-robust control design method that exploits design alternatives and system properties, and (3) an integrated indoor target tracker and gun-turret system that provides a realistic combat environment simulation.

AMERICAN RESEARCH CORP. OF VIRGINIA
P. O. BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655
Topic#: 91-014 ID#: 91MTL-020
Office: MTL
Contract #: DAAL01-93-C-4049
PI: Mr. Howard F. Groger
Title: Thin Film Sensors to Evaluate Chemical and Biological Threats to Army Structures
Abstract: Recent developments in the world political situation have raised concerns about the readiness of the U.S. Armed Services in battlefield scenarios involving chemical and biological warfare agents. Although methods are presently available for long-range threat identification, there remains a need for field-usable sensors to detect the diffusion of chemical and biological materials in Army structures to alert Army personnel to immediate danger. To address this need, the Phase I program was directed toward an evaluation of the feasibility of embedded optical sensors having thin-film chemically specific coatings for the detection of chemical and biological threats. Phase I results included the demonstration that membrane-potential sensitive dye could be used to detect micro-organisms at concentrations comparable with the best immunological methods. The Phase II program would accomplish the feasibility demonstrated in Phase I through achieving technical objectives of developing receptor materials, fabrication of patterned coated optical waveguides, application of pattern recognition procedures, acquisition of families of test data and optimization of sensor selectivity to provide an integrated optical instrument for transfer of technology and commercialization in the Phase III segment of the program. Successful completion of the Phase II objectives would result in the development of a chip-based, inexpensive sensitive optical detection system for chemical and biological threats.

ANALYTICAL SPECTRAL DEVICES, INC.
4760 WALNUT STREET, SUITE 105
BOULDER, CO 80303
Phone: (303) 444-6522
Topic#: 92-145 ID#: 92CRR-007
Office: CRREL
Contract #: DACA-93-C-0007
PI: Brian Curtiss
Title: Submersible Ice Spectroradiometer
Abstract: Measuring light transmission through sea ice in Arctic regions is important to the understanding of the biological

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potential, the regional heat and mass balance, and for the investigation of possible through-ice communication. Past measurements have been made with a submersible scanning spectroradiometer. The research community has requirements to make optical measurements of sea ice under cloudy and partly cloudy conditions. A dual spectrometer detector array based instrument is required to meet these requirements. In Phase II, we will design, build and test a prototype and revised prototype dual CCD spectroradiometer to measure simultaneously the surface irradiance with a standard cosine receptor and the under-ice irradiance by means of a submersible cosine receptor-fiberoptic bundle coupled to one of the surface spectroradiometers. Both the first and the revised prototype will be tested in three stages: 1) in the laboratory; 2) at a frozen pond in New Hampshire; and 3) in the Arctic. Phase II of this project will last for 24 months.

ANRO ENGINEERING, INC.
450 BEDFORD STREET
LEXINGTON, MA 02173
Phone: (813) 957-3080

Topic#: 91-043 ID#: 91BRD-009
Office: BRDEC
Contract #: DAAK70-93-C-0024
PI: Gerald F. Ross, Ph.D.

Title: Ultra-Wideband (Impulse) Radar Array Systems for the Detection of Buried Mines and Bunkers

Abstract: Under Phase I, ANRO demonstrated its patented impulse S-band transmitter and an active cancellation technique to detect buried metallic and non-metallic mines to a depth of several inches from an elevated platform. The use of method-of-moments computations comparing co- and cross-polarized returns yielded encouraging results which would lead to a dependable means of discrimination. Based upon these successful results, it is proposed to construct an innovative, high power impulse radar array for detecting buried objects. In this proposal ANRO will analyze the requirements for a detection system for small-shallow objects such as mines, and also large, deeply buried objects such as bunkers. Primary factors to be considered include target size, target depth, soil optimum selection of transmitter frequency, antenna configuration, transmitter power and signal processing technique. ANRO will then construct breadboard hardware for evaluation by the US Army and Air Force. A design objective of the program is to increase sensor standoff to about 100 feet which will permit operation from an airborne platform.

ATLANTIC AEROSPACE ELECTRONICS CORP.
470 TOTTEN POND ROAD
WALTHAM, MA 02154
Phone: (617) 890-4200

Topic#: 91-005 ID#: 91-NV-304
Office: CECOM
Contract #: DAAB07-93-C-U016
PI: Tamar Peli

Title: Morphology-Based ATR for FLIR-Based Systems

Abstract: It is proposed to complete the development of the innovative new class of automatic target detection and recognition (ATR) algorithms demonstrated in Phase I, and to bring the technology to a state of maturity sufficient for its insertion into Army FLIR and IRST sensor systems. In Phase I we demonstrated several major performance advantages of a new class of signal processing techniques based on morphological filtering, for detection/segmentation and feature extraction in FLIR imagery. Phase II is aimed at refining and optimizing these algorithms, testing them against a broad set of Government-provided data, and extending the processing beyond front-end applications to include the complete ATR sequence (detection, discrimination, classification). A focused evaluation is proposed for characterization of detection and classification performance. We will also port the algorithm software to the C2NVEO testbed in order to allow the sponsor to test and evaluate these algorithms independently on additional scenarios and sensor data. We will investigate the feasibility of incorporating a morphology accelerator board in the C2NVEO facility in order to facilitate rapid and interactive evaluation of the technology at C2NVEO. Although the primary emphasis of the proposed program is on second generation FLIRs, we are proposing an optional task (OPTION 1), to extend the basic algorithms to active sensors such as laser radar, scanning MMW radars and SARs, and to extend the utility of the morphology paradigm to the fusion problem in multi-sensor environments. In addition, we propose to adapt our processing methodology to the detection/tracking problem in ground-based IRST systems and to compare the resultant performance against that of the Army's AADEOS system (OPTION II).

ATLANTIC AEROSPACE ELECTRONICS CORP.
6404 IVY LANE, SUITE 300
GREENBELT, MD 20770
Phone: (301) 982-5273

Topic#: 91-016 ID#: 91HDL-301
Office: HDL
Contract #: DAAL02-93-C-0078
PI: Victor C. Sanchez

(11)

Title: Low Cost Conformal Electronically Scanned Antenna
Abstract: An innovative approach to providing electronic azimuth scan of a radar beam by a combined switching network and active Rotman lens has been parametrically investigated in Phase I. Since the Rotman lens provides true time delay azimuth scan, the radar function can be shared with an ESM function and the potential for multiple simultaneous beams exists. The proposed Phase II effort will concentrate on the issues of achieving broadband polarization diversity and elevation beam control. A two-dimensional dual-polarized array will be fabricated and tested. An elevation beamformer network which provides a CSC-squared beam in elevation will be integral with the array hardware. A "beam steering network" will be fabricated and tested to demonstrate our unique Rotman lens input port combining scheme. A "polarization selection network" will also be fabricated and tested to quantify the polarization diversity of the array.

ATLANTIC AEROSPACE ELECTRONICS CORP.
6404 IVY LANE, SUITE 300
GREENBELT, MD 20770
Phone: (301) 982-5254
Topic#: 90-278 ID#: 90TAC-010
Office: TACOM
Contract #: DAAE07-93-C-R069
PI: Andrew Humen
Title: Four Input Stacked Microwave Antenna
Abstract: The objective of the Army's "Four Input Stacked Microwave Antenna" (FIMA) program is to investigate improved hardware solutions to the four channel link required for one-way transmission of high resolution video data from unmanned Ground Vehicles (UGV's) to an Unmanned Ground Vehicle Control Testbed (UGVCT). In Phase I, a breadboard antenna was designed, fabricated and tested which demonstrated a 2.5 to 7.5 dB increase in link margin relative to the current multiplexer-based system. The Phase II program covers design, fabrication, and testing of one Advanced Development Model (ADM) FIMA system and one Engineering Development Model (EDM) FIMA system with an integrated Global Positioning System (GPS) function. Three options are also proposed as part of Phase II. These include a FIMA-based microwave repeater system to solve non-line-of-sight problems, additional production of up to 12 EDM systems, and field test support.

BIOTEK, INC.
21-C OLYMPIA AVENUE
WOBURN, MA 01801
Phone: (617) 938-0938
Topic#: 91-218 ID#: 91MED-064
Office: MEDICAL
Contract #: DAMD17-92-C-2047
PI: E.S. Nuwayser, Ph.D.
Title: Production of Polyclonal Antibodies in Rabbits
Abstract: Cholinesterases are widely distributed throughout the body. They hydrolyze acetylcholine (ACh) is a compound which serves also as the neurohumoral agent in peripheral junction transmission. Cholinesterases are known to be crucial for cholinergic neurotransmission. During Phase I of the SBIR contract polyclonal antibodies were successfully raised from rabbits against acetylcholinesterase, butyrylcholinesterase, and five synthetic peptides using immunogens supplied by WRAIR. The binding capacity of the peptide antisera was determined by enzyme linked immunoassay. Most of the titers at half maximal absorbance were greater than 1 x 10 to the 4th power. All antibodies were submitted to WRAIR. Antibodies against the enzymes were assayed by WRAIR for IgG and enzyme content. The objective of the Phase II application is to continue the work started during Phase I to raise antibodies from rabbits against cholinesterases, synthetic peptides, and monoclonal antibodies which inhibit the activity of cholinesterase. The immunogens used in the preparation of the antibodies will be supplied by WRAIR. The binding capacity of the antibodies to the immunogen will be determined by enzyme linked immunosorbant assay (ELISA). The antibodies will be submitted to WRAIR for use in the development of assay procedures, localization of cholinesterase activity, and understanding the mechanisms of action in various tissues.

CAPE COD RESEARCH, INC.
P.O. BOX 600
BUZZARDS BAY, MA 02532
Phone: (508) 759-5911
Topic#: 91-024 ID#: 91AMC-353
Office: TACOM
Contract #: DAAE07-93-C-R050
PI: Mr. Francis L. Keohan
Title: Novel Chromium-Free Surface Pretreatment Process for Corrosion Control
Abstract: Current metal surface preparation processes use chemical agents that are environmentally unacceptable. Thus there is a trend towards replacing current paints, primers and paint strippers with products and processes which accomplish the protection of metals without using environmentally damaging materials. Phase I research identified a promising new process

for stripping and priming metals. This process, Primer Activated Surface Treatment, involves using high pressure aqueous solutions to simultaneously clean and prime metal surfaces. This approach produced high strength and hydrolytically stable bonds for adhesive bonding on aluminum and titanium alloys. This Phase II research builds on these Phase I results with a more comprehensive study of the effects of PAST on other alloys as well as on preparing surfaces for repainting.

CENTRAIR CORP.
325 NORTH CARSON ROAD
BIRMINGHAM, AL 35215
Phone: (205) 854-5992
Topic#: 91-045 ID#: 91BRD-003
Office: BRDEC
Contract #: DAAK70-93-C-0068
PI: Mr. Craig Estes
Title: Active Noise and Vibration Control for Auxiliary Power Units
Abstract: The Phase II effort will be to design and build a light weight three Phrase 10 KW API in accordance with MIL-STD 1332B Class 2B with integrated subsystems that: (1) reduce noise at points one meter outside of the shelter from 85 dB(A) to less than a maximum of 55 dB(A), and inside the shelter workspace to less than a maximum of 55 dB(A); (2) reduce vibration inside the shelter work space to less than 0.04 g P-P at frequencies below 8 Hz, and at frequencies of 8 Hz and above reduce vibration in accordance with MIL-STD-1472D, Page 179, Figure 43. The integrated active noise and vibration cancellation subsystem will use DSP hardware with emphasis on adaptive nonlinear polynomial neural network algorithms, and will utilize electrical control actuators and sensing accelerometers mounted on the APU and the shelter/vehicle, plus a shelter/vehicle inertial displacement sensor for vibration sensing and control. The noise cancellation approach planned will eliminate the conventional upstream reference microphone and make direct use of feedback from the error microphone. The fee forward microphone will be replaced by an electrical reference signal from the alternator.

CENTURY COMPUTING, INC.
1014 WEST STREET
LAUREL, MD 20707
Phone: (301) 953-3330
Topic#: 91-148 ID#: 91HEL-039
Office: HRED
Contract #: DAAA15-93-C-0088
PI: Karl Wolf
Title: User Interface Management System for GIS Applications
Abstract: Increasingly, system designers and developers look to graphic user interface (GUI) technology to implement modern computer applications. But as software becomes easier to use, the development costs soar; for example, it is common to see the user interface constitute 60% or more of application development costs. The proposed project is for development of innovative software tools, the purpose of which is to increase productivity of the system developers and to increase the quality of the resulting user interfaces. We specifically target applications for Geographical Information Systems (GIS), where the end-user manipulates vector-oriented overlays on a map background of raster data. The product will be based upon TAE Plus, a powerful and widely-used User Interface Management System (UIMS) developed for NASA by Century Computing. TAE Plus will be the UIMS "platform" which we will enhance with features specifically designed for GIS applications.

CHARLES RIVER ANALYTICS, INC.
55 WHEELER STREET
CAMBRIDGE, MA 02138
Phone: (617) 491-3474
Topic#: 91-210 ID#: 91ARI-020
Office: ARI
Contract #: MDA903-93-C-0132
PI: Greg L. Zacharias
Title: Intelligent Flight Trainer for Initial Entry Rotary Wing Training
Abstract: The Phase II objective is to develop and validate an Intelligent Flight Trainer (IFT) for Initial Entry Rotary Wing (IERW) training. Concept feasibility was demonstrated under the Phase I effort, and relies on an Intelligent Tutoring System (ITS) architecture incorporating Adaptive Training to progressively improve student pilot proficiency. The IFT structure includes: a teacher model which includes algorithmic and expert system assessments of student performance; a domain expert model which maintains in-depth knowledge of maneuver criteria and strategies; and a student model which reflects student proficiency. Under Phase I we implemented the IFT, integrated with the UH-1 Training Research Simulator (UH-1 TRS) at Ft. Rucker, and demonstrated real-time operation in teaching student pilots elementary hover maneuvers. Under the Phase II effort we propose to extend the IFT to a full-scope IERW trainer, validate its effectiveness, and specify requirements for developing it into an add-on module for existing simulators. We propose a four task Phase II effort: 1) expansion of IFT functionality and component enhancement; 2) transfer-of-training effectiveness validation with the UH-1 TRS; 3) demonstration

of interfacing with the simulator Complexity Testbed (SCTB); and 4) specification of full-scope rotorcraft IFT.

CHI SYSTEMS, INC.
GWYNEDD PLAZA III, BETHLEHEM PIKE AT SHEBLE LANE
SPRING HOUSE, PA 19477
Phone: (215) 542-1400
Topic#: 91-018 ID#: 91AVS-313
Office: AVRDEC
Contract #: NAS2-13814
PI: Allen L. Zaklad, Ph.D.
Title: AMMI: Active Man-Machine Interface for Advanced Rotorcraft
Abstract: Pilots of advanced rotorcraft have a vast amount of data and information available to them. This trend will become more pronounced in the future with the fully digital cockpit. But there is a high cost in increased mental effort to all this information. In order to maintain mission effectiveness, the pilot must have intelligent help with processing and prioritizing all this data. The caution warning (CW) system, which informs the pilot of aircraft subsystem problems, is a good example of this need. CHI Systems has come up with an innovative cognitive modeling methodology called COGNET which can embed a model of the pilot and mission into the rotorcraft computer. This embedded model, called the active man-machine interface or AMMI, enables the system to intelligently process CW data, to provide the pilot with only the most important information at any point in the mission, and recommend needed actions. In the Phase II effort, we will design and implement this intelligent embedded system, demonstrate it on an advanced flight simulator, and evaluate its effectiveness.

CIENCIA, INC.
111 ROBERTS STREET, SUITE K
EAST HARTFORD, CT 06108
Phone: (203) 528-9737
Topic#: 91-212 ID#: 91MED-021
Office: MEDICAL
Contract #: DAMD17-92-C-2051
PI: Salvador M. Fernandez, PhD
Title: Real Time, Light Weight X-Ray Imager
Abstract: A portable, light weight, large area, high resolution two-dimensional real-time digital X-ray imaging system, based on the development of an integrated a-Si:H photodetector array as an image sensor is proposed. The first prototype image sensor will have a sensitive area of 8.5"x11" with 1024x1280 pixels coupled to an optimized high efficiency scintillator CsI(TI) as an X-ray converter. Each diode element is connected through an integrated TFT to a dynamic analog shift register controlled by fast clock pulses. With a data transfer time of 0.1 second/frame, and a display time of less than 5 seconds, the output data is further digitized, processed, and displayed by a portable RISC computer. The digital image system has a sensitive area and an image resolution comparable to the traditional screen-film combination; the system can have a much higher sensitivity and dynamic range than the existing screen film combination.

COGNITIVE TECHNOLOGIES, INC.
4200 LORCOM LANE
ARLINGTON, VA 22207
Phone: (703) 524-4331
Topic#: 91-150 ID#: 91HEL-027
Office: HRED
Contract #: DAAA15-93-C-0044
PI: Marvin S. Cohen
Title: Human Performance Issues in Automatic Target Recognition
Abstract: The successful introduction of automated target recognition systems will depend on how well they interface with the knowledge and processing strategies utilized by human pilots. The goals of the proposed research include an investigation of cognitive issues in human recognition performance, and an exploration of their implications for human interaction with automated recognition devices. Experimental research is proposed in the following specific areas: (1) Stages of visual processing and implications for the display of visual and non-visual data, (2) favored levels of generality in verbal classification and implications for the display of ATR classification conclusions, (3) reasoning with mental models and implications for the display of uncertain ATR conclusions, and (4) strategies for verifying recognitional conclusions and implications for the display of prompts and data when ATR conclusions are uncertain. The results of the research will include empirically supported design principles for the design of ATR-human interfaces, and a set of specific ATR interface design concepts.

COLEMAN RESEARCH CORP.
5950 LAKEHURST DRIVE
ORLANDO, FL 32819
Topic#: 91-253 ID#: 91PM-015
Office: STRICOM
Contract #: M67004-93-C-0040

(A)

Phone: (407) 249-7717 PI: Mr. George Betts
Title: Indirect Fire Weapon Simulation
Abstract: This proposal addresses the problem at the Army's Combat Training Centers (CTCs), that is, the SAWE-RF/MILES II systems now being deployed do not provide exercise participants (players) with audio-visual (A-V) cues telling them indirect fire impacts are taking place within their area of observation. This means that players may not know they are under attack until they become casualties. Without cues telling players the approximate direction and distance from themselves to the impact location, the players do not have the opportunity to make the decisions to safely move out of, or avoid moving into, an attack. Coleman Research Corporation (CRC) has postulated a system that will safely provide real-time visual and realistic sound effects to each exercise participant. The system will make use of information provided by the SAWE-RF/MILES II harness. The Phase II effort, proposed in this document, will develop a design for this system, evaluate and choose needed vendor components, build two prototype systems, interface the prototypes into a SAWE-RF/MILES II harness, and test the system for its effectiveness for training. In addition, a report discussing the Phase II effort and the system design will be developed.

COMMONWEALTH COMPUTER RESEARCH, INC. Topic#: 91-006 ID#: 91-SW-302
P.O. BOX 907 Office: CECOM
ARLINGTON, VA 22216 Contract #: DAAB10-91-C-0157
Phone: (803) 842-7050 PI: Daniel F. Wiener II
Title: Advanced Information System Technologies for Expert AMBISS
Abstract: Sensor placement constitutes a critical component of Intelligence and Electronic Warfare (IEW) operations. To meet this need, CSWD is developing Expert AMBISS, an automated system to recommend IEW asset placement and movement planning. Expert AMBISS is/was addressed by this proposal and the Phase I effort, a proof of concept development effort where the effectiveness of a global optimization approach was successfully demonstrated and tested on example problems with known optical solutions. This approach, Sensor Placement Analyzer (SPA), provided an impressive capability for a proof of concept effort, a super interface that allowed for easy definition of the specific sensor placement problem over a map background. SPA also provided a host of important features operating very efficiently, thus quickly providing a near optimal solution for large sensor placement regions. Phase II objectives will be as follows: 1. Implement a field operable prototype of Expert AMBISS on a designated Army/IEW workstation; 2. Integrated terrain, propagation models (from MAPS), and feature data to guide sensor placement; 3. Provide for explicit trade-offs between multiple conflicting objectives within the implementation of Expert AMBISS; and 4. Incorporate multiple sensor types and provisions for next generation IEW sensors. Our approach will be based on extending the formal problem definition to encompass the additional modeling efforts in MAPS; optimizing the objective functions therein; and incorporating multiple objectives within the optimization routines of Extended SPA. This approach will produce a finished prototype of Expert AMBISS that can serve as a baseline for field testing.

CREARE, INC. Topic#: 91-023 ID#: 91AMC-313
P.O. BOX 71 Office: TACOM
HANOVER, NH 03755 Contract #: DAAE07-93-C-R051
Phone: (603) 643-3800 PI: Paul H. Rothe
Title: Environmentally Acceptable Cleaning Processes
Abstract: Creare proposes to develop a guidebook for replacement of CFC-113 for metal cleaning at Army facilities. The Army's present use of CFC-113 for metal cleaning is widespread at its depots and arsenals, and these uses of CFC-113 are diverse. Each of many thousands of cases has different needs, requirements, and constraints. Creare proposes to address these broad issues by the engineering case method. During the Phase II period of performance, Creare will lead the technical resolution of selected cases from several depots and arsenals, document them individually, and generalize our findings. By these means, some CFC-113 replacement will occur rapidly, exemplary cases will be available for guidance, and general tools and considerations will be developed and presented. The findings of the proposed work will be unique. Existing literature stresses electronics rather than metal cleaning and describes research to compare cleanliness of metal coupons rather than overall mechanical engineering resolution of metal cleaning requirements in the field.

CREATIVE OPTICS, INC.
360 STATE ROUTE 101, SUITE 201
BEDFORD, NH 03110
Phone: (603) 472-6686

Topic#: 91-015 ID#: 91HEL-308
Office: TECOM
Contract #: DAAD05-93-C-0240
PI: James C. Kilian

Title: Innovative ATR-I/O Emulator for an ATRMMI Experimentation Platform

Abstract: Creative Optics, Inc. is proposing a program for advanced development of a concept for integrating virtual world technologies with psychophysical test technologies that can, in turn, be used to establish operational bounds on man-machine interfaces in combat system simulators used in interactive battlefield simulations. Determination of the impact of simulators/simulation fidelity on crew workload and task performance is the kernel of the proposed Phase II program. Our proposed work will improve the ability to determine acceptable fidelity for interactive simulations relative to such objectives as virtual prototyping, acceptance testing, operational testing, or training. Our Phase II program will result in a demonstrable test capability for man-machine interaction applicable to interactive combat system simulators.

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Topic#: 90-213 ID#: 90BRD-012
Office: AMSAA
Contract #: DAAA15-94-C-0006
PI: James C. Kilian

Title: Innovative Methodology for Development of a Camouflage, Concealment and Deception (CCD) Effects Model

Abstract: Creative Optics, Inc. is proposing a program to the US AMSAA for advanced development of a concept for estimating the impact of CCD (camouflage, concealment and deception) measures on man-in-the-loop munition effectiveness. Determination of an approach to modelling visual detection, recognition, and engagement tasks by the observer is the kernel of the proposed Phase II program. The program presented here is innovative in our primary thrust to link basic research that has done both on information processing by the human visual system and on cognitive processes with meaningful measures of mission effectiveness. Our Phase II program continues work demonstrated in Phase I, as well as work on computer-based evaluation of CCD measures. The results of Phase II will be a model for investigating visual and thermal IR (8-12 um) CCD effects in target acquisition studies.

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Phone: (415) 324-9681

Topic#: 90-034 ID#: 90-SW-014
Office: CECOM
Contract #: DAAB10-90-C-7053
PI: M. D. Drory

Title: Diamond Heat Pipes for Efficient Cooling of High Power Density Devices

Abstract: The high levels of heat being generated in state-of-the-art electronics systems are rapidly becoming the primary barrier to improved system performance. Without improved methods of thermal management, future increases in system speed will be increasingly difficult and in some cases impossible. This problem will be addressed through the use of all diamond ceramic composites -- a Crystallume proprietary technology. Thick section diamond composites with exceptional thermal conductivity will be fabricated as heat pipes for insertion in the high-power PWB application. This method provides a lower-cost alternative to heat pipes formed of solid CVD diamond slabs. In Phase II, design calculations will be performed to optimize the physical dimensions of the heat pipes for the specified application. Further development of the composite material will provide thermal conductivity greater than 10W/cm in useful heat pipes geometries. Fabrication issues will be addressed and incorporated in a prototype production process.

DANIEL H. WAGNER ASSOC., INC.
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HAMPTON, VA 23669
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Topic#: 91-234 ID#: 91SDC-234
Office: SDC
Contract #: DASG60-93-C-0035
PI: J.W. Greer

Title: Integrated Automated Search Systems for Underwater Search

Abstract: This Phase II proposal, based on a Phase I SBIR project, will provide a wholly integrated automated search and recovery system which will provide advance search planning support, target probability maps based on sensors' impact scoring, optimal search plans for real-time searches, automated control of search platform paths, automated contact data collection and

reduction, automated contact correlation, and automated re-planning support including Bayesian update of target probability maps using unsuccessful search information. It will also provide an investigation and recovery component, linked to on board computers, that will support remotely controlled, short-range surveying and debris recovery. The components of the system are separate, proprietary packages and the integration concepts are derived from a previous Wagner Associates project for on board search mission support software for the Navy's Deep Submergence Rescue Vehicle.

DELTA INFORMATION SYSTEMS, INC.
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Phone: (215) 657-5270

Topic#: 90-235 ID#: 90-AS-044
Office: CECOM
Contract #: DAAB07-93-C-B763
PI: Alan R. Deutermann

Title: Lightweight Video Computer Unit (LWCU) for Imagery Transmission

Abstract: This document is a proposal to develop a Lightweight Video Computer Unit (LVCU) that provides for imagery transmission in the battlefield. The LVCU is implemented as an integral part of the Army Lightweight Computer Unit (LCU) and is fully compatible with the Army common-hardware-software (CHS) concept. A Tactical Communications Interface Module (TCIM) is included to support the Army operational communications requirements. The units provide for the transmission of freeze-frame and motion TV imagery. They also provide for the storage and retrieval of the imagery for subsequent display and/or transmission. The development of custom hardware and software is to be minimized. As much off-the-shelf hardware and software is to be used as possible. The data compression algorithms employed will be based on existing standards to promote compatibility. Likely candidate standards are H.261, MPEG and JPEG/NITF. The proposed program includes demonstrations of the units via SINCGARS and MSE.

DYNA EAST CORP.
3201 ARCH STREET
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Phone: (215) 386-4884

Topic#: 91-087 ID#: 91MIC-125
Office: MICOM
Contract #: DAAHO1-93-C-R163
PI: Michael G. Crilly

Title: Design of an Advanced Tandem Penetrator System

Abstract: We propose to continue the development of the advanced tandem penetrator. Design issues to be addressed include: shape-charge warhead design and performance; KE (kinetic energy) penetrator design and performance; system performance versus delay time and standoff (against targets of interest); and target response. Phase I warhead designs will be manufactured and tested in full scale. CE shots will be performed to determine the design envelope of the shape-charge warhead against targets of interest. Sub-scale KE penetrator designs with various length-to-diameter ratios will be tested against advanced reactive armors. Sub-scale tandem tests (with CE surrogate warhead) will be performed to access the blast effects of the warhead on the KE penetrator. Sub-scale tests will be performed to demonstrate the feasibility of the concept. The proposed design and test efforts will provide for the cost effective development of a tandem penetrator system.

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Phone: (408) 730-5633

Topic#: 91-196 ID#: 91CER-033
Office: CERL
Contract #: DACA88-94-C-
PI: Andrew Whittaker

Title: Active Control of Building Structures Using Shape-Memory Alloys

Abstract: In recent years there has been a growing shift in earthquake-resistant design philosophy, from the conventional "life-safety" approach to performance-oriented and damage-control approaches. Providing a structure with the capability to dissipate large amounts of energy in a controlled and stable manner is one very effective means to achieve a performance-base design. Key requirements of any such energy dissipation (or damping) system are that it be reliable, perform stably, have low temperature and frequency dependencies, fatigue-resistant, and above all be predictable for design purposes. Shape-memory alloy damping systems encompass all of these features. Phase I results indicate that SMA damping concepts are very promising for passive seismic energy dissipation. This Phase II program involves the development of prototype SMA dampers, systems-level earthquake simulator tests of non-ductile reinforced-concrete and ductile steel frame structures incorporating SMA devices, and complementary analytical and parametric studies. A design guideline, which will synthesize the overall understanding of passive energy dissipation for building seismic design, and SMA devices in particular, will be prepared.

EASTERN ANALYTICAL, INC.
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Phone: (301) 314-7818
Topic#: 91-220 ID#: 91MED-068
Office: MEDICAL
Contract #: DAMD17-92-C-2054
PI: Larry J. Moore
Title: Field Portable Methods for Rapid Water Quality Analysis
Abstract: The availability of potable water is essential to protect the health of soldiers in combat and training. Current methods for the detection of pathogens or their indicator organisms typically require at least 24 hours, and perhaps as much as several days. Recent and ongoing advances in gene amplification and related measurement technologies offer the promise of developing a system that can be used to characterize these pathogens or their indicators in a fraction of the time now required. The Phase I project results have demonstrated the feasibility elements leading to the implementation of a prototype field portable system. These elements included a filtering system to isolate the E. coli bacteria from lake water samples, demonstration of a more efficient microwave lysis capability, and the evaluation, optimization and implementation of the E. coli DNA amplification process. In the proposed Phase II project, we plan to develop further the system components leading to the implementation of a prototype portable water analysis system. These components include an improved filtering system and survey of water sample types, optimization of the microwave lysis and DNA amplification efficiencies, and a simplified detection system for the amplification products.

EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450
Topic#: 91-107 ID#: 91107-03
Office: TACOM
Contract #: DAAE07-93-C-R120
PI: R. David Rauh
Title: Variable Emittance Devices and Coatings
Abstract: The purpose of this program is to demonstrate a technology in which optically switchable structures can be laminated onto planar and nonplanar surfaces. Phase I demonstrated the feasibility of a surface showing continuously tunable diffuse back reflectance. A technology review conducted during Phase I also revealed new liquid crystal technology which would be useful for large area laminates. Phase II will examine both electrochromic and liquid crystal designs of these surface laminates for diffuse reflective optical switching. Using these individual components, multicomponent laminates will be designed and tested. The goal of Phase II will be a demonstration of these optical switching devices, comprising arrays of individual elements so that either switching over the entire surface or in selected patterns can be achieved. Modifications to existing optical computer models will be employed to predict the optical effects of such surfaces.

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Phone: (617) 769-9450
Topic#: 91-145 ID#: 91ETD-115
Office: ETDL
Contract #: DAAL01-93-C-3355
PI: Dr. K. M. Abraham
Title: Rechargeable Lithium Battery with Solid Electrolyte
Abstract: The development of a solid-state Li/LixMn2O4 rechargeable battery, suitable for powering the Army's man-portable devices for communication, target acquisition, sensors and other applications is proposed. It utilizes a solid polymer electrolyte based on polyacrylonitrile (PAN) with a room temperature conductivity of about 3x10 to the -3ohm to the -1.cm to the -1. The feasibility of the battery was demonstrated in Phase I. The Phase II effort will focus on improving the low temperature performance of the battery, by identifying improved electrolytes, developing a practical LixMn2O4 composite cathode, and by fabricating and testing prototype cells and batteries. The Phase II effort will also deal with characterization of the Li/polymer electrolyte interface, and studies of the overcharge and overcharge behavior of the solid-state battery.

ELECTROKINETICS, INC.
LOUISIANA BUSINESS & TECHNOLOGY LSU, SOUTH STADIUM
BATON ROUGE, LA 70803
Phone: (504) 388-3992
Topic#: 92-151 ID#: 92WES-020
Office: WES
Contract #: DACA39-92-C-0140
PI: Robert Marks
Title: Feasibility of Using Acetic Acid for Improving Electrokinetic Remediation
Abstract: The basic scientific understanding acquired in development of electrokinetic remediation technology displays its

potential in in-situ removal of heavy metals, radionuclides, and some organic chemicals from soils. One specific problem associated with the current processing technique was precipitation of the metal close to the cathode as a metal hydroxide. It is demonstrated that acetic acid depolarizing of the cathode reaction and membrane techniques can successfully be used to remove and/or avoid this precipitate. This phase is designed to move the technology to full-scale field remediation. Pilot scale laboratory optimization studies and a pilot scale in situ demonstration study will be conducted. The pilot scale set-up will be installed at the hazardous waste research laboratory at WES. Soils from a military site will be used. Acolyte and catholyte recycling techniques will be evaluated. The effect of up-scale from bench-scale , assessment of the optimum processing conditions with respect to the electrode geometry and spacing will be determined. Project will be concluded by a pilot-scale in situ demonstration study at a military site. Construction and design guidelines will be developed.

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Topic#: 91-118
Office: WTD
Contract #: 93-C-0030
PI: L. C. Elmore

ID#: 91BRL-012

Title: BLPG Combustion Control by Means of Multipoint Ignition and Chamber Geometry

Abstract: The Phase II experimental and analysis program is aimed at fulfilling the following specific objectives: * Evaluation of Multipoint Ignition (MPI) concept ability to partition Bulk Loaded Liquid Propellant Gun (BLPG) combustion into cells capable of influencing the combustion process. * Experimentally determine feasibility of detecting onset of faulty BLPG combustion and ability to correct these anomalies. * Evaluate the effect on BLPG interior ballistic performance of a T-breech configuration and its potential utility as a mechanism for velocity control. * Determine the effectiveness of programmed MPI as a means of increasing BLPG performance. * Develop an MPI data base, in convenient format, for analysis within the program and by the Army Research Laboratory. * Employ MPI test equipment diagnostic capability to develop a better general understanding of the BLPG combustion process.

ENERGY COMPRESSION RESEARCH CORP.
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Phone: (619) 450-6612

Topic#: 91-142
Office: ETDL
Contract #: DAAL01-93-C-3354
PI: David Giorgi

ID#: 91ETD-081

Title: Power Combiners for Picosecond Rise-Time Multi-Megawatt Pulses

Abstract: ECR proposes to build and test a high power microwave source based on laser activated silicon switches (LASS) for Army ECM applications. The high power microwave source, which operates at low impedance, will be coupled to an efficient impedance transformer to enable connection to the 50 Omega (nominal) input impedance of the antenna. The source will generate either one pulse or one complete cycle of microwave energy with a peak voltage of 20kV into 50 Omega with a rise-time of less than 200ps. The repetition rate (dependent on the laser system and available funds) will be between 10Hz and 10kHz. The system life-time (source and laser) will be up to 10(5) shots. The laser will be a diode-pumped Nd:YAG laser with sufficient energy to operate the switches in the "linear" as compared to "avalanche" regime. In the linear regime the switches possess low jitter (<1ps), low "on state" impedance, high power capability and long life. To date, these sources have demonstrated the highest power with the fastest rise time of any competing technology. Under the Phase I SBIR program ECR demonstrated over 60 MW with a rise time of 136ps. In a related program long life-time (~2 million shots at 30MW) with reasonable laser requirements (83nJ of laser energy per megawatt of microwave power) was demonstrated. With further development in coupling techniques, improvement by a factor of eight is expected in the conversion of optical to RF energy.

FEMTOSCAN CORP.
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Topic#: 91-007
Office: ERDEC
Contract #: DAAA15-94-C-0001
PI: Neil S. Arnold

ID#: 91CRD-021

Title: Integrated, Handheld Automated Vapor Sampling-Transfer Line Gas Chromatography

Abstract: Phase I SBIR developments along with corporate efforts by FemtoScan and Graseby Ionics have demonstrated the feasibility of a handheld TLGC/IMS device for monitoring ambient vapors at low concentrations in near real time. The presently proposed effort is to construct an integrated, application ready system for sample preconcentration, automated vapor sampling,

transfer line gas chromatography and ion mobility spectrometry. This program proposes the construction of two AVS-TLGC/IMS prototypes which will be capable of TWA level responses in <2 min utilizing highly specific, 2-dimensional GC/IMS detection techniques. To obtain the most responsive system currently possible, development of improved data acquisition and reduction techniques for the increased data yield rate and dimensionality, as well as an improved GC to IMS source interface will be undertaken. Finally, a portion of the program will be directed toward application development and performance testing to evaluate the full range of analyses suitable to AVS-TLGC/IMS analysis and to verify the performance level of the prototype devices.

FLAM & RUSSELL, INC.
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Topic#: 90-278 ID#: 90TAC-009
Office: TACOM
Contract #: DAAE -R070
PI: J.P. MacGahar

Title: Four Input Omnidirectional Microwave Antenna (FIMA) (with directional option)

Abstract: Current robotic ground vehicles transmit four simultaneous microwave frequency video channels back to a command and control center. Because there is little available room, use of separate antennas for each transmitter is not feasible and frequency multiplexers have unacceptably high losses because of the small channel separations used. This Phase II proposal is for the development of an omnidirectional antenna array fed by a Butler matrix, which allows the array to be "reused" by each transmitter. Up to seven transmitters operating in the 1.71-1.85 and 2.2-2.3 GHz telemetry bands can simultaneously be connected to this antenna without interference. This novel approach will improve system performance and versatility through elimination of the lossy and frequency specific multiplexers presently in use. Six prototype antennas plus an environmental test article are to be produced in the Phase II effort. The design will be thoroughly evaluated in the laboratory and in the field while mounted on a robotic vehicle. The feasibility of this concept was proven in a Phase I effort through the design, construction and evaluation of an engineering test model. This proposal includes an option for conversion of the array to a single input steered directional antenna.

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WALTHAM, MA 02154
Phone: (617) 890-3200

Topic#: 91-095 ID#: 91NAT-034
Office: NATICK
Contract #: DAAK60-93-C-0062
PI: Tom Walton

Title: Nonplastic Substitute for the Plastic Milk Bladder

Abstract: The U.S. Army and the Navy have identified the need for biodegradable food containers to prevent pollution of the environment and potential injury to marine life during the disposal of shredded and pulped food wastes at sea. In this recently completed Phase I program, Foster-Miller identified several biopolymers that simultaneously offer environmental degradability, mechanical durability, FDA and USDA approval, processibility and low cost into a single product. Results of mechanical, permeability and adherence test conducted during Phase I showed that commercial biopolymer films meet all performance requirements for biodegradable milk bladder applications. The proposed Phase II program will further refine and characterize the novel, environmentally degradable biopolymer films studied in Phase I. Concurrently, we will develop two designs for a biodegradable milk bladder that meets or exceeds all performance requirements and is practical to produce. Phase II will include a rigorous test program including specimen, intermediate and full-scale milk bladder testing. Additionally, Foster-Miller will work closely with milk bladder manufacturers, milk packagers and biopolymer suppliers, so as to provide a smooth transition of the technology into commercialization.

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Topic#: 91-089 ID#: 91NAT-008
Office: NATICK
Contract #: DAAK60-93-C-0041
PI: Leslie S. Rubin

Title: Three-Year Shelf Life, High Barrier Food Container

Abstract: Foster-Miller has recently completed a Phase I in which we demonstrated the feasibility of using liquid crystal polymer (LCP) to produce thermostabilized meal trays (TMT) that provide a 3-yr shelf life. We clearly demonstrated that biaxially oriented LCP films produced using Foster-Miller's proprietary extrusion process have oxygen and water vapor permeabilities

that are significantly lower (1 to 2 orders of magnitude) than today's leading food packaging barrier films. Analysis by industry experts have indicated that 3 to 6 mil thick LCP films should readily provide the barrier protection needed to ensure a 3-yr shelf life TMT. The primary goal of this Phase II program is to produce and test LCP based prototype TMTs that will provide a 3-yr shelf life, withstand retort temperatures as high as 280° F at over pressures of 22 to 28 psi, remain inert and impermeable to greases, acids, fats, and aroma, maintain container integrity after exposure to vibration and rotations drop from 18 in., and be dual ovenable. The TMT also will be economical and have a heat sealable closure that is reliable, yet relatively easy to open.

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CEDAR GROVE, NJ 07009
Phone: (201) 239-3400
Topic#: 91-117 ID#: 91BRL-007
Office: WTD
Contract #: 93-C-0068
PI: Gregory C. Burke
Title: Laser Ordnance Ignition Systems

Abstract: Proposal to investigate, produce, and demonstrate methods to couple high energy laser radio into confined high-pressure regions for the purpose of igniting propellants for large caliber gun propulsion for the Army is described. The technology required to seal optical fibers in rugged steel components (optical fiber feedthroughs) is being developed. Metallic thin films are deposited onto the fibers using ceramic adhesives, organometallics, chemical vapor deposition and metal sputtering. The fibers can then be welded into metal components of any shape and used for the transmission of laser radiation into heretofore optically inaccessible areas. The same feedthrough technology will be used in commercial markets for environmental sensors, laser delivery for surgery, medical sensors, high vacuum or high pressure access, chemical in-process control for industry, optical access for radioactive environments, automotive applications (engine combustion analysis), fly by light applications, space station and marine and oceanographic sensors. Dual use technology applications: Optical fiber feedthroughs are needed in nearly every commercial sector where a safe and reliable method to convey laser light, sensor information, data and spectrophotometric information is required. Optical fiber feedthroughs are a dual use technology and have applications in many industries. Applications include space, aerospace, marine, medical and industrial process and control and wherever transmission of optical information across and environmental barrier is necessary. Optical feedthroughs which General Fiber Optics is developing are being used to couple laser energy into hostile, high-pressure areas for large caliber gun propulsion. This work is performed under the LIGHT Program (Laser Ignition in Guns, Howitzers and Tanks) for the Advanced Field Artillery System (AFAS) liquid propellant gun and the Unicharge 155 mm howitzer. The technology developed under the Phase I and Phase II has been used to develop feedthroughs sold to customers such as NOAA for underwater spectroscopy, AED for space and atmospheric research, Exxon for petrochemical research, and NASA Langley for space plane engine.

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Phone: (315) 339-5502
Topic#: 91-199 ID#: 91CER-045
Office: CERL
Contract #: DACA88-93-C-0009
PI: Thomas V. Edwards
Title: Geo-based Environmental Audit Support System

Abstract: The recent years have brought increasing demands on DoD environmental managers to support Underground Storage Tank (UST) program maintenance and compliance. These demands arise in part from the enormous data management requirements associated with the environmental compliance and decision support and in part from the increased environmental awareness in general. A complex fusion of diverse data types and formats is required to support the decision making process stressing the current predominantly manual procedures for data organization, management, retrieval, and processing. In this Phase II proposal, we build on the successful Phase I design and prototype demonstration, to provide a well-integrated, comprehensive, and easy-to-use mapping and data management/retrieval capability for UST program management and compliance support. The proposed GRASS-based system focuses on the requirements of a candidate end-user, Fort Drum, providing interoperability with USACERL for regulatory data dissemination, and interoperability with USATHAMA for compliance management. The proposed system is adaptable to any DoD organization and industry faced with UST regulatory program requirements.

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Topic#: 90-470 ID#: 90ARD-030
Office: ARDEC
Contract #: DAAA21-91-C-0024
PI: R. Glenn Wright

Title: Expert System Verification and Validation Paradigm Development

Abstract: The proposed research will result in the development of expert system verification and validation paradigms, implemented through a handbook and automated tool approach, which may be used throughout the expert system life cycle. This will be accomplished through detailed analysis and comparison of expert system and conventional software development practices and standards, determination of differences, and generation of new and adaptation of existing verification and validation techniques. Concurrent engineering and design for testability techniques specifically tailored to the field of artificial intelligence will form a significant portion of our approach. These results would be incorporated into a suite of handbooks and automated tools to assist in accomplishing verification and validation. Rule-based, model-based, and hybrid expert system requirements will be addressed, as will the various features of these systems, including interfaces to database systems, external programs and routines, user interfaces, explanation and trace facilities. Recommendations for implementing the results of this research, including possible areas for consideration for standardization, will also be developed and presented.

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Topic#: 90-472 ID#: 90ARD-032
Office: ARDEC
Contract #: DAAA21-91-C-0062
PI: Edwin S. Hodge

Title: Powdered Metal Preforms for Barrel Liners

Abstract: Recent improvements in hot isostatic pressing techniques have allowed an Austrian company to supply full length liners made from Nimonic 105 to a Swiss gun manufacturer. These techniques have been utilized in the U.S. for lining of tubes for the chemical and nuclear industries and for lining of valves for wear and erosion resistance. This technology, based upon cold and hot isostatic pressing techniques, will be developed for the specific materials of interest using staff, equipment, and innovative technology to produce a superior material in the rifled barrel section without an unacceptable cost impact. Two basic approaches could be used to accomplish the end objective. The first approach would be to fabricate the liner as requested by isostatic processing, machine the liner, shrink fit the liner into the conventional barrel, and heat treat. The second approach would involve processing in a piggy-back fashion barrel-liner composite specimens in a cost effective manner. This approach would be to simultaneously fabricate the liner and bond it to the barrel to avoid machining to close tolerances, insertion and shrink fitting of the liner, and possible the final heat treatment. This approach permits lower fabrication temperatures, grain size control and permits improved microstructural control. The cost analysis would compare both approaches with the current fabrication costs and benefits.

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Topic#: 90-209 ID#: 90BRD-008
Office: BRDEC
Contract #: DAAK70-93-C-0014
PI: William J. Graham, Ph. D.

Title: Focused Rectangular Synthetic Array for Microwave Detection/Imaging of Mines

Abstract: This proposal is for the Phase II SBIR contract to experimentally verify a focused synthetic rectangular array technique for microwave detection and imaging of mines proposed by Graham Research Corporation. The results of the Phase I contract have conclusively demonstrated that surface reflections are significantly reduced, and subsurface target detection enhanced. The Phase I experiments have demonstrated feasibility of the concept of a focused rectangular synthetic array using a simplified crossed line array geometry. The goal of the Phase II program will be to design, fabricate, and test an experimental rectangular synthetic array for experimental verification and simulation of the proposed method. The Phase II experiments will determine the performance, capabilities and limitations of the proposed system for various soil and target conditions. System parameters will be determined such as resolution, attenuation, reduction of surface reflections, and effects of refraction due to dielectric constant and conductivity of the soil. The results of the experimental program will allow an improved system design concept to be developed. This will provide the basis for an advanced development model of the system in Phase III.

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Topic#: 90-016 ID#: 90ARD-015
Office: ARDEC
Contract #: DAAA21-93-C-0083
PI: Dr. Ronald W. Gumbs

Title: Electronics Encapsulation Using Conducting Polymer Coatings

Abstract: The technical approach involves polymerization of a number of promising aromatic mines identified during Phase I with emphasis on increasing the conductivity and mechanical properties for the polymers and on improving the quality of the coatings. The capability to prepare films of uniform thickness and free of defects will provide a solid framework for investigating the effect of layering on the EMI shielding effectiveness in the GHz region. An integral component of the research plan is the continuation of theoretical studies in order to design and synthesize more highly conductive poly(aromatic mines). The approach adopted in line with the objectives of the program includes the development of intrinsically conductive epoxy encapsulant in light of the fact that the poly(aromatic mines) are miscible with liquid epoxy resins.

HIGH PERFORMANCE MATERIALS
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Topic#: 91-152 ID#: 91HDL-302
Office: HDL
Contract #: DALL02-93-C-0056
PI: T.C. Peng

Title: Advanced Composite Solder for Microelectronics

Abstract: During Phase I of the U.S. Army SBIR program on Advanced Composite Solders for Microelectronics, HPM, Inc. successfully demonstrated the feasibility of producing by induction melting and inert gas atomization conventional 63Sn-37Pb solder powders and dispersion strengthened Tin-Lead solder alloys and composites with desired powdered characteristics and significant improvements in room and elevated temperature strength, creep resistance and fatigue life over conventional solders. The proposed Phase II program is to define the manufacturing parameters critical to process control, develop a large scale commercial powder plant for the production of high performance solders, implement quality control inspection techniques for producing composite solders and demonstrate a computer model of the composite solder matrix to allow transition of technology to MIL-STD-2000 soldering standards. 100-500 lb. batches of Sn-Pb-X (X-Cu, Ni, Ag, Sb, In, Bi) and lead free Sn-Ag solder alloys will be produced by induction melting/gas atomization, consolidated by hot isostatic pressing, and extruded to rods. Solder powders as well as bulk solders will be evaluated for microstructures, mechanical properties, and solderability by HPM, Inc., as well as by the potential customers. A business plan for commercialization of the product during Phase III will be prepared.

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Topic#: 90-371 ID#: 90MTL-022
Office: MTL
Contract #: DAAL01-93-C-4001
PI: Thomas Jones

Title: Portable Thermographic Inspection for Composites

Abstract: Infrared thermal imaging, combined with advanced image processing techniques and design for portability, is proposed as a method for enhancing the detection of critical defects in composite structures in a field environment. The infrared imaging approach offers the advantages of providing a portable, non-contact inspection system with one-sided inspection capability and rapid inspection of relatively large areas. Data can be collected on videotape and can be viewed in real-time for many defect conditions. Post-inspection analysis of the data at an image enhancement workstation can increase the sensitivity for the detection of less severe defect conditions. The Phase I results established the feasibility of using the portable design and advanced image processing to demonstrate the sensitivity of thermographic inspection to detect composite impact damage (including minimal damage barely detectable by visual methods). The Phase II program will further refine the design concepts and the image processing to optimize sensitivity for various types of discontinuities. A wide range of composite samples will be available for the Phase II program by arrangements made with MTL and many other DoD-related organizations. Samples will include laminates and sandwich structures. Degradation processes will include impact, moisture, and heat. The Phase II program will include guidance for test interpretation and a preliminary evaluation of defect impact on performance. A prototype portable inspection system will be developed, demonstrated, and delivered under the Phase II program.

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Phone: (408) 446-9812
Topic#: 91-075 ID#: 91MIC-012
Office: MICOM
Contract #: DAAHO1-93-C-R128
PI: Richard A. Becker
Title: Rugged/Low-Cost Pigtailing Approaches for LiNbO3 Fiberoptic Gyroscope Chips II
Abstract: It has been widely recognized that optical techniques offer significant advantages in the fields of communications, sensors, and signal processing. However, methods of environmentally robust and low-cost packaging remains undeveloped. The principal technical objective of this Phase II Proposal is the development of the devices, approaches, and processes demonstrated in Phase I, culminating in the design of equipment and facilities for producing large quantities of small, high-performance integrated optic components. The totally monolithic approach to fiber attachment that was demonstrated in Phase I and uses no organic adhesives will be developed. Precision-saw based micromachining techniques will be heavily utilized. The finished devices will be environmentally robust and capable of being produced in volume at low cost. Equipment and facilities for mass-production will be designed. The Optical IC Concept discussed in Phase I will be demonstrated in Phase II. It is believed that this revolutionary approach to device interconnection will have far-reaching effects on the field of photonics within five to ten years. In summary, the topic considered by this Proposal is the reduction to practice of advanced micromachining-based fiber pigtailing approaches for the mass production of robust and low-cost integrated optic components.

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Topic#: 90-223 ID#: 90-EW-034
Office: CECOM
Contract #: DAAB07-93-C-U268
PI: Chris Wilder
Title: Lightweight Surveillance Radar Array
Abstract: The proposed program objective is a demonstration of a lightweight, low power, man portable electronically (azimuth) scanned array at an affordable cost. A successful demonstration of a lightweight array when combined with a coherent processor will provide the U.S. Army with a Lightweight Battlefield Surveillance Radar (LBSR) that, when compared to the AN/PPS-5/15, is estimated to provide twice the detection range for personnel and vehicles, require less battery power, provide higher reliability, and lower total system weight. In addition, the demonstration of a production procurement specification and a realistic estimate of production cost will be provided. Several key technologies have been designed into the LBSR concept during Phase I that should now be demonstrated to confirm the preliminary performance predictions of Phase I. The enabling technologies and materials that make a lightweight and efficient electronically scanned radar possible are: (1) a low rf loss and bias efficient 5-bit phase shifter; (2) a monolithic rf circuit assembly; and (3) an extremely lightweight housing made of a conductive composite and honeycomb material (for EMI shielding).

INTEGRATED TECHNOLOGIES FOR MED.
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Phone: (301) 681-8307
Topic#: 91-153 ID#: 91HDL-009
Office: HDL
Contract #: DAAL02-93-C-0039
PI: Perry Skeath, PhD
Title: Development of Microscale Fluidic Devices
Abstract: The purpose of this work is to develop the technology for designing and manufacturing high-performance and high-reliability microfluidic components. In the Phase II portion of the work, the emphasis is on microfluidic device microfabrication methods and on production of prototypes.

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Topic#: 90-018 ID#: 90ARD-017
Office: ARDEC
Contract #: DAAA21-90-C-0091
PI: Alice B. Scandura
Title: Improving RAM in Large Systems by Combining the "Waterfall" and "Rapid Prototyping" Models
Abstract: Better development and maintenance methods and tools are needed to improve software reliability, availability and maintainability (RAM). Of particular importance are reducing costs and facilitating communication between developers and maintainers throughout the life cycle. Our Phase I research has demonstrated the feasibility of a new cognitive technology (with

supporting tools) which combines re-engineering (maintenance) along with the "waterfall" and "rapid prototyping" models of development. In the Phase II research we propose to: 1. Develop training materials on the cognitive technology and tools required for its implementation. 2. Assess special Army software needs pertaining to the cognitive technology and implement ways to meet those requirements by adapting methodology, creating links between tools and/or adding needed enhancements. 3. Select three software development and/or maintenance projects, which both we and responsible project personnel believe could benefit from adoption of the cognitive technology. 4. Train Army and associated contractor personnel in use of the cognitive technology and supporting tool sets. 5. Provide consultation to help Army project personnel successfully apply the cognitive technology and support tools to the selected projects. 6. Document project progress with particular attention to similarities and differences as compared to traditional methodologies and tools. 7. Present the results at a seminar and workshop open to all interested Army personnel and contractors. 8. Prepare a report evaluating the above projects for broader dissemination throughout the Army and the DoD generally.

INTERNATIONAL ELECTRONIC MATERIALS
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Topic#: 91-152 ID#: 91HDL-007
Office: HDL
Contract #: DAAL01-93-C-0111
PI: Jennie S. Hwang

Title: Advanced Composite Solder for Microelectronics

Abstract: With the continued innovation and development of microelectronic circuitry toward higher density, faster speed, light in weight and smaller in size, the demands on solder interconnections, particularly for the board-level packaging, become increasingly stringent. The increased density and decreased size in solder joints, per se, draw concerns about the reliability of such solder joints which are made of conventional solder materials. Furthermore, it has also been a concern in the manufacturing sector that a significant portion of the cost in producing microelectronic assemblies is contributed by the inspection and rework of solder joints. The objectives of this project are to further advance the science and technology of solders by utilizing the fundamental scientific principles; to explore and establish the technology for strengthening solder materials; to devise useful products which offer superior performance to conventional solders; and, concurrently, to explore the scientific and manufacturing feasibility in reduction of lead (Pb) usage in solder materials. The effort of the proposed Phase II program will focus on three main areas; (i) to establish the material base which imparts superior performance characteristics as demonstrated in the scouting effort of Phase I program; (ii) to develop a process in producing the new materials in powder form; (iii) to design the new materials in paste form to meet the commercial requirements of manufacturing automation using surface mount and fine pitch technology. It is anticipated that the success of the program will provide the government and industry a new generation of superior solder materials which are in ready-to-use and much-in-demand paste form as well as in other physical forms as desired for commercial applications.

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Topic#: 90-233 ID#: 90-EW-042
Office: CECOM
Contract #: DAAB07-93-C-U257
PI: Dr. James Castracane

Title: Advanced Microchannel Plate 1 Based Laser Detector Intensifiers

Abstract: As amply demonstrated in Operation Desert Storm, the remote sensing and tracking of threats is a critical technology. To overcome advances in electro-optic countermeasures, the detection of extremely low levels of light is necessary. Present day systems used by the U.S. Army such as the High Resolution Search/Track Sensor (HRSTS) incorporate high speed PIN silicon detector arrays. These arrays offer high spatial resolution and good responsivity for sensing scattered light. However, the inclusion of a light amplification stage before the PIN photodiodes can extend their range significantly. For this application, an ideal choice is the microchannel plate (MCP). The MCP has found widespread use in image sensing, spectroscopy and other applications requiring high resolution, low light level detection. The Phase I effort developed an optimized MCP design for direct coupling to the HRSTS PIN array. Performance predictions yielded several orders of magnitude improvement for the compound system. The proposed Phase II effort will involve the procurement and assembly of the optimized MCP based image intensifier and a testing program for a calibrated demonstration of system improvement. The anticipated results of Phase II include a finished prototype for interface to the HRSTS system for field tests and advanced development and deployment.

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Topic#: 91-126 ID#: 91ARO-060
Office: ARO
Contract #: DAAL03-91-C-0045
PI: J. Albert Schultz

Title: Technique for In-Situ Quantifation of Dopants and Major Element During Epilayer Growth and Processing

Abstract: Control of atomic composition during deposition of ternary heteroepitaxial thin films (e.g. quantum well structures) is crucial to device fabrication and is difficult to accomplish. Furthermore, real time measurement of dopant concentrations during deposition is impossible. Now, however, our Phase I results using Mass Spectroscopy of Recoiled Ions (MSRI) from GaAs wafers offer an experimental technique for accomplishing this necessary real time control. In addition, we have established detection limits for the systems GaP/InP/InAs, AlGaAs, InGaAs doped with Si and Be, and polyster films. Our technique works on highly insulating films and is sensitive to elements like N and Zn which are difficult to detect by Secondary Ion Mass Spectroscopy (SIMS). Two objectives of Phase II will be to: 1) commercialize an instrument which can perform simultaneous MSRI/SIMS sputter profiling for in situ analysis and 2) use MSRI for in situ analysis during film growth of InGaAsP optoelectronic material by Chemical Beam Epitaxy (CBE).

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Topic#: 90-081 ID#: 90TEC-006
Office: TECOM
Contract #: DAAD05-93-C-0100
PI: Thomas S. Johnson

Title: Projectile Follower Ranging and Tracking Control System

Abstract: The Phase II program will perform an evaluation of the gun barrel characteristics and sensing system and evaluate the correction factors required to implement a tracking algorithm. This effort will develop an enhanced sensing and prediction scheme for the PFS. The design, fabrication, test and integration of a real time in barrel ranging system and a projectile tracking system for use with PFS in a closed loop control configuration are objectives of this phase. The PFS will use a ranging system to determine the projectile exit profile from the gun barrel and select the correction profile of the mirror drive. An acquisition sensor system will initiate active control of the PFS mirror as the projectile accelerates from the gun barrel. A tracking system is used in conjunction with the PFS and tracks the projectile after it exits the muzzle. The proposed system utilizes a short pulse high repetition rate laser illuminator, expanded acquisition, sensor conditioning, and angle and range measurement system to develop angle errors and provide target discrimination. An inner loop Two Axis Beam Steerer maintains the tracking detector field of view and the laser beam on the projectile for real time control of the Projectile Follower Tracking System.

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Topic#: 91-046 ID#: 91-NV-259
Office: CECOM
Contract #: DAAB07-93-C-U008
PI: Blaine Johs

Title: Real Time Monitor and Control of MBE Growth of HgCdTe by Spectroscopic Elliopsometry

Abstract: Hg1-xCdxTe is a II-VI semiconductor used extensively in infrared imaging and night vision electronics. These materials have soft surfaces, and growth of reproducible values is extremely important but difficult. Device yields are low and costs are high. Thus there is a great need for non-destructive, non-invasive process control. Spectroscopic ellipsometry is capable of measuring, and thus controlling, the x value to very high accuracy. Layer thickness control during etching is also possible by ellipsometry with atomic scale resolution. In Phase I we demonstrated the effectiveness of an ellipsometer which measures at 12 wavelengths simultaneously and with sufficient speeds that accurate control of x value during growth should be possible. In both growth and etching the surface roughness can be measured in real time. Our goals in Phase II are to build, install, and test an ellipsometer on the Army Night Vision Laboratory MBE chamber which will lead to accurate control of mercury content as well as monitor roughness during MCT growth. This technology will then also be available for other DoD MCT contractor laboratory use.

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Topic#: 90-452 ID#: 90ARI-006
Office: ARI
Contract #: MDA903-93-C-0092

Phone: (513) 873-8166 PI: Caroline E. Zsambok
Title: A Comprehensive Program to Deliver On-the-Job Training (OJT)
Abstract: The goal of this project is to develop a reliable, effective program for delivering on-the-job training (OJT). The project will highlight the critical role of the experienced worker tasked with guiding novice personnel to competency, using Cognitive Task Analysis methods to identify the skills, knowledge, and abilities of highly proficient OJT providers. The program will encompass OJT for individuals and for teams working toward a collective goal. The proposed program of research will be carried out with Army armor units at the SIMNET facility at Fort Knox, KY. The Army has recognized the importance of field exercises and high fidelity simulators in development of combat skills. But little attention has been given the role of NCOs, platoon leaders, and company commanders in training those skills. Training is a recognized part of their role, although they are not classroom instructors. Like their counterparts outside the military in health care, manufacturing, and industrial settings, they have received little guidance and few tools to help them function as trainers. The project will produce a comprehensive overview of requirements for a successful OJT program including selection and performance requirements for OJT providers, methods and materials for training OJT skills, and criteria and tools for evaluating OJT effectiveness.

KVH INDUSTRIES Topic#: 92-152 ID#: 92WES-026
110 ENTERPRISE CENTER Office: WES
MIDDLETOWN, RI 02840 Contract #: DACA39-92-C-0141
Phone: (401) 847-3327 PI: A. Kits van Heyningen
Title: Acoustic Buoy Release for Locating Underwater Instruments
Abstract: KVH Industries proposes to design and demonstrate a low-cost shallow-water acoustic buoy release system designed to locate and retrieve underwater instruments. The proposed Phase II effort will finalize the design and deliver to the US Army Corps of Engineers two pre-production hardware buoy release systems that fully address the challenges of search rate, homing, slant range measurement, localization, buoy release, and acknowledgment. The Phase II effort will build upon the Phase I proof-of-concept breadboard design and complete the design, development, field trials, tooling, and pre-production prototype delivery of two low-cost shallow-water buoy release systems. While focusing on the development of a system priced at less than $1,000, KVH will ensure that the design optimizes in-water life and correct response to address and command while minimizing the probability of a false trigger. Our goal will be to ensure that delivered pre-production prototypes can successfully complete field trials and demonstrate performance equal to or better than buoy release systems costing from three to eight times more. By the completion of the Phase II effort, KVH will have sufficient in-water data to define the operational envelope of the system prior to delivery of the two pre-production prototypes.

LABTEK CORP. Topic#: 91-004 ID#: 91-SE-305
565 WAGON TRAIL Office: CECOM
ORANGE, CT 06477 Contract #: DAAB07-93-C-Q006
Phone: (203) 877-2880 PI: Thomas E. Griest
Title: Reusable and Adaptive Schedules for Ada Real-Time Applications
Abstract: This project will conduct research and development on Reusable and Adaptive Schedulers for Ada real-time applications. A proposed product: "AdaTIME" is envisioned which is a set of software tools and runtime routines which support the life-cycle software engineering for real-time applications. The end objective of this project is to advance the state of the practice in the development of real-time software in Ada. The product covers four areas of computer aided software engineering: 1. tools for accurately determining worst case execution time; 2. runtime support for flexible scheduling; 3. tools for software reuse; and 4. methods for enhancing the predictability of real-time software.

LB&M ASSOC., INC. Topic#: 91-248 ID#: 91PM-002
211 SW 'A' AVENUE Office: STRICOM
LAWTON, OK 73501 Contract #: M67004-93-C-0042
Phone: (405) 581-3722 PI: William R. Brown
Title: Simulation Networking (SIMNET) Training Performance Assessment
Abstract: LB&M will develop a prototype Automated Training Analysis and Feedback System (ATAFS). ATAFS is an expert system that automatically generates after action review (AAR) training aids for SIMNET collective training exercises based on

answers to preexercise questions, trainer responses to interactive prompts, and rules embedded in ATAFS's knowledge base. ATAFS approach reduces the number and complexity of operator skills needed to operate the system, and compliments the trainer's level of technical and tactical competence and skills of observation. For the Phase II we will encode rules developed during Phase I for platoon task: "Execute Actions on Contact" and acquire sufficient hardware to demonstrate three capabilities. First, we will demonstrate the functioning of rules which trigger the generation of AAR aids based on the recognition of specific tactical events by the system or the trainer. Second, we will demonstrate ATAFS's ability to perform computations and construct AAR aide during and after the exercise. Third, we will demonstrate ATAFS's ability to arrange AAR aids generated from diverse sources and integrate them into a single medium.

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Topic#: 91-241 ID#: 91SDC-178
Office: SDC
Contract #: DASG60-93-C-0043
PI: Ben C. Platt, PhD

Title: High Energy Laser Target Plane Diagnostic Instrumentation (BDI) Development

Abstract: Lentec successfully completed Phase I of this technical effort and has completed the Phase I Final Report. The objective of Phase I was to develop the requirements for at least one instrument that can measure/determine the HEL beam intensity in the target plane using one of three methods. Lentect exceeded the Phase I objective by developing the requirements and a conceptual design for a suite of modular instruments integrated into a common opto-mechanical structure that could measure/determine the HEL beam intensity in the target plane using all three methods. This proposal is for the development of two of the most innovative instruments that can have significant commercial applications. One is a power and aberration monitor (PAM). The other is a modern imaging spectrometer and spectropolarimeter (MISSP?R). The optomechanical structure and a basic Data Cube data acquisition system are also proposed. Both have growth potential to support all the instruments developed in the Phase I study. The instruments are modular so they can be removed and used in other set ups. The high resolution 2-D, imaging spectrometer comes with an InSb camera that has frame rates up to 1000 Frames per second.

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Topic#: 91-028 ID#: 91MED-317
Office: MEDICAL
Contract #: DAMD17-91-C-1107
PI: Stephen A. Livesey, MD, PhD

Title: Prolonged Preservation of Human Platelets for Combat Casualty Care

Abstract: The aim of this proposal is to develop protocols for the long-term 4 degree Centigrade storage, cryopreservation and ultimately, freeze-drying of transfusable human platelets for transfusion. Optimization of platelet isolation, cryopreservation and freeze-drying will be combined with specific modulation of membrane dynamics and stimulus response coupling mechanisms to reversibly inhibit activation of the stored platelet. This approach has the potential to greatly extend the shelf life of functional platelets stored at 4 degrees Centigrade, enable long-term cryoperservation at -80 degrees centigrade and ultimately enable highly stable freeze-dried preservation of platelets, thereby addressing in a sequential manner the current major limitations of platelet storage. The effectiveness of the processing procedure will be assessed by numerical recovery, morphology and in vitro functionality. In vivo assessment of total recovery and circulatory half-life will be conducted in two animal models, the rabbit and the rodent. Following animal studies, safety and half-life of 4 degrees Centigrade stored, cryopreserved and freeze-dried platelets will be assessed in small volume clinical studies. Extended preservation of platelets will be assessed in small volume clinical studies. Extended preservation of platelets as described in this proposal will facilitate the availability of platelets for combat casualty care and enable the storage of autologous or typed platelets for civilian use.

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Topic#: 91-028 ID#: 91MED-332
Office: MEDICAL
Contract #: DAMD17-91-C-1105
PI: G. Duncan Hitchens

Title: Electrochemically Based Modules for Water Sterilization in the Field

Abstract: The goal of this project is to develop an ozone gas sterilizer suitable for operation in field medical situations. In the field, fast sterilizer cycle times and the ability to operate with few logistical constraints are critical requirements. In Phase I,

an electrochemical ozone generator was successfully assembled, and the potential for rapid sterilization using ozone was demonstrated. A key element of the project success was based in the high concentration of ozone (15-20 wt %) produced by the electrochemical reactor. The Phase I results established a sound technical base for reactor scale-up. Sterilizers based on electrochemical ozone generation offer significant technology and logistic advantages over all other sterilization methods for field use. Ozone is a highly effective sterilant against all classes of microorganisms. The electrochemical ozonizer will generate ozone from water on demand; hence, the logistical requirements are minimal and the high gas phase concentrations contribute to short sterilization cycle times. There are no hazardous residuals associated with ozone use (it decomposes to oxygen), and aeration times are short. Lynntech, Inc., has prepared a Phase II proposal to develop and test an integrated electrochemical ozone generator-ozone sterilizer that will permit rapid sterilization turn-around cycles, enable application of logistic benefits and provide alternative ozone uses for support of military field activities (i.e., treatment of drinking water, preparation of pharmaceutical-grade water and biomedical waste treatment). The principal research and development components of the Phase II project are: (i) scale-up of the electrochemical ozone generator; (ii) establish sterilization parameters for biological indicator microorganisms using 15-20 wt % gas phase ozone; (iii) design and fabrication of an integrated pilot-scale ozone sterilizer system, and (iv) demonstration testing of the pilot-scale system.

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Topic#: 92-151 ID#: 92WES-017
Office: WES
Contract #: DACA39-92-C-0183
PI: Dalibor Hodko

Title: Pulsed DC Electric Fields for Heavy Metal Decontamination of Soil

Abstract: In a Phase I SBIR project, Lynntech, Inc. demonstrated the feasibility of a novel approach for electrokinetic (EK) processing of soils contaminated with heavy metals. The innovative approach combined homogeneous (DC) and non-homogeneous (pulsed DC or AC) electric fields and interrupted pumping of pore liquid through contaminated soil to bring about enhanced decontamination rates of heavy metal pollutants. The results of the Phase I study identified a rationale for applying advanced electrokinetic processing techniques which offer significant cost advantages. Specific areas have been identified for further development and scale-up in Phase II. Three key features of the approach form the basis of follow-on development studies in the Phase II project: (1) increased migration and removal of heavy metal ions from soil by application of nonhomogeneous electric fields; (2) and electrode well design that yields enhanced contaminant flux in soils; and (3) interrupted pumping in combination with EK treatment for enhanced decontamination of soil. Development of advanced EK technology will not only be of considerable use to the Federal Government, but also has significant commercial potential as a cost effective, environmentally benign, in situ method for soil decontamination. The technology involves no excavation or transportation of contaminated soil and should be very acceptable as a remediation method by the public in adjacent communities. The overall objective of the Phase II effort is to optimize parameters associated with the advanced EK soil remediation process developed in Phase I and to determine the effectiveness of the process for heavy metal contaminant removal from soil under conditions encountered in an actual contaminated field site.

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Topic#: 91-254 ID#: 91PM-016
Office: STRICOM
Contract #: M67004-93-C-0041
PI: John Morrison

Title: A Flexible Distributed Interactive Simulation Adapter Unit (DAU) for Interconnectin Existing Simulators

Abstract: DoD has a substantial investment in stand-alone simulators. Upgrading these simulators to DIS network compatibility would extend their useful lives and increase their utility for training and combat development. Mak proposes to complete the already-running Phase I Silicon Graphics based DAU. The Phase I prototype is an existence proof of the feasibility of the Phase I concept. Mak's Phase II advances include multi-language support for the computer languages of existing simulators, and hypertext-based documentation to decrease the cost of using the DAU. The flexible proposed architecture supports system-level, board-level, and software-only products for integration into existing simulators. This allows the DAU to be used with systems with widely different technical characteristics. The flexible design of the software also allows modification to meet the increasingly complex requirements of Distributed Interactive Simulation, allowing the existing simulators to be compatible with evolving DIS standards.

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Topic#: 90-370 ID#: 90MTL-032
Office: MTL
Contract #: DAAL01-93-C-4035
PI: Dr. Gerald E. Pollon
Title: Proposal for Design of Piezo-Electronic Scan FLAPS Antenna
Abstract: Malibu Research is proposing an entirely new concept for an electronic scan antenna, which is particularly applicable at millimeter and short microwave wavelengths. This is based on use of piezoelectric materials and the Malibu Research FLAPS (flat parabolic reflectors) phased-surface technique. Malibu Research has already performed a Phase I SBIR feasibility investigation for this concept with very positive results. It was found that a .03 piezo-strain is sufficient to achieve complete scanning and that this was achievable using a more-or-less standard PZT bimorph element, at a cost of about $1 per element. A validating, FLAPS-PZT laboratory demonstration of piezo-phase-shift was performed. This Phase II SBIR proposal is to fabricate and test a full-up millimeter wave prototype piezo-electronic scan antenna. Our proposal contains extracted data and results of the Phase I feasibility study and a preliminary piezoelectronic millimeter wave scanning antenna design with estimated performance. Background and data is also provided on the Malibu Research FLAPS phased-surface technique and applications.

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Topic#: 91-201 ID#: 91ETL-004
Office: TOP
Contract #: DACA76-93-C-0027
PI: Gregory James
Title: Three Dimensional Modelling Station
Abstract: As a result of our Phase I work, recommendations were made to procure and integrate two hardware and software workstation configurations, and to develop a set of modelling tools to create a library of feature models based on those found in DMA's Interim Terrain Data. The objectives of this Phase II proposal are to initially purchase one PC based computer system configured with two CAD software packages and peripheral devices to develop the model library. Development and integration of software modelling tools will also be performed. The model library and modelling tools appear to have commercial application and are designated for further development under a Phase III effort. A second, more powerful Unix based workstation will also be purchased and configured through this project. Its purpose is for working with more complex geometric functions and to provide greater computing skills and power when processing large numbers of polygons. This system will accept the DMA data and will house the data base of completed library models. Software tools will be developed for this system that will perform the necessary data base functions, data extraction from the Interim Terrain Data, and manipulation and placement of library model.

MATERIAL & ELECTROCHEMICAL RESEARCH
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Phone: (602) 574-1980
Topic#: 90-373 ID#: 90MTL-043
Office: MTL
Contract #: DAAL01-93-C-4043
PI: Lori A. Leaskey
Title: Controlled Microstructural Development of Silicon Nitride to Enhance Fracture
Abstract: The Primary objective of researchers for the heat engine market is to produce materials with improved performance and increased reliability at lower cost. Silicon nitride ceramics have been the focus of many such investigations, including that of the Phase I program of this proposal. In this program high performance Si3N4 ceramics were developed, with the optimum materials produced from the Nd2O3-Al2O3 system, particularly when the sintering additive(s) were deposited as coatings. An extensive microstructural study showed that superior mechanical properties could be achieved with lower aspect ratio grains, thus indicating that lower additive amounts could be utilized. The uniform distribution of a very small amount of additives may also result in improved high temperature properties including creep resistance. It is therefore proposed that the Phase I work will be further developed and that the focus of the Phase II be: (1) Developing controlled microstructure Si3N4-Nd2O3 and Si3N4-Nd2O3_Al2O3 ceramics (2) Fully characterizing in terms of microstructure, RT and high temperature (1400 degrees Centigrade) strength and fracture toughness, and measuring creep resistance and oxidation resistance of optimum materials (3) Relating processing conditions to microstructure and mechanical and physical properties to develop an understanding of the technology to produce controlled microstructure Si3N4 (4) Fabricating complex shapes from optimized materials.

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Phone: (502) 745-0099
Topic#: 90-326 ID#: 92CRD-041
Office: CRDEC
Contract #: DAAA15-92-C-0048
PI: N. L. JARVIS
Title: Miniature CW Agent Detector
Abstract: The objective of the Phase II program is to design, build, and evaluate four demonstration models of a Mini-CW Agent Detector with the small size, light weight and high performance required to meet the Marine Corps requirements for a personal CW agent detector with the flexibility to perform other agent monitoring missions as well. The approach will be to design, build, and evaluate a new, optimized version of the Mini-CW Agent Detector conceived in Phase I. The initial effort will be to review in detail the design of each subsystem of the Mini-CW Agent Detector and determine how the size and power consumption of each components can be reduced while maintaining high performance. This will require the redesign, fabrication and testing of the mini-concentrator, the electronic system (including the microcomputer, frequency counters, pump and concentrator circuitry), and the SAW sensor. Once each of the subsystems are designed, built, and individually evaluated, the components will be integrated into a complete system and four demonstration Mini-CW Agent Detector units will be fabricated. Extensive software will be developed for system control, data acquisition, and threat analysis based on the sensor response data. An extensive test and evaluation program will be conducted.

MILLITECH CORP.
SOUTH DEERFIELD RESEARCH PARK, P.O. BOX 109
SOUTH DEERFIELD, MA 01373
Phone: (413) 665-8551
Topic#: 91-134 ID#: 91ETD-013
Office: ETDL
Contract #: DAAL01-93-C-1111
PI: G. Richard Huguenin
Title: Compact Camera for 94 Ghz Passive Millimeter Wave Imaging
Abstract: Phase I of the Passive Millimeter Wave Imaging System Program demonstrated the phenomenology of millimeter wavelengths and the ability to penetrate fog, snow and other inclement weather that this portion of the electromagnetic spectrum offers. Because of the need to have a real time capability in a size that is practical. We propose the development of those elements necessary to demonstrate a compact Focal Plane Array camera. The key technical components to be developed in this program will be: (1) the millimeter wave imaging lens design, (2) the load comparison capability, using a monolithic PIN diode array, needed by each channel of the passive imaging FPA to control received gain fluctuations and (3) the beam steering optics technology by developing quasioptical phase shifting diode arrays by means of GaAs MMIC's. By steering the unsampled beams, we can double or even quadruple the effective number of pixels, enhancing the system's resolution in proportion. The emphasis and uniqueness of the proposal is the lens design and the quasioptical monolithic diode arrays. An option that could be exercised is to implement a 16x24 element FPA, using existing technology, into a complete camera. The FPA's could be either Millitech's design or supplied GFE from Ft. Monmouth's ET&D Laboratory.

MISSION RESEARCH CORP.
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Phone: (703) 339-6500
Topic#: 90-355 ID#: 90HDL-040
Office: HDL
Contract #: DAAL02-93-C-0053
PI: Khanh Ngyen
Title: AURORA High-Power Microwave Generation with Plasma Wakefield Relativistic Klystron (PWRK)
Abstract: The Plasma Wakefield Klystron (PWK) utilizes the experimentally observed plasma wakefield effect to strongly modulate (bunch) an electron beam, which is then used to generate microwave radiation. Our primary goal in this program is to determine the potential of the PWK as an efficient, lightweight, compact, high-power microwave source for Army applications, and to demonstrate its successful operation via numerical simulations, and a proof-of-principle experiment. During the Phase I research program, advanced particle simulation techniques were successfully used to demonstrate the potential capability of the PWK to operate as a 1 GHz high-power source. Additional analyses and numerical results performed in the Phase I indicated that the PWK can also be driven by high repetition-rate electron beam pulsers with no difficulty as may be required for Army applications. An experimental design and plan for a Phase II proof-of-principle demonstration was also developed. The Phase II PWK demonstration will employ either TEMPO or the new high repetition-rate pulser (currently under development by HDL). The selection of the beam pulser will be determined in the initial stage of the Phase II program in consultation with HDL personnel.

MOIRESTRESS, INC.
PO BOX 475
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Phone: (516) 632-8311

Topic#: 91-171 ID#: 91MTL-028
Office: MTL
Contract #: DAAL01-93-C-4018
PI: F.P. Chiang, Ph.D.

Title: High Strain Rate & High Temperature Laser Speckle Strain Measuring Device

Abstract: In order to design structures that withstand impact, penetration, etc., it is necessary to test materials under high strain rate, high heating rate and high temperature. The most difficult part of these tests is the accurate measurement of strain. Conventional strain measuring devices such as resistance gages, clip gages, etc., often fail under extreme testing environment. The proposal addresses the further development and prototype manufacturing of a non-contacting 2-D strain measuring device using laser (or white light) speckle. Speckle patterns at different stages of loading are digitized and compared using appropriate software yielding displacement components at different points. Strain/stress distribution of other mechanics parameters are then calculated. Two complementary systems are proposed: one is a high-resolution-two-exposure system and the other a continuously recording system.

NORTH STAR RESEARCH CORP.
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ALBUQUERQUE, NM 87108
Phone: (505) 296-3596

Topic#: 90-332 ID#: 90HDL-017
Office: HDL
Contract #: DAAL02-93-C-0034
PI: Dr. Richard J. Adler

Title: A Nested High Voltage Generator Approach to HPM Pulse Power

Abstract: The use of DC accelerators with energy storage capability and grid control of the cathode can provide a low cost, high confidence means of generating high quality electron beams. North Star's Nested High Voltage Generator (NHVG) technology is well suited to the production of such beams in the 0.25 - 2.0 MeV, 0 - 1 kA range with pulse durations of 0.05 - 1.0 microseconds. These generators are compact and inexpensive, and are capable of very high (85% power grid to beam) efficiencies. In the proposed Phase II program, we will adapt this technology to pulsed beam operation and build a 500 kV, 100 ampere, 1000 ns pulsed beam generator at 500 Hz repetition rate with the potential to be upgraded in the future to 5000 Hz. We note that the proposed device will be capable of operating at up to 5000 Hz with enhanced prime power and nested component modifications. The Phase II device will demonstrate grid control which is the key untested feature of the technique for pulsed beams. The ultimate portable, fielded system cost, size, and weight will also be estimated.

NOVA ELECTRONICS & SOFTWARE
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Topic#: 91-040 ID#: 91ARD-115
Office: ARDEC
Contract #: DAAA21-93-C-1014
PI: Dr. Tumay O. Tumer

Title: An Innovative, Radiation Resistant and High Resolution System for X-ray Inspection of Munition Items

Abstract: The Phase I feasibility study a of novel radiation resistant and high resolution system for realtime x-ray inspection of munition items with high spatial resolution, excellent radiation tolerance, high angular and energy resolution for 300 keV to 2 MeV x-rays was successfully completed. The Nondestructive Advanced Detector for Inspection Application (NADIA) is based on a new innovation in x-ray detection. The design of NADIA was significantly enhanced during the Phase I study. It has a strong potential to work continuously under high x-ray fluxes without significant degradation of its physical properties. It has excellent spatial resolution of > 0.01 mm^2. It also has x-ray photon direction measurement capability with an angular resolution of about 1 degree. This information can lead to 3-dimensional imaging capability. The energy of the x-ray photons can be measured with an energy resolution of about 6% at 1 MeV. NADIA has the capability to discriminate scattered x-ray photon background using the energy and direction measurements. A fully functional small prototype detector will be designed and built during Phase II for realtime inspection of munition items. A scaled up version can be designed with high sensitivity which will help reduce x-ray source strength for the realtime imaging of high density and/or large munition items. It will have real time data analysis and imaging hardware and software for realtime imaging of munition items. The proposed detector has excellent potential for commercial applications in nondestructive inspection. With modification it can be designed into a high sensitivity detector which can be used for locating weak sources such as depleted uranium shells, explosives, and plastic mines. It can also be used for medical imaging such as the single photon emission computed tomography (SPECT) instruments.

ONTAR CORP.
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Phone: (617) 739-6607
Topic#: 90-461 ID#: 90ARD-022
Office: ARDEC
Contract #: DAAA21-93-C-0060
PI: Dr. John Schroeder
Title: Advanced Signal Processing Methods for Smart Munitions Seeker
Abstract: The contract objective of this proposal is to develop a work station for evaluating ATR system performance. The problem is that software exists for some pieces of the ATR evaluation process, but not for all. ASPS Phase II is to integrate existing software and fill in missing software to produce a seamless package for evaluating ATR system performance. The innovation, in the integration, is ASPS method of presenting and accepting information in a form natural to the human operator. The human operator understands and analyzes images with unbelievable proficiency. For example a popular estimate is that humans process images at a rate of 10**15 bits per second. ASPS tools for image selection, image processing and atmospheric modification give the user great flexibility for inputting image information. ASPS tools for signal processing and filtering provide the user a wide array of visual output information.

OPTRON SYSTEMS, INC.
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Phone: (617) 275-3100
Topic#: 91-080 ID#: 93STR-001
Office: STRICOM
Contract #: DAAHO1-93-C-R141
PI: Dr. James E. Hubbard, Jr.
Title: Flickerless Membrane-Mirror-Modulator-Based Large Screen Projection Display System for Flight Simulator Applications
Abstract: Application of large-screen projection displays (LSDS) within the Department of Defense include: flight simulators, training and simulation aids, map display, and battle management, command, control and communications. This Phase II proposal is concerned with the development of a new high-definition, high-contrast light valve intended for use in a high-brightness, three-color, flickerless, large-screen projection display system for flight simulator application. The proposed electron-beam-addressed membrane mirror light modulator achieves its high resolution, high contrast and flickerless operation through the use of a novel ceramic charge-transfer plate technology, and secondary-electron grid stabilized operation. The system offers the high-brightness and high resolution of the high-end oil-film-based projectors at less than one-tenth the cost, along with better reliability and a much lower cost of ownership. As such, it offers superior on-screen brightness as compared with the cathode-ray-tube and liquid-crystal-based systems that are being developed by competitors in the U.S., Japan, and Europe. The base program focuses on the development, characterization, and demonstration of a membrane mirror light modulator with 1040 x 1280 pixels. Option I builds upon the base program and is concerned with the development and demonstration of a 2048 x 2048 membrane mirror monochrome light valve system with a 71 mm square active area that will be read out with a 500 W arc lamp. This system will be delivered to the Army for testing in the automatic characterization facility at ETDL, Fort Monmouth. We are already seeking a manufacturing partner for the Phase III program which will involve joint development and manufacture of a full three-color LSDS.

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Phone: (415) 489-8100
Topic#: 90-275 ID#: 90NAT-013
Office: NATICK
Contract #: DAAK60-93-C-0014
PI: Dr. Frank Doljack
Title: Lightweight Flexible Composite Tent Material
Abstract: Phase I of this proposal is designed to identify, evaluate, and provide samples of current state-of-the-art materials and fabrication techniques which satisfy the desired minimum requirements of the Five Soldier Crew Tent. To date, the identified material candidates which most effectively meet these requirements are lightweight composite systems. Current processing technologies are available to fabricate these systems into a variety of configurations using different combinations of commercially available films, fibers, and coatings. Phase II of the program seeks to continue the exploration and optimization of these lightweight composite systems. The most promising material candidates and composite structures identified in the Phase I testing will be fabricated into sufficient quantities of prototype yardage to assess large scale material manufacturing feasibility and full specification testing. Yardage will be supplied to one or more tent manufacturers in order to assess various fabrication technologies, optimize system configurations, assess repair effectiveness, and assure congruence with current Army methods. Finally, sufficient quantities of prototype yardage of one or more optimized lightweight composite materials, along with recommended end item fabrication processes, and at least one fully-fabricated end item will be supplied for use in actual field

test applications.

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Topic#: 90-236 ID#: 90-AS-045
Office: CECOM
Contract #: DAAB07-93-C-U273
PI: Steven G. Morton

Title: Non-volatile, VHSIC-density, Neural Network Chip with Variable Wafer Dicing

Abstract: Flexible, powerful, neural network chips are required to solve many vital DoD and commercial problems in real-time. Adequate chips are not available. The A236 Chip will satisfy these needs. During Phase I, we conceived and demonstrated the architecture for a flexible, powerful, very low pin-count, VHSIC-density, digital neural network chip, the "A236 Chip", that combines memory, processing, control and communications into one. We identified specific commercial and government customers who have applications for this chip, and have begun working with some of them on their applications in anticipation of its availability. During Phase II, we propose to: (1) model the A236 Chip and common neural networks using the DoD's VHSIC Hardware Description Language (VHDL), (2) lay out and build the Chip using submicron, CMOS technology, (3) write an easy to use, icon-based, "Application Builder" program that runs under Microsoft Windows to enable users to quickly implement common neural networks on an A236 Chip, (4) build an evaluation board to test and demonstrate the Chip, and (5) demonstrate a real-time neural network application using the A236 Chip. Optionally, we also propose to: (1) build a multichip module using eight unpackaged A236 dice to provide even more computation power in a small package, (2) guild an evaluation board for the module, and (3) extend the Application Builder to implement neural networks built from multiple A236 Chips.

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Topic#: 91-109 ID#: 91TEC-001
Office: TECOM
Contract #: DAAD07-93-C-0117
PI: Mr. Harry Nelson

Title: Aerial Cable Inspection Trolley

Abstract: The objective of the Phase I study was to determine the feasibility of an inspection system mounted on a trolley that could evaluate the condition of a 16,000 foot long serial cable fabricated from a synthetic material in the form of a rope. The results of the Phase I study demonstrated that an inspection trolley system was feasible. The objective of the Phase II program is to design and build a full-scale engineering model inspection system that will be used to field test a 16,000 foot cable suspended from mountain peak to peak at WSMR. The time allocated for the inspection is 30 minutes (one-way). External damage detection is required. The aerial cable inspection equipment is to be mounted on a self-contained, remotely controlled trolley which can traverse the length of the cable while measuring data that can be correlated with cable damage. This data is to be relayed via an Rf data link to the base of the target launch tower and then down to a controls and displays system in a remote building, or the data is recorded on board the trolley and off-loaded when the trolley is returned to the docking position.

PACIFIC-SIERRA RESEARCH CORP.
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Topic#: 90-309 ID#: 90ASL-007
Office: BED
Contract #: DAAL01-93-C-2002
PI: Ernie Carroll

Title: Impact of Scene Shadows on Target Acquisition - Phase II

Abstract: The Army target acquisition model TARGAC for visual and near-infrared (IR) systems (which include direct view optics, image intensifiers, and silicon television devices) has no provision to treat the effects of either solar or lunar shadows cast by targets or other scene features. Shadows may well increase acquisition range by providing additional target cues, or they may decrease range by masking the target or increasing clutter. The Phase I effort examined scene shadow effects on target acquisition range prediction. It included not only solar shadows, but also lunar shadows because of their effects on near-IR night vision devices. The technical objectives of the Phase II program are to develop a geometrical scene shadow algorithm for TARGAC that includes shadowing effects produced by clouds, large-scale scene features, and small-scale (i.e., clutter) scene features; and to make modifications (e.g., delta-Eddington approximation, solar/lunar geometry, clutter, contrast transmission, scene geometry) to TARGAC software in order to account for shadow effects. Phase II will result in software, documentation, and a final technical report.

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Phone: (301) 927-4567
Topic#: 90-467 ID#: 90ARD-027
Office: ARDEC
Contract #: DAAA21-93-C-0065
PI: Judy Pecht
Title: Effects of Long-Term Storage on Electronic Devices
Abstract: The Phase II effort involves the implementation of the failure mechanism models identified in Phase I into software. The software provides the user with the capability to evaluate microelectronic reliability in terms of average time to failure under various storage environments. Input to the software includes geometric and material characteristics of the devices. Each potential failure mechanism will be analyzed and ranked so that the dominant failure mechanisms will be highlighted. The results of the reliability analysis can then be used to assess long term storage reliability, to develop tests and screens, and to point out design improvements.

PHOTONICS RESEARCH, INC.
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ALBUQUERQUE, NM 87108
Phone: (505) 262-1705
Topic#: 91-242 ID#: 91SDC-033
Office: SDC
Contract #: DASG60-93-C-0078
PI: Greg R. Olbright, PhD
Title: Three-Dimensional Optoelectronic Signal Processor Using Surface-Emitting Laser Interconnects
Abstract: The objective of the Phase II program is to demonstrate a prototype 3D signal processor that uses standard GaAs and Si application specific integrated circuit (ASIC) electronic logic hybridize to optical interconnects consisting of GaAs-based optoelectronic transceivers. The prototype processor design is aimed at guided-missile applications such as tracking, acquisition, and command, control and communication (C3). The processor will be designed to meet United States Army Strategic Defense Command next generation interceptor signal processor requirements. The hybrid Si/GaAs 3D optoelectronic processor will utilize vertical cavity surface-emitting laser diodes, optoelectronic detectors, and diffractive/refractive optics to optically interconnect memory central processor units and arithmetic logic units. The Phase II program is a continuation of PRI's Phase I contract wherein we met and surpassed our Phase I goal: demonstration of surface-emitting laser interconnects. Two major goals of the program are: (i) to prove the feasibility of reliable free-space optical interconnects suitable for linking multi-chip modules and (ii) hybrid packaging of Si microelectronic logic and GaAs optoelectronic components to form optically interconnected multi-chip modules. Our approach will be to (i) design/fabricate a special purpose Si-based multiple processing element chip. The GaAs optoelectronic components will be flip-chip bonded to the processor chip to form a processor module with optical transmitting and receiving capabilities (a transceiver), (ii) design/fabricate the transceiver, (iii) develop the required hybrid Si/GaAs packaging technology, (iv) construct the processor modules, (v) design/fabricate the diffractive/refractive optical interconnect media, (v) construct the 3D optoelectronic processor comprising optical interconnects, (vi) design and construct the computer control system, (vii) demonstrate the working 3D prototype processor, and (viii) develop a Phase II option and Phase III plan to fabricate an upscaled/optimized 3D processor suitable as a next generation interceptor signal processor. In Phase II we will develop a plan for commercialization of the technology.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
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Phone: (310) 320-3088
Topic#: 91-144 ID#: 91ETD-093
Office: ETDL
Contract #: DAAL01-93-C-3318
PI: Michael Wang, Ph.D.
Title: Optically Assisted Three-Dimensional Packaging for Multichip Module Applications
Abstract: The Phase I feasibility study successfully demonstrated the proposed waveguide-backplane-waveguide optical interconnects and direct laser-backplane detector interconnect configurations. For Phase II, Physical Optics Corporation (POC) proposes to demonstrate a complete optical interconnection system for 3-D packaging of multichip modules. Optical interconnects are potential candidates to replace electrical interconnects for chip-to-chip and board-to-board applications due to their high data rate (over GHz) signal transmission, large fanout densities, and immunity to EMI. In Phase I, we fabricated channel waveguide arrays on LiNbO3 with a packing density of 50 channels/cm to route optical signals within a circuit board. The board-to-board interconnects were implemented with holographic backplanes. The backplane gratings demonstrated 56.5% diffraction efficiency at a wavelength of 780 nm. This can be optimized to >90%. Coupling from laser to channel waveguide to backplane to channel waveguide to detector demonstrated the feasibility of board-to-board interconnects. A compact portable prototype (4" x 4" x 4.5") laser-backplane-detector configuration was also demonstrated. The wide bandwidth of the optical

35

interconnect, independent of interconnection distance, places optical interconnects high among interconnect techniques for chip-to-chip and board-to-board applications. In Phase II, a complete compact interconnection system (flip-chip bonded) with wide bandwidth characteristics will be demonstrated.

PLANAR SYSTEMS, INC.
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Phone: (503) 690-1100
Topic#: 91-135 ID#: 91ETD-017
Office: ETDL
Contract #: DAAL01-93-C-3320
PI: Scott Cockey
Title: Development of Chip on Glass Technology for Flat Panel Displays
Abstract: This program is directed towards developing a pilot manufacturing line for chip-on-glass (COG) monochrome and color thin film electroluminescent (TFEL) flat panel displays. This manufacturing line will use the same COG process identified and qualified in Phase I. A statistically significant quantity of VGA flat panel displays will then be built on this manufacturing line to verify the COG manufacturing process capability.

POWDERED MATERIALS APPLICATIONS, INC.
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Phone: (216) 892-5800
Topic#: 90-287 ID#: 90TAC-019
Office: TACOM
Contract #: DAAE07-93-C-R055
PI: Walter J. Maciag
Title: Application of New Bearing Technology to High Mobility Multipurpose Wheeled Vehicles
Abstract: During Phase I, a new, innovative bearing design concept named "Geometric Contouring " (GC) for its design configurations, demonstrated its feasibility to reduce wear significantly beyond that experienced in currently utilized U.S.Army bearings in direct one-to-one comparison bench tests. Also demonstrated was the ability of these bearings to eliminate the need for lubrication maintenance. Phase II continues to concentrate upon the objectives of Phase I, ie. reducing Operating & Support (O&S) costs while increasing the state of readiness and field availability of Tactical Vehicles. It is felt that the greatest reduction in HMMWV field maintenance will result by eliminating the need for periodically lubricating all of the HMMWV's universal joints, driveline and intermediate (steering) shaft. The elimination of needle rollers and other enhancements concurrently provide considerable unit cost savings and field operational advantages. The universal joint (U-Joint) development of Phase I, GC Propeller Shaft U-Joints, will be completed in Phase II. It is expected that the U-Joints will successfully pass the HMMWV field requirements. Bench tests will emphasize operating the U-Joint Bearings in their normal oscillatory condition, which was not attempted in Phase I due to limited funding. The designs will then be finalized and samples manufactured. Samples of GC U-Joints will be then installed on the Front & Rear Propeller Shafts of the HMMWV Demo 3 Vehicle and final field verification testing conducted. The successful development of the HMMWV U-Joint will make possible GC Bearings for the HMMWV Intermediate (Steering) shaft and for most roller and ball bearings, and all sleeves, bushings and thrust washers applications. Their significantly lower costs and eliminated lubrication maintenance promise a major beneficial impact for all commercial & military vehicles, equipment and appliances.

PRECISION COMBUSTION, INC.
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NEW HAVEN, CT 06511
Phone: (203) 786-5215
Topic#: 91-011 ID#: 91ARO-312
Office: ARO
Contract #: DAAH04-93-C-0055
PI: William C. Pfefferle
Title: POWER GENERATION: Electric Power Sources and Diesel and Gas Turbine Engines
Abstract: Integrating a catalytic ignitor into a fuel injector offers an opportunity to significantly improve ignition and flame stability, producing a number of important benefits. Compared to conventional spark ignition systems, benefits using an air blast ignitor will include easier starting, reduced soot and NOx emissions, improved pattern factor, ignition independent of fuel droplet size, longer ignitor and hot section component life, and a smaller, lighter and less expensive ignition system (with no high voltage requirement). Faster, leaner light off will produce cooler starts with less smoke and hot end distress. In addition, an integral catalytic ignitor/injector will isolate the ignition function from the combustor liner geometry. In the Phase I of this project, a prototype produced leaner ignition at low power with diesel fuel was achieved at the liner lean limit of a production liner and even leaner in a lean primary zone liner. Lean flame out was suppressed with the ignitor power on. In Phase II we propose to build on Phase I results to develop and test the technology for Army gas turbine engines. Two major aerospace

component manufacturers will be providing collaborative assistance.

PRINCETON SCIENTIFIC INSTRUMENTS
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Phone: (908) 274-0774
Topic#: 91-116 ID#: 91TEC-052
Office: TECOM
Contract #: DAAD05-93-C-0090
PI: John L. Lowrance
Title: Digital Enhancement and Video Storage of Real-Time Flash X-Rays
Abstract: Pitch and yaw at the moment of launch are important parameters when characterizing the ballistic performance of a kinetic energy projectile. Presently, data on projectile orientation is acquired using photographic film which must be developed and the images then manually measured to extract geometric data. This Phase II program replaces the photographic film based x-ray image in near real time for quick look analysis and later digital data reduction. There is a substantial commercial market for such digital x-ray imaging cameras within all branches of DoD and in industrial x-ray applications.

PRINCETON SCIENTIFIC INSTRUMENTS
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Phone: (201) 274-0774
Topic#: 90-475 ID#: 90ARD-035
Office: ARDEC
Contract #: DAAA21-91-C-0035
PI: John L. Lowrance
Title: Sight Integration of an Automatic Muzzle Reference System
Abstract: The primary objective of this Phase I study was to develop concepts for automatically and continuously measuring a M1A1 tank gun tube's muzzle angle and integrating these data into the tank's fire control system. One of the design constraints was to be able to do this as a retrofit of an existing M1A1 tank. A second objective was to explore the possibility of eliminating the need for the gunner to manually carry out the periodic MRS boresighting procedure currently required by the M1A1 tank fire control system. The study found that an automatic muzzle reference system (AMRS) can be designed so as to require relatively minor modifications to the M1A1 tank. It appears that the tank modifications and installation of the AMRS could be done at tank depots, minimizing the cost and making it much more practical to add an AMRS to existing tanks. This AMRS would be applicable to M1A2 tanks also. This Phase II proposals is to design, build and test an AMRS on an M1A1 tank.

RECOGNITION RESEARCH, INC.
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Phone: (703) 231-6500
Topic#: 91-204 ID#: 91ETL-034
Office: TOP
Contract #: DACA76-93-C-0021
PI: Dr. J. Patrick Bixler
Title: Text Identification, Extraction, and Manipulation of Raster Map Images
Abstract: This SBIR Phase II effort is intended to provide the Army topographic/terrain production units with the capability to quickly and automatically annotate their products, including imagery from Landsat or SPOT data IPBs and TDAs, with text and other features extracted directly from raster map data. The basic techniques developed under Phase I will be enhanced and refined to apply to a wider range of maps and will be integrated into a production annotation package. An efficient user interface will be designed to allow for priority operation on individual maps as well as on-going production in batch mode. A normalized data format will be developed to facilitate the use of the extracted information by other applications. Location and orientation information for extracted text will be converted to absolute WGS-84 or (MGRS) coordinates so that the text can be automatically placed on target imagery. Techniques for automatically converting the raster text into ASCII form will also be investigated. In addition to text, other map features such as point symbols and major roads and drainage will be considered for automatic segmentation and extraction. An approach to classifying individual features and, where possible, associating them with the correct text will also be developed.

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Topic#: 91-053 ID#: 91-AS-035
Office: CECOM
Contract #: DAAB07-93-C-B764
PI: Dan R. Ballard
Title: Microchip-Based Inferencing Mechanism for High Performance Diagnostics - TestMaster

Abstract: Electronic systems are becoming increasingly more complex. Advances in packaging technology and increasing device complexity are demonstrating that current techniques of in-circuit testing and fault diagnosis are inadequate. Industry and DoD have initiated several efforts to help solve this problem. DoD issued MIL-STD-2165 which dictates the incorporation of test and maintenance criteria in all new hardware developments. The Joint Test Action Group (JTAG) was formed to find a solution to increasing problems of system testing. Unfortunately, improvements in testability provided by MIL-STD-2165 and IEEE P.1149.1 do not lead to improvements in fault diagnosis or fault prognosis. AI/expert systems techniques have proven to be extremely effective in solving complex system diagnosis problems. However, these diagnostic systems are historically required extensive amounts of computational resources and were not suitable for embedding in hardware in deployed weapons systems. During Phase II, Reticular Systems, Inc. will develop ASIC versions of an AI/Expert System Microchip we call TestMaster (tm). The TestMaster (tm) microchip contains knowledge about the system under test, which significantly improves the speed and accuracy of its test diagnosis. TestMaster (tm) provides a unique opportunity to use proven AI/expert system technologies for enhancing maintainability and supportability of complex systems while reducing life-cycle costs.

S-TRON
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Phone: (415) 903-4949
Topic#: 91-064 ID#: 91-AS-072
Office: CECOM
Contract #: DAAB07-93-C-B506
PI: Oliver J. Edwards
Title: Human Factors Solutions for Soldier's Computer
Abstract: This proposal addresses the human factors and human engineering of the design, interface and application of the Soldier's Computer; a lightweight, shirt-pocket sized computer with input/output and control interfaces appropriate to the field. The critical problem is provision of a man-machine interface which will be transparent to the user, and which will effectively link his observation, personal input/output, awareness and thinking with his personal silicon intelligence and the data from his world, and which will support the soldier as a node in a network.

SCHWARTZ ELECTRO-OPTICS, INC.
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Phone: (305) 291-8871
Topic#: 91-112 ID#: 91TEC-035
Office: TECOM
Contract #: DAAD01-93-C-0056
PI: 1Robert A. Olsen
Title: Line of Sight Verification
Abstract: At present there is no adequate method for the verification of the existence of a clear line-of-site (LOS) between multiple weapons systems and multiple targets. In Phase I of this SBIR Program, Schwartz Electro-Optics, Inc. (SEO) developed a Line of Sight Verification System employing a quasi-Lambertian laser source mounted to the weapons platform, and a hemispherical field-of-view (FOV) detector array mounted on the target. Untypical of Phase I programs, SEO built and evaluated a breadboard system to verify the calculated performance. With the experience gained from this breadboard, SEO will design and build a LOSVS with enhanced performance and reliability during Phase II.

SCIENTIFIC APPLICATIONS & RESEARCH
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HUNTINGTON BEACH, CA 92649
Phone: (714) 373-5509
Topic#: 90-459 ID#: 90ARD-020
Office: ARDEC
Contract #: DAAA21-91-C-0034
PI: Dr. Timothy M. Rynne
Title: Electromagnetic Interference (EMI)/Electro Magnetic Pulse (EMP)/High Power Microwave (HPM) Protection for Packaged Ammunition
Abstract: Modern battlefield conditions pose severe electromagnetic environments to military electronic systems. Such threats range from enemy generated Nuclear EMP and HPMs to friendly radar and communication system RF radiations. While these threats have been increasing in power and frequency, the fuzes used in modern weapons have been increasingly based on sensitive electronics, such as integrated circuits for timing, radar altitude sensors, and proximity fuzes. These sensors, in conjunction with their electronic detonators, may be activated by the various electromagnetic threats. The issues addressed in this SBIR program will be: 1- What level of hardening is desired by the Army from the ammunition containers? This gives guidance in the determination of what type of measures need to be taken in modifying the containers. 2- What is the present shielding effectiveness of the present ammunition cases? If some types of present cases offer significant shielding, there may

not be any need for modifying such cases. Similarly, knowing the present shielding effectiveness of present cases will aid in identifying hardening modifications. 3- What type of modifications can be made to the containers? Included in this issue are the added questions a) what is the effectiveness of each modification and b) what is the cost of each type of modification?

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Topic#: 91-141 ID#: 91ETD-078
Office: ETDL
Contract #: DAAL01-93-C-3331
PI: M. Meyyappan

Title: A Process Model and Complementary Experiments for the Electron Cyclotron Resonance

Abstract: This proposal describes a research program to develop electron cyclotron resonance (ECR) technology suitable for use in device fabrication. Specific processes to be addressed are ECR deposition and etching. ECR is receiving much attention as a processing technique. It has the potential to deposit dielectric films at low temperatures with desirable characteristics. Operating at sub-millitorr pressures, ECR etching has the potential to etch extremely fine feature sizes in device fabrication. As the technology is at its early stages, a thorough understanding is needed to make the technique viable in device fabrication which is the goal of this program. The objective of this program is to be achieved through a combination of deposition and etching process development, evaluation of deposited film characteristics, residual etch damage characterization, surface chemistry, plasma diagnostics and process modeling. Primary candidate processes are deposition of dielectrics (ex: silicon nitride) and fine feature III-V compounds etching. The anticipated results include deposition and etching process viable for use in device fabrication and a user-friendly software which would be a design tool.

SENSOR PLUS, INC.
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Topic#: 91-212 ID#: 91MED-056
Office: MEDICAL
Contract #: DAMD17-92-C-2050
PI: Mustafa E. Kutlubay

Title: Real-Time, Light Weight, X-ray Imager

Abstract: The development of a real-time digital imager to replace current x-ray film cassettes is proposed. X-rays will be detected by a fluorescent screen and read out by an array of charge-coupled-devices which are controlled by a high speed microcomputer. The image will then be displayed on a high resolution display (LSD). This project also involves development of number of data processing algorithms which combine the segmented images to a high quality image output.

SEPARATION SYSTEMS TECHNOLOGY, INC.
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Topic#: 91-001 ID#: 91BRD-344
Office: BRDEC
Contract #: DAAK02-93-C-0007
PI: Robert L. Riley

Title: Identification and Evaluation of Biocides for ROWPU Systems

Abstract: Mobile reverse osmosis water purification units (ROWPU) have been used by the armed services for over a decade to produce potable water for field applications. While this technology has proven successful, a need exists to protect the membrane elements from microbial decomposition during long-term storage. Biocidal agents must be environmentally safe and effective at inactivating micro-organisms associated with membrane surfaces without compromising membrane performance. Phase I studies successfully demonstrated that appropriate methods and testing protocols for evaluating candidate biocides for their activity and compatibility with membranes were feasible. A Phase II program is proposed to extend this evaluation of chemical biocides and methodologies for element reservation. Potential biocides, identified from database surveys and other sources, will be screened to determine their microbiocidal activity against biologically fouled membranes. Microbicidal activity will be determined by growth tests and microscopic methods involving redox dyes. Membrane compatibility will be determined by comparing transport properties before and after exposure to potential biocides. Candidate biocides will be further evaluated under dynamic flow conditions and in element soak tests to confirm membrane compatibility and long-term stability. Biocides will be ranked according to microbicidal activity, long-term stability, membrane compatibility, cost and environmental safety.

SIMEX SYSTEMS & SOFTWARE CORP.
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Phone: (602) 323-9759
Topic#: 91-062 ID#: 91-C3-088
Office: CECOM
Contract #: DAAB07-93-C-B769
PI: A. Wayne Wymore
Title: Design and Implementation of System of Systems Model Fusion Environment
Abstract: The main expected area where analysis, modeling and simulation work will be needed in the near to mid-term future is the development of System of Systems. Model fusion methodology supporting reuse and composition of large existing simulations is needed to support this System of Systems concept. The objective of Phase II is to design and implement a modeling and simulation environment that is fully capable of meeting the requirements of the DoD and industrial design of System of Systems. The proposed approach is to design a software workbench containing modeling and simulation tools that supports the DEVS/SES Model Fusion methodology.

SIMPEX TECHNOLOGIES, INC.
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Topic#: 91-161 ID#: 91HDL-046
Office: HDL
Contract #: DAAL01-93-C-0023
PI: Bernard K. Siu
Title: Automated Composite Material Inspection System
Abstract: The feasibility of detecting surface and internal flaws of composites by a single machine has been confirmed. The surface flaws were detected by automated illumination and statistical histogram techniques. Internal flaws and embedded metal parts were detected by microfocus x-ray techniques. Detected flaws are documented and marked by a computer controlled marker and XY transport stage. Initial results of Phase I efforts were supported by both military and composite manufactures. Phase II technical objectives are geared towards the completion & packaging of a fully automated internal & external inspection system (ACMIS) and expanding its inspection capabilities to cover additional unique shaped composites such as munition nose cones and large radius curved surfaces. Besides technical objectives, system design for operator safety and ease of use will be addressed. Specific efforts include:1) Integrate appropriate enabling flaw detection techniques into the ACMIS; 2) Develop Windows based user friendly menu; 3) Build in automated data collection and analysis for process control; 4) Safety designs to enclose the ACMIS; 5) Develop inspection algorithms for munition nose cones and large radius composite tubes; 6) Further explore laser ultrasonics technology for composites; 7) Final documentation and Government demonstration.

SOFTWARE PRODUCTIVITY SOLUTIONS, INC.
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Phone: (407) 984-3370
Topic#: 90-228 ID#: 90-SE-038
Office: CECOM
Contract #: DAAB07-93-C-Q005
PI: Dr. Andres Rudmik
Title: *Component Usage for Reuse Enhancement*
Abstract: In order to reuse software, the potential reuser must find components that "fit" a particular application, evaluate it for selection and understand it for usage. The difficulty in understanding, particularly large components, has been a significant impediment to achieving reuse in-the-large. The proposed Component Usage for Reuse Enhancement (CURE) effort will develop automated tools for the selection, understanding and usage of software components. The effort proposed to apply a new formalism, called usage cliches, to the problem of representing component usage information. The concept is an innovative extension of MIT research in the Programmer's Apprentice. Because the approach captures usage information in a formal manner, it also has application for component certification. The proposed approach will be interoperable with the Automated Reusable Components System (ARCS). ARCS is an Army-funded SBIR product, now in Phase II commercialization under the trade name InQuisiX by Software Productivity Solutions (SPS) and its strategic partner Science Applications International Corporation (SAIC).

SPIRE CORP.
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Phone: (617) 275-6000
Topic#: 91-026 ID#: 91AMC-356
Office: MTL
Contract #: DAAL01-93-C-4050
PI: Piran Sioshansi, Ph.D.
Title: Ion Beam Assisted Deposition: A Replacement for Wet Chemical Plating

Abstract: The Department of Defense relies heavily on corrosion- and wear-resistant coatings for improving the performance and lifetime of critical system components. However, the wet chemical plating operations by which these coatings are deposited produce copious amounts of hazardous wastes, and are being quickly regulated out of existence. Since the coatings are crucial elements in device and system performance, it is imperative that a replacement technology be developed and implemented. Spire proposes to develop ion beam assisted deposition (IBAD) to replace wet chemical plating operations. IBAD is an advanced coating technology which combines evaporation with concurrent ion bombardment to produce coatings with essentially no residual waste products. IBAD can produce ultra-adherent corrosion- and wear-resistant coatings which are dense, ductile, and low stress. Phase I established feasibility by exploring several coatings (zinc, chromium, aluminum, and nickel) and demonstrating comparable or superior performance to standard electroplated coatings. Phase II will focus on one coating system, zinc-nickel, for its enhanced corrosion resistance and improved mechanical properties. The program will produce optimized coatings, demonstrate their performance in humidity and salt spray tests, and investigate all of the peripheral issues surrounding implementation of a new technology, such as production equipment design, cost, and quality assurance/quality control procedures.

STATISTICAL SCIENCES, INC.
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Phone: (206) 283-8802
Topic#: 92-140
Office: CERL
Contract #:
PI: Doug Martin
ID#: 93CER-046
Title: Integrated GIS and Statistical Data Analysis System
Abstract: Current Geographic Information Systems (GIS's) offer at best very limited statistical data analysis and modeling capabilities. S-PLUS is a modern object-oriented language and system for graphical data analysis and statistical modeling. The innovation consists of integrating S-PLUS with GIS systems, so as to provide broad statistical analysis and modeling tools to GIS users. During Phase I our goal was to integrate S-PLUS with the GRASS GIS. We met our research objectives fully by completing an integrated S-GRASS prototype. Our prototype work establishes the feasibility of producing viable commercial products by integrating S-PLUS with GIS's. In Phase II, we shall focus our research on developing a robust interface to the leading public GIS (GRASS) as well as the leading commercial GIS (ARC/INFO). In support of this research objective, we will develop a Paradigm View Controller for data transport, an object oriented method for External Objects, concurrent S-PLUS which functions as a server analytic engine, and a user friendly graphical interface.

STERIS CORP.
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MENTOR, OH 44060
Phone: (216) 354-2600
Topic#: 91-219
Office: MEDICAL
Contract #: DAMD17-92-C-2049
PI: Raymond C. Kralovic
ID#: 91MED-058
Title: Development of a Cold Sterilant for Field Medical Use
Abstract: Field medical use of many surgical instruments, including delicate instruments such as endoscopes, requires cold sterilization, cold being defined as a temperature range between ambient (25°C) and moderately elevated (up to 60°C). Because of hazards in transporting and using ethylene oxide, it has been eliminated from field medical use; and glutaraldehyde, a disinfectant which has many undesirable characteristics involving logistics support, user safety and product effectiveness, is currently being used as a replacement. Required is a safe and effective dry powder sterilant that can be added to water to effect the cold sterilization of instruments. It should be packaged as an inert powder that can be safely and efficiently transported and stored; and the waste solution should not pose a toxic hazard to users.

STOTTLER HENKE ASSOC., INC.
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Phone: (415) 595-1692
Topic#: 91-198
Office: CERL
Contract #: DACA88-93-C-0015
PI: Richard H. Stottler
ID#: 91CER-041
Title: An Environmental Knowledge Base System
Abstract: In Phase I, we proved through research and prototype development that environmental information can be acquired, represented and used to aid facility designers, contractors and managers in considering environmental factors when making design, construction and operation decision. We now propose to build upon the success of the Phase I effort and develop a

full-scale Environmental Knowledge Base System (EKBS). Using advanced Artificial Intelligence (AI) and Object-Oriented software technology, the EKBS will evaluate the environmental impact of building materials, taking into account issues such as natural resource depletion, hazardous wastes and emissions to produce the material; the exposures caused by the material on building occupants; and whether the material can be recycled or must be land filled. The environmental impact is presented to the designer in a clear, easy-to-understand form. Alternative materials can be compared to allow selection of the most environmentally friendly material. Alternative systems and buildings can also be evaluated and design advice can be given to suggest more environmentally friendly design alternatives.

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Topic#: 92-144 ID#: 92CRR-002
Office: CRREL
Contract #: DACA-93-C-0006
PI: Robert H. Cormack

Title: A New Instrument for Automatic Measurement of Cloud Liquid Water Content and Droplet Size

Abstract: Reliable automated measurements of liquid water content (LWC) and drop size in icing conditions have been notoriously difficult to make. Such measurements are needed to predict icing rates and loading on structures, power lines, off-shore oil rigs, forests and airplanes. In Phase I, the objective was to design, build and test a laboratory breadboard model of an instrument that demonstrated promise for making good automatic measurements of LWC and drop size. A laboratory prototype of a new optical instrument that measures with high angular resolution the forward scattered light from an ensemble of cloud drops was built in Phase I. The new instrument measured accurately the (known) size distribution of 3-30 um polystyrene spheres in aqueous solution. Comparisons of LWC measurements in an icing wind tunnel were also very good. The instrument has the unique ability to automatically correct for optical misalignment and contamination in software. It is anticipated that a fully-automated, computer-controlled version of the instrument capable of operation in harsh environmental conditions can be built in Phase II.

SURFACES RESEARCH & APPLICATIONS, INC.
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Topic#: 91-100 ID#: 91100-03
Office: TACOM
Contract #: DAAE07-93-C-R109
PI: Paul Sutor, Ph.D.

Title: High Temperature Military Diesel Tribology System

Abstract: Advanced low heat rejection diesel engine performance and life expectancy have been limited almost entirely by performance of the engine lubricant. Prior to Surfaces Research's work on Phase I of this program, no advanced diesel engine lubricant was able to even approach meeting the severe high-temperature requirements of the uncooled U.S. Army Advanced Integrated Propulsion System (AIPS) diesel engine. Surfaces Research produced the first lubricant predicted to meet these engine requirements, based on laboratory bench tests, in the Phase I program. In the Phase II program proposed here, we will demonstrate superior engine test performance of aromatic ester lubricants under both current and uncooled AIPS engine operating conditions. We will extend development of these exceptionally stable lubricants to encompass all MIL-L-2104 viscosity grades, with particular emphasis on a 15W40 multigrade. We will produce lubricants in pilot plant scale and address commercial production processes and costs. We will incorporate improved, innovative base stocks and additives in these products and optimize them for performance in U.S. Army diesel engines.

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Topic#: 91-225 ID#: 91MED-016
Office: MEDICAL
Contract #: DAMD17-92-C-2048
PI: Edward M. Davis

Title: Cyanide Poisoning Prophylactics

Abstract: There is a need to develop pretreatment agents to counter chemical warfare gases such as hydrogen cyanide. The proposed work aims to develop cyanide antagonists that may be self-administered in low doses by troops. Novel polymers with the capacity to bind and detoxify lethal doses of cyanide will be synthesized and tested in vitro. Based on preliminary results, these novel cyanide antagonists are anticipated to overcome many of the problems presently encountered when using therapeutic agents from providing prophylaxis against cyanide poisoning.

SYSTEMS & PROCESSES ENGINEERING CORP.
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Topic#: 91-031 ID#: 91ARD-033
Office: ARDEC
Contract #: DAAA21-92-C-0036
PI: Dr. N.B. Penrose
Title: Deep Strike Security Expert Planner (DSSEP)
Abstract: GESMC is a coordinated SPEC/TEXTRON/ARDEC initiative to enhance Intelligent Minefield Management for the Army. SPEC has worked closely with ARDEC/TEXTRON to ensure a consistent evolution of IMF management concepts and activities resulting in Phase I functional allocation of GATEWAY Device. Phase II offers GATEWAY expert system functional module positioned for ARDEC IMF Testbed Lab. Phase III is embedded expert system to support ARDEC BAA IMF C2 initiative for a GATEWAY prototype to support C2 on the move. Phase II GESMC supports evaluation of minefield mission order strategies by IMF Controller Testbed for Engineer School and ARDEC. Via replication of enemy unit engagements (Testbed OSAGE system) using DUELS model, detailed controller implementation of strategies can be refined and optimized using BLOOM intercommunications and GLASS to emulate the controller and mines. GESMC Phase II expert system module meets architectural specification of the OSAGE system utilizing software development tools to support development efficiency. AI technology supports GESMC having four major types of knowledge: declarative, procedural, semantic, and episodic. Possible inferencing techniques for GESMC will depend on the particular function with processes to support deductive, inductive, or abductive reasoning. Preliminary plan is to use CLIPS or Nexpert Object as development tool.

TACAN CORP.
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Topic#: 91-156 ID#: 91HDL-025
Office: HDL
Contract #: DAAL02-93-C-0045
PI: Mark E. Tucker/S.R. Schae
Title: RF Diode Laser Modulator
Abstract: Lasers offer enhanced capabilities for detection and ranging systems compared to systems operating in the radio and microwave region. Systems based on laser radiation which has been intensity modulated at RF frequencies offer many of these advantages, while still allowing the target return signal to be processed with conventional radar techniques. Based on our related experience in the development of ultra-wide bandwidth diode laser drivers and Multiple Quantum Well (MQW) optical modulators, we propose to develop diode laser modulators based on two different approaches. The first approach uses direct modulation of the diode laser injection current. A compact laser modulator based on this approach will be fabricated in a hybrid package. The proposed specifications for the modulator package include operation from 100 to 700 MHz for a diode laser with 90 mW of optical output. A second approach is proposed which furthers the development of external modulators based on GaAs/AlGaAs multiple quantum wells. Devices based on these materials will be tested with an emphasis on optimizing the device performance for high optical powers.

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Topic#: 91-007 ID#: 91CRD-006
Office: ERDEC
Contract #: DAAA15-93-C-0087
PI: Dr. William L. Bell
Title: Novel Sorbents for Chemical Warfare Agents
Abstract: Activated carbon has long been used in air purification. The recent discovery of fullerene carbon, including the speriodal molecule C60, opens new avenues to improved sorbents for protection from chemical warfare (CW) agents. In Phase I we investigated the surface properties of fullerene carbon, determining that it has a higher heat of adsorption for the freon CFC-113 than does activated carbon, while having lower heat of adsorption for water. This indicates that fullerene carbon sorbents could perform better, particularly in the presence of water, than currently used activated carbon. To realize this potential, in Phase II we will prepare new fullerene solids with high specific surface area, determine their properties, and test their performance as sorbents by measuring breakthrough curves with simulants for CW agents. We will also prepare platinum derivatives of the fullerene solid, which are promising materials for collective protection by catalytic oxidation of CW agents. We will test the performance of these new catalysts in low temperature oxidation of CW agent simulants. We will also conduct a systems analysis to compare the performance and cost of the new materials to currently used sorbents and catalysts.

TECHNICAL EVALUATION RESEARCH, INC.
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Phone: (908) 219-0020
Topic#: 91-054 ID#:91-AS-081
Office: CECOM
Contract #: DAAB07-93-C-B253
PI: Benjamin Tirabassi
Title: Voice Processing for Command and Control Application Phase II - Miniaturization Technology
Abstract: The objective is the exploratory development, miniaturization, and demonstration of a universal and advanced technology voice recognition and synthesis capability suitable for a tactical environment. TERIs active participation in state-of-the-art voice processing systems presents a unique opportunity for the preliminary development of a microchip implementation based upon TERIs experience with Phase I development of a miniaturized architecture, and knowledge of ATCCS and Battlefield Functional Area applications. TERIs candidate architecture demonstrates the feasibility of a wide range of Army personnel verbally communicating with Army C2 applications as a replacement for or adjunct to more traditional I/O devices (i.e., keyboard, trackball, display, etc.). Common military language input is recognizable and acted upon by the C2 application then the TERI developed interface drivers interpret commands using an ATCCS universal multi-layered API. Computer generated voice output demonstrates the effective combination of candidate methods, including: unlimited text-to-speech synthesis, a predefined unique pronunciation library, and a high quality digital reproduction capability. Use of sub-micron process technology is proposed for the implementation of common processing module silica that is central to the miniaturization of the voice interactive functions and has DoD wide spin-off application to ASIC and MCM chip packaging and manufacture.

TERRA RESEARCH, INC.
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Phone: (408) 734-3096
Topic#: 91-205 ID#:91ETL-044
Office: TOP
Contract #: DACA76-93-C-0016
PI: Dr. Jack Liu
Title: Urban Feature Digital Database
Abstract: In Phase I, Terra Research successfully formulated a modular architecture for an urban feature digital database to support military operations over urbanized terrain (MOUT), based on urban terrain zone (UTZ) delimitations of built-up areas, and demonstrated a prototype database. Phase II will develop a layered approach for streamlining the process of UTZ-based urban terrain feature database preparation of limited access or denied areas with data that might reasonably be expected to be available. The approach will handle satellite and aerial imagery of varying resolution and accommodate constraints on preparation time and resources. Level 1 provides a synoptic description of the area of interest; Level 2 depicts key areas at higher resolution; and Level 3 addresses key area details. The preparation methodology will be formulated on a commercially available geographic information system (GIS) in the course of constructing sample databases on the Atlanta, GA and Gettysburg, PA areas. Imagery recognition keys will be developed along with identification of training requirements for terrain analysts. Successful completion of Phase II will establish the viability of the UTZ-based modular database concept and provide the basis for follow-on Phase III activities with the Army as well as many other application areas.

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Phone: (512) 263-2101
Topic#: 91-127 ID#:91ARO-061
Office: ARO
Contract #: DAAH04-93-C-0012
PI: Dr. Alan Bray/David White
Title: Estimating Remaining Life In Biological/Chemical Suit and Enclosure Materials
Abstract: Phase I successfully demonstrated the feasibility of using nondestructive inspection (NDI) penetrant based methods for detecting fatigue cracks and similar breaches of integrity in chemical protective (CP) clothing and shelters. The high detection rates available with this technique will be further refined and incorporated into a field deployable NDI kit in Phase II. The kit will use optimized penetrant systems to detect actual or impending defects in protective clothing and shelter materials, and thus provide a direct estimate of remaining life for CP clothing and shelters. An adjunct goal is to determine the feasibility of using penetrants to determine the extent of decontamination achieved--providing a quantitative basis for improving protective clothing decontamination procedures and techniques.

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Topic#: 90-279 ID#: 90TAC-011
Office: TACOM
Contract #: DAAE07-93-C-R002
PI: Frederick M. Tingley

Title: The Development and Testing of a Heat Pipe Based Cooling Accessory for the HMMWV Differential

Abstract: Following the proof of the concept of cooling the HMMWV differential with heat pipe based coolers, it is proposed that fully engineered prototypes be designed, built and tested. Each will be an array of heat pipes running from the oil sump to free air near the vehicle sides. Both collector and dissipator ends will be finned to extend the transfer surface. It is further proposed that the reduction in the temperature of the oil in a fully loaded differential owing to the cooler be measured both in the laboratory and on the vehicle with a chassis dynamometer.

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Topic#: 91-233 ID#: 91SDC-256
Office: SDC
Contract #: DASG60-93-C-0032
PI: Harold Jacobson

Title: Impact Detection System for Kwajalein Atoll Application

Abstract: Under a Phase I SBIR, we examined radar range-trilateration for detecting the impact of reentry vehicles at the Kwajalein Atoll. The Geometric Dilution of Precision (GDOP) contours for Trilateration Systems were computed and found to offer accuracy superior to that of the existing Splash Detection Radars. During Phase II, we propose to examine various implementations of trilateration to determine the most cost-effective design for Kwajalein applications. The implementations of interest include scanning and non-scanning concepts as well as monostatic and bistatic operation. Bistatic operation potentially offers wide coverage without the added expense of additional transmitters. We will extend our GDOP analysis to include back-projection of the plume track as needed to estimate where the plume emerges from the water. A simulation of radar data fusion from the multiple sites will be used to determine the accuracy of back-projection as a function of site equipment measurement accuracy and measurement rate, the size of the time window for measurements, and whether the measurements between sites are synchronous or asynchronous. The results will be presented as coverage contours about the Kwajalein Atoll. At the conclusion of Phase II, the most cost-effective design will be identified and its performance quantified in sufficient detail that the government will be in a position to decide whether or not to initiate the procurement of trilateration systems for Kwajalein.

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Topic#: 90-218 ID#: 90-SE-029
Office: CECOM
Contract #: DAAB07-93-C-Q007
PI: Arvind Goel

Title: An Efficient ADA/POSIX Implementation for Developing Real-time Applications

Abstract: The overall objective of the Phase II effort is to implement a very high efficiency Ada Runtime System using the functionality available in the POSIX operating system, the POSIX real-time extensions, and the POSIX threads extension. This Ada Runtime System (RTS) will support high performance capability and will enable Ada real-time applications that run in a POSIX/Unix environment to meet their time and memory constraints. The DDC-I Ada RTS hosted and targeted on top of LynxOS will be used for the Phase II implementation. The major effort during Phase II will be the implementation of Ada tasks as POSIX threads. Other tasking areas that will be implemented using threads functionality are task creation, cancellation, abort statement, rendezvous, task completion, and termination. Ada RTS features that will also be implemented using POSIX functionality include Ada program scheduling, task scheduling, delay statement, finer granularity of timing services, synchronous I/O, asynchronous I/O, real-time files, Ada address clauses, and interrupts. A major goal of the Phase I design was to make critical sections in the Ada RTS to be as short as possible as long critical sections can affect an Ada program's ability to respond quickly to asynchronous events and to meet its timing constraints. The Phase II implementation will go a long way in the acceptance of Ada for implementing real-time applications on the POSIX/Unix operating system.

45

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Topic#: 91-088 ID#: 91NAT-003
Office: NATICK
Contract #: DAAK60-93-C-0038
PI: Harry S. Katz

Title: Thermoplastic Elastomer (TPE) Coated Fabric for Toxicological Agents Protective Suit

Abstract: We successfully met all the objectives of the Phase I program. We developed thermoplastic elastomer/fabric laminates that are good permeation barriers and can be manufactured on standard high production equipment. Since this product is readily heat sealable, it will provide a great reduction in the cost of manufacturing TAP suits. Further improvements in the performance will be achieved during Phase II of the program. Among our objectives for the Phase II will be to fine-tune 1 or 2 materials for optimum barrier properties, decontamination characteristic, film/fabric bond strength, thickness, producibility and other pertinent properties; and make a short run production run (min 300 yds.) of the two best TPE coated fabrics. We will provide samples of bonded joints and demonstrate effective methods for fabricating the TAP suit. At the end of our Phase II program, we will submit detailed specifications for the laminates developed and procedure used. During the last two months of the program, we will fabricate a prototype TAP suit with our best laminate, and submit this suit to Natick. We will provide quarterly reports and a comprehensive final report on all the work performed. The completion of our Phase II program will be followed by a Phase III production operation, which will produce materials and the TAP suits with improved performance and low cost protection for military and civilian uses.

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Topic#: 90-003 ID#: 90ARD-002
Office: ARDEC
Contract #: DAAA21-93-C-0061
PI: Edward B. Fisher

Title: Ignition of High-Energy Density Charges - Solid Propellants

Abstract: To minimize system size and weight, and also, to increase ballistic performance, ballistic system design is making increasing use of solid propellant concepts that are characterized as having high energy per unit volume. These propellants include conventional formulations that are compacted or consolidated to higher density, more energetic formulations, and combinations of these. As energy density increases, combustion characteristics become increasingly sensitive to charge configuration and to the mode of ignition. If ignited improperly, events including excessive performance variability, extreme ignition delays, incomplete combustion, flamespread-driven pressure wave, overpressure and breechblow can occur. Therefore, well designed ignition systems must be developed to begin the ignition sequence in an orderly manner as required by the physical and chemical properties of the propellant. The objective of the proposed program is to choose a system of current interest to the Army, and using modeling and ignition diagnostics techniques, develop and tailor an ignition system. The proposed approach will address the specific physical chemical, physical, and mechanical properties and characteristics of the chosen propellant system, which can be consolidated ball, granular, or stick propellant; LOVA propellant; or a monolithic charge featuring chemical catalysts and high solids loading.

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Phone: (716) 689-0177

Topic#: 91-007 ID#: 91CRD-035
Office: ERDEC
Contract #: DAAA15-93-C-0064
PI: Robert L. Talley

Title: Improved Laboratory Testing Procedures for Evaluating Protective Clothing Ventilation Rates

Abstract: The Army has identified a need to develop better laboratory testing procedures for evaluating the effectiveness of chemical/biological protective clothing than the static procedures currently in use. New techniques are sought that provide a more accurate representation of the rigors actually experienced by protective clothing as the soldier performs his mission on the contaminated battlefield. To meet this objective, a direct measurement of protective clothing ventilation rates is desired. Veritay has identified two approaches to measuring ventilation rate: flex gage and air-flow monitor. Both approaches are suitable for "man-in-the-suit" testing and can provide information about the pressure differences across the cloth testing area when the fabric is subject to time-motion profiles typical of those encountered on the contaminated battlefield. The flex-gage concept provides a reading of the "stress-strain" force profile, which can then be reproduced in the laboratory on a similar swatch of clothing to determine ventilation rate as a function of pressure difference across the swatch. The Air-Flow Monitor (AFM) concept is the preferred approach for advanced development during Phase II since it is capable of measuring the ventilation rate of the

chemical/biological protective clothing directly, while the clothing is being worn in the simulated battlefield environment -- thereby eliminating an intermediate laboratory procedure.

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Phone: (716) 689-0177
Topic#: 91-119 ID#: 91BRL-020
Office: WTD
Contract #: 93-C-0031
PI: Edward B. Fisher
Title: Down Barrel Propellant Injection
Abstract: Although Bulk-Loaded Liquid Propellant Guns (BLPGs) offer numerous potential advantages over solid propellant guns, successful development of a BLPG system has been hampered by technical difficulties encountered in controlling the combustion process. Even so, the lure of improved logistics, lower overall costs, decreased vulnerabilities and the inherent simplicity of the basic concept has sustained a high level of interest in BLPGs. The first-hand experience gained by Veritay during nearly a decade of experimental work with BLPG systems has led to an improved understanding of the technical problems previously encountered, and confidence that effective solutions can be realized. During Phase I, two candidate concepts believed to have the potential for achieving combustion stability, progressivity, and reproducibility in BLPGs were experimentally explored. Both were shown to have a favorable influence in exerting control over combustion evolution in BLPG systems. The Phase II effort will be devoted to validating key investigative procedures and techniques; demonstrating the ability of the candidate concepts to control the ballistic process, to achieve repeatability and satisfactory muzzle velocities; and to developing preliminary BLPG concepts for weaponization.

VERITAY TECHNOLOGY, INC.
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Phone: (716) 689-0177
Topic#: 91-211 ID#: 91MED-090
Office: MEDICAL
Contract #: DAMD17-92-C-2053
PI: Robert L. Talley
Title: Environmental Health Monitor: Temperature Sensor Suite Advanced Development
Abstract: A laboratory-scale, experimental program conducted during Phase I demonstrated the feasibility of developing a compact temperature sensing suite capable of supporting a heat-stress management computer model. Experimental findings indicated that the miniaturized black globe thermometer based upon digital integration of multiple surface thermosensors will provide an equilibrium temperature value in approximately three minutes. The wet bulb with a miniaturized wetted surface will generate the natural wet bulb equilibrium temperature value in a similar time range. The dry bulb thermosensor to indicate the equilibrium temperature is a function of the thermister rate constant. During Phase II, Veritay will conduct advanced development of the self-contained suite of sensors capable of measuring, storing, and downloading upon command selected environmental temperature parameters to use as input to heat-stress predictive models. The four-sensor suite (i.e. dry bulb (ambient air temperature); wet bulb (relative humidity); black globe or mean radiant temperature (radiant energy); and anemometer (windspeed)) will be suitable for use with either the standard WGBT model or with the heat-stress model currently under development by the U.S. Army.

VIASAT, INC.
6120 PASEO DEL NORTE, SUITE J2
CARLSBAD, CA 92009
Phone: (619) 438-8099
Topic#: 91-115 ID#: 91TEC-104
Office: TECOM
Contract #: DAAD05-93-C-0220
PI: Mark Johnson
Title: Unmanned Ground Vehicle (UGV) Indoor Tracking System
Abstract: A Precision Vehicle Tracking System (PVTS) that provides very accurate position information for UGVs in a Robotics Test facility is proposed. The PVTS relies on a small, lightweight, frequency hopped transmitter (Beacon Subsystem) which is attached to the UGV. No tether or hard-wire connection from the UGV to the control station is required. This system will support tracking of multiple UGVs simultaneously and can provide orientation information in addition to x,y position data. The system is designed to counteract the severe multipath interference environment resulting from operation within a metal building. The design is consistent with the ruggedization required for operation in a severe physical environment. The overall proposed system is designed to minimize procurement and life-cycle cost, eliminate accuracy degradation with time and temperature, and not interfere with other test facility systems. The small size and weight of the Beacon Subsystem assures it will not interfere

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with the UGV function. Phase I design and analysis has shown that the Beacon subsystem will weigh less than 1 lb. and require less than 10 cubic inches of space (excluding ground plane). Phase II program objectives are to refine, design, fabricate and test a fully functional PVTS system in the Robotics Test Facility.

VIASAT, INC.
6120 PASEO DEL NORTE, SUITE J2
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Phone: (619) 438-8099
Topic#: 91-245 ID#: 91SDC-110
Office: SDC
Contract #: DASG60-93-C-0047
PI: Mark D. Dankberg
Title: Voice/Data Multiplexer for Communications
Abstract: This proposal describes an SBIR Phase II program to design, build, test, and demonstrate a proof-of-concept prototype voice/data multiplexer. This Phase II program continues the Phase I work which demonstrated the feasibility of developing a voice/data multiplexer. The motivation for this program is the reduction of the government's recurring telecommunications cost through the more efficient use of telephone lines. The proposed voice/data multiplexer will simultaneously provide a secure, full-duplex, toll-quality voice circuit and, full-duplex, error-free performance will be provided through an innovative combination of several technologies, including: low rate voice encoding with speech interpolation, data source coding, error detection and correction coding, multiplexing, and advanced wireline modulation, ViaSat has extensive experience in these areas of technology and is well qualified to complete the work within the schedule and cost described in this proposal.

XONTECH, INC.
6862 HAYVENHURST AVENUE
VAN NUYS, CA 91406
Phone: (714) 894-2286
Topic#: 91-235 ID#: 91SDC-241
Office: SDC
Contract #: DASG60-93-C-0078
PI: Stanley Cottrill
Title: Real Time Coherent Processor for the Kwajalein FPQ-19 Radar
Abstract: The FPQ-19 radar element of the Kwajalein Missile Range is a coherent radar with capabilities potentially of benefit to real time operations and to post mission data analyses. Currently, the coherent capability of the radar contributes little to the value of the radar. Proposed below is a Coherent Signal Processor (COSIP) which 1) will greatly extend the operation range of the radar is real time through coherent integration, and 2) will similarly extend the value of the data through implementation of a recording scheme to capture the coherent data currently available at the radar output. The hardware elements proposed for the development are essentially all commercial-off-the-shelf (COTS) elements; the software is based on software existing currently within XonTech. The heart of the hardware is a new, high speed Digital Signal Processor chip capable of computing 1,024-point Fourier transforms in 80 microseconds. Under a Phase II contract, XonTech, Inc. with the aid of Catalina Research, Inc., will develop the hardware and software required to complete fabrication of the COSIP. The developed system will be fully tested and documented in CONUS and be ready to install at Kwajaalein, under a separate contract. Specifications will be written which address the (minimal) FPQ-19 modifications.

ADCOM SYSTEMS TECHNOLOGY, INC.
30 GRANT ST
WALTHAM, MA 02154
Phone: (617) 899-5905
Topic#: 90-152 ID#: 41249
Office: NSWCDDWO
Contract #: N60921-94-C-0019
PI: Elie Baghdady
Title: Passive Ranging with Limited Data
Abstract: Innovative intraplatform induced Doppler frequency shift (IDFS) utilization techniques are proposed for implementation and experimentation in a Phase II Program to validate theoretical-analytical findings established under Phase I, and demonstrate a passive RF surveillance and targeting sensor for single-platform, real-time accurate measurements of range/location of OTH threat RF emitters. The techniques proposed herein have been determined in Phase I to enable the realization of single-platform passive RF ranging systems that satisfy essential physical constraints on sensor aperture dimensions and compatibility with submarine and other Navy platforms. The proposed implementation is planned to allow experimentation analyses to demonstrate design and operational trade-offs, and the effects of such conditions as variable platform attitude, position and dynamics. Definitive sensor configurations, sensor processing schemes/techniques, computational algorithms and operating modalities will be tested and demonstrated, and design and implementation latitudes will be established, complete with performance predictions for the development of operational prototypes for single-platform passive ranging systems designed for specific Navy surface and other platforms.

ADVANCED ENGINEERING & RESEARCH ASSOCS
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ARLINGTON, VA 22202
Phone: (703) 769-1810
Topic#: 90-270 ID#: 41017
Office: NAWCTRE
Contract #: N68335-94-C-0012
PI: Charles B Franks
Title: A Model for Predicting the Performance Deterioration in Gas Turbine Engines
Abstract: A model for predicting the performance deterioration of gas turbines will be finalized and implemented in this Phase II effort. The model is based on the Phase I results and predicts performance deterioration based on the engine mission, the engine's physical and design performance characteristics, and the environmental conditions. The methodology uses a stage stacking technique combined with data correlations for the turbine to determine the amount of deterioration. During Phase II, the performance deterioration methodology will be finalized and developed to include three specific engine simulation models. In addition, a generic simulation modeling capability will be developed using the NNEP simulation model. The model will be documented in a user's manual, an implementation manual, and a final technical report.

ADVANCED OPTICAL SYSTEMS, INC.
1103 DEBORAH DR
HUNTSVILLE, AL 35801
Phone: (205) 880-0548
Topic#: 90-252 ID#: 41198
Office: NAWCLKE
Contract #: N68335-94-C-0010
PI: Richard L Hartman
Title: Aircraft Landing Optical Recognition Experiment (ALORE)
Abstract: The Navy wants innovative technology to aid the Landing Systems Officer on a carrier. The system must identify incoming aircraft, and verify that the wheels and tailhook are down. The Navy expects to place an NDI sensor suite in the fleet, and is exploring optical processing for the recognition and verification task. An optical processor uses light instead of electricity to carry and manipulate information. It is especially suitable for jobs where the information is in parallel. The optical processing correlator uses the theoretical optimum way to recognize images. In Phase I, AOS showed the feasibility of recognizing aircraft at ranges greater than two miles, detecting wheels down at greater than 1 1/2 miles, and detecting tailhook at one mile. The demonstration was experimental, not a paper study. In a response to concerns at NAEC about real IR images, AOS also demonstrated correlation discrimination between aircraft using computer image files of real FLIR imagery of an A6, an F18 and an F14. The Phase II program will consist of the design and fabrication of an optical correlator optimized for the ALORE mission, laboratory experiments, field experiments with real aircraft, and a demonstration at a Naval Air Station.

ADVANCED SCIENTIFIC CONCEPTS, INC.
2441 FOOTHILL LANE
SANTA BARBARA, CA 93105
Phone: (805) 966-3331
Topic#: 91-303 ID#: 91N40-268
Office: ONR
Contract #: N00014-93-C-0271
PI: Roger Stettner, Ph.D.

Title: Experimental Verification of a Staring Underwater Laser Radar FPA
Abstract: The long-range objective of the proposal team (ASC and its subcontractor IMAT) is to deliver a high-speed, high-sensitivity, low-weight, high-resolution 3-dimensional blue-green laser imaging system for use in remote detection and identification of underwater objects from airborne or submerged platforms. Just a single pulse is necessary to develop the three dimensional image (area and depth) using an extra-ordinarily light and compact structure -- the key component of the system which gives the receiver subsystem. In addition to the advantages already mentioned, the readout chip offers the advantage of much higher resolution at greater depths than any competing or existing technology. This is because the detector integration time is matched to laser pulse length reducing "continuous" noise sources such as particulate backscatter of laser photons (veiling luminance), solar radiation and detector dark current. The primary objectives of this Phase II proposal are: (1) to experimentally verify that the readout chip performs as anticipated, with negligible noise, and (2) to develop a customer-responsive marketing plan for Phase III funding, using systems analysis and software modeling. The analysis will include processing schemes which significantly lessen the processing load and associated false alarm rate.

ADVANCED STRUCTURES TECHNOLOGY, INC.
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Topic#: 90-240 ID#: 41003
Office: NAWCWAR
Contract #: N62269-93-C-0234
PI: Michael J. Happ

Title: Phase II Research, Development, and Testing of a Pretensioning Device for Helicopter Crewmember Crash Protection
Abstract: A frequent cause of death and serious injury in "survivable" helicopter crashes is that crewmembers have a tendency to significantly loosen their restraint system (shoulder straps) to gain comfort and mobility during flight operations. The loosened shoulder straps increase the occupant "flail" envelope and degrade the restraint system's ability to protect the occupant during a crash. Other factors (strap elasticity between the initeria reel and the seatback strap guide, and inertia reel "film-spooling" and prelock payout of the webbing) combine to increase the occupant flail envelope by 10 inches. The objective of the SBIR Phase I effort was to study the feasibility of designing a device that would automatically sense crash onset and pretension the occupant's restraint system and reduce/eliminate the negative effects of strap elasticity, inertia reel film-spooling, and prelock payout. In so doing, the pretensioning device can provide better occupant crash protection (by reducing occupant flail), thereby reducing the potential for death or serious injury in survivable crashes. The AST Phase I pretensioning device design clearly demonstrated that such a device is technologically feasible and meets all Phase I design goals. The relatively simple design will permit cost-effective production and minimal in-service maintenance. During the proposed Phase II effort, AST will perform further design optimization and testing of the pretensioning device, leading to commercial development during Phase III.

ADVANCED SYSTEM TECHNOLOGIES, INC.
12200 E BRIARWOOD AVE - STE 26
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Topic#: 90-180 ID#: 41168
Office: NSWCDDWO
Contract #: N60921-93-C-0178
PI: DR Robert T Goettge

Title: Knowledge-based Distributed Operating System Assistant
Abstract: Use of real-time computing in Navy systems is increasing, including the use of distributed computing. Real-time operating system services provide an Interface between application software and the hardware. Requirements for real-time performance, reliability/fault tolerance, and security must be addressed by a these services. Use of complex operating systems in applications having stringent requirements is itself a complex task. A knowledge-based assistant will facilitate the use of operating system services, especially distributed operating systems (DOS) services, in Navy applications. In Phase II a prototype DOS assistant will be developed and demonstrated. The CLIPS expert system shell will be used as a framework for the DOS assistant. Knowledge will be acquired from internationally recognized experts in operating system usage and performance. The knowledge will be encoded as production rules. Demonstrations of the utility of the DOS assistant will be based on trial users developing realistic time-critical applications. Knowledge for a specific real-time operating system will be entered into the DOS assistant and the assistant will advise these trial users on alternative designs and implementations. Expert evaluation, simulation, and performance measurements will be used to determine the effectiveness of the advice offered by the DOS assistant.

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AERODYNE PRODUCTS CORP.
76 TREBLE COVE RD
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Phone: (508) 663-7411
Topic#: 87-229 ID#: 87N10-601
Office: NAWCTRE
Contract #: N68335-93-C-0061
PI: Morton Camac
Title: A Non-Intrusive Turbine Temperature for Diagnostic and Monitoring Applications
Abstract: Accurate measurements of turbine blade temperatures are important in monitoring turbine engine performance. Current two color pyrometry can encounter accuracy problems due to interference by relected radiation from the combustor. The Phase I program demonstrated an active pyrometry system that is insensitive to relected radiation from the blade. This system determines the blade temperature by measuring the change in infrared emission produced by heating the blade with a short duration pulse of laser light. The temperature determination is not sensitive to the laser pulse intensity or duration. The Phase II program will obtain temperature profiles of stator and rotator blades in an operating turbine engine on a test stand. The intense radiation from the combustor will not affect the active pyrometry measurements. The system can be ruggedized for use on an engine by coupling the laser and detectors with fiber optics to the engines.

AERODYNE RESEARCH, INC.
45 MANNING RD
BILLERICA, MA 01821
Phone: (508) 663-9500
Topic#: 90-073 ID#: 40902
Office: NAWCWAR
Contract #: N62269-93-C-0535
PI: Malcolm LaCompte
Title: Passive Non-cooperative Target Recognition Sensor
Abstract: Exploitation of the polarization of aircraft infrared (IR) signatures has been studied as a means to identify non-cooperative aircraft targets beyond visual range. Detection of IR radiation polarization contributes four new and measurable attributes: polarization degree, angle, spatial and temporal variation to a target IR signature. All four can be determined for an unresolved or marginally resolved target with suitably designed sensors and implementation. If a target has been detected or is being tracked, and its range is known, then its aspect will be sufficiently well known to predict its signature polarization. The utility of signature polarization for non-cooperative target recognition (NCTR) or NCID (non-cooperative identification) derives from its dependence on shape and paint differences between targets. This approach to NCID exploits the same identification keys (i.e. target color and shape) usually associated with visual discrimination. However, the IR signature polarization attributes can be exploited day or night and at much greater than visual ranges. The feasibility of this technique was assessed in the Phase I study performed by Aerodyne Research, Inc. (ARI) for Naval Air Systems Command (NAV AIRSYSCOM) and the Naval Air Development Center (NADC).

ALPHATECH, INC.
50 MALL ROAD
BURLINGTON, MA 01803
Phone: (617) 273-3388
Topic#: 92-020 ID#: 92N47-076
Office: NSWCDDWO
Contract #: N60921-94-C-A319
PI: Ms. Kendra Moore
Title: Mobile Surveillance Systems (NBS) Performance: Analytical Capability
Abstract: Phase I of this research demonstrated the feasibility of using advanced Petri net technology to analyze the performance of a particular Naval surveillance system. Our approach treats Petri net tokens as objects that carry their own attributes and provides an object-oriented design approach that applies real-world constraints (e.g. timing, resources) to abstract object-oriented data structures. Phase I involved data collection, model construction, and system-wide performance analysis (processing delays and operator workload) for a specific Mobile Surveillance System Combat DF. Phase I demonstrated that an existing software tool for Petri net modeling of C3I systems is mature, and permits efficient modeling, analysis, and simulation of large systems. Phase I also determined that today's Navy has a greater need for a tool to support consolidation, integration, restructuring, and enhancements of existing software systems than for a tool to support the design of new systems from scratch. Phase II will modify the existing software to support planning for integration and rehosting of existing software systems onto new shipboard computing environments. The Phase II product will allow a systems engineer to "walk through" each step of the re-engineering process, and to identify performance bottlenecks along the way. Immediate users of the Phase II product will be Navy C3I systems managers and their support staff. The Phase II software product will be suitable for use by and made available to other DoD agencies and non-DoD agencies, and will be distributed commercially.

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EXECUTIVE PLACE III 50 MALL RD
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Phone: (617) 273-3388
Topic#: 91-297 ID#: 91N3E-096
Office: ONR
Contract #: N00014-93-C-0077
PI: James C. Deckert
Title: Condition-Based Machinery Maintenance
Abstract: Phase I of this effort clearly demonstrated the feasibility of incipient fault detection for vibrating systems not only for bench test conditions (helicopter gearbox) but also for mild operating conditions (condensate and fire pumps). This proposal presents four technical tasks to extend the Phase I methodology to deal with more realistic field operating conditions. The first clarifies the relative importance of detection versus identification. The second makes feature selection, analysis, and extraction substantially more efficient--which is important given the amounts of data that must be processed to develop a reliable system. The third addresses the four major barriers to scaling our Phase I technology to field systems: the wide range of normal operating conditions, the presence of other vibrational sources, the need to reduce false alarm rates to less than 1 per 5000 hours (est.), and the need to provide timely, high-confidence warning. The final task will determine whether or not these stringent specifications can be net with field data, which is invariably less forgiving than bench test data and mild-operation data. The output of Phase II will be a proven generic capability to design and test incipient failure detection systems.

AMERASIA TECHNOLOGY, INC.
2248 TOWNSGATE ROAD
WESTLAKE VILLAGE, CA 92152
Phone: (805) 495-9388
Topic#: 90-293 ID#: 93N37-040
Office: NAWCMUGU
Contract #: N68936-93-C-0020
PI: Dr. Edward Staples
Title: Airborne Real Time Response Monitor
Abstract: This proposal addresses the need for advanced signal processing in airborne surveillance and targeting receivers. An innovative real time compressive receiver architecture using Surface Acoustic Wave (SAW) transformers is proposed as a phase coherent airborne response monitor. In Phase I, simulations and hardware demonstrations confirmed the coherence of the response monitor design concept. The airborne response monitor will provide simultaneous coherent time and frequency domain analyses in real time with 100% probability of intercept. The objective of the Phase II effort is to build a developmental receiver per the architecture developed under Phase I of this project. The receiver shall be capable of installation in an airborne platform for the purpose of evaluating performance against real emitters and in actual electronic warfare environments.

AMERICAN ELECTRONICS, INC.
9332 ANNAPOLIS RD
LANHAM, MD 20706
Phone: (301) 459-4343
Topic#: 90-114 ID#: 40938
Office: NRL
Contract #: N00014-93-C-2118
PI: David W Rose
Title: Sensor Fusion Using Electro-optic and Radar Signal Modulation Data
Abstract: The ability to distinguish between friendly, enemy and neutral targets is a major problem in the conduct of modern warfare, where standoff weapons can engage targets at ranges far beyond those at which they can be identified. Identification systems based on Radar Signal Modulation (RSM) technology are one possible solution to this problem, and have been given a high priority in NCTR research. As part of the Phase I research, AMELEX developed and implemented a novel RSM processing algorithm which may have the potential to identify targets at longer ranges and under more adverse conditions than current algorithms. The purpose of this Phase II research is to (1) refine the novel technique developed in Phase I, (2) search for other novel RSM processing techniques, (3) combine these techniques into an optimal RSM ID system capable of handling all the exceptions and special cases which occur in the real world, (4) rigorously test and compare the performance of the new algorithms against current systems, using real-world data provided by NRL. If successful, Phase III would involve developing real-time implementations of the new algorithms for incorporation into existing RSM processing hardware.

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ARLINGTON, VA 22202
Phone: (703) 415-2676
Topic#: 91-041 ID#: 91N47-253
Office: SPAWAR
Contract #: N00039-94-C-0019
PI: Dr. Stephen Lane
Title: Fractal Image Analysis, Automation, and Detection for the Integrated Undersea

Abstract: IUSS has an urgent need for more efficient methods of signal detection and classification. To meet this end, existing detection and classification systems must be re-examined and modified. This proposal develops an innovative technique, fractal image analysis, combined with standard image processing techniques such as wavenumber filtering, Walsh transforms and Wiener filtering, to detect and possibly classify submarines using passive undersea surveillance data. This concept was examined in Phase I where a fractal measure was applied to a limited set of lofargrams. The proposed work includes collection of a larger data set, optimizing and improving the Phase I fractal analysis code in a prototype system, further evaluation of the optimized code on areal data and automation of the technique. The system will be developed as an optional application tape to make use of SPAWRSYSCOM's pd 60 univied build. In addition, applicable oat modules will be used or built to broaden the capability of the operational system to be developed in phase III.

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Phone: (401) 849-9390

Topic#: 90-087 ID#: 40915
Office: NAVAIR
Contract #: N00019-93-C-0108
PI: Robert H Wallace

Title: Standardized Interactive Electronic Presentation of Weapon System Troubleshooting
Abstract: Risk reduction for Integrated Diagnostics Demonstration (IDD) project and provide cost metrics for the deployment of Interactive Electronic Technical Manuals. For further information contact Ms. Nodgaard at (703) 692-7890 x6309.

ARCCA, INC.
700 SECOND STREET PIKE
RICHBORO, PA 18954
Phone: (215) 322-8396

Topic#: 90-084 ID#: 40910
Office: NAVAIR
Contract #: N00019-93-C-0154
PI: Edward J. Ramsay

Title: Automated Integration of Level of Repair Analysis (LORA) with Logistics Support
Abstract: The Phase I effort successfully demonstrated the concept of an automated integration link between LSAR and LORA data bases. A Phase II development effort will result in a capability which will reduce redundant labor intensive manual operations currently required to maintain the independent data bases. Because engineering and program data become more clearly defined as hardware development progresses, data bases must be continually updated. The data bases are presently independent; an automated integration link would reduce labor intensive LORA data set definition and maintenance, increase consistency between files, allow for more rapid generation of reports, and streamline the maintenance planning/acquisition process. We propose a flexible, user-controlled data link concept whereby the volume of data flow (user-defined types and categories) can be specified, in order to comply in the greatest way possible with the application needs of the analyst. Significantly, the Phase II effort will address both the challenges facing the logistics community familiar with the traditional LSAR processes, and also the new requirements and opportunities presented by the adoption by DOD of MIL-STD-1388-2B in January 1991. LORA data will be extractable from either configuration. This will drastically reduce the need to purchase new 1388-2B commercial software now being developed. Finally, by structuring the software design for flexibility in consideration of the CALS initiative, the Phase II product will be able to access anticipated new data bases (manufacturer's Part Number/Work Unit Code (WUC) cross reference dictionaries, and other CALS related data bases) and existing data bases (the Reliability Centered Maintenance (RCM) data base) with minor modification, allowing innovative, comprehensive types of analyses which, at present, are not readily possible.

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Topic#: 90-118 ID#: 93N14-392
Office: NAVAIR
Contract #: N00019-93-C-0150
PI: Robert Wittemeyer

Title: Ribbonized Organized Integrated (ROI) Electrical Wiring
Abstract: Flexible automated manufacturing cells are to be developed to produce ROI wiring harnesses and systems by the use of programmable robotics and changeable end point manipulators and gippers. The thrust is to develop a highly consistent, yet versatile manufacturing process geared to guide changeover with repetitive accuracy to handle various wiring harnesses in an automated mode. The intent is to develop handling techniques, methods and processes to completely automate ROI harnesses to support major programs such as the V-22 Osprey.

ASTRON CORP.
470 SPRING PARK PLACE
HERNDON, VA 22070
Phone: (703) 471-0600
Topic#: 92-017 ID#: 92N07-055
Office: MARCOR
Contract #: M67854-94-C-0007
PI: Ed Farren
Title: Combined Antenna Systems for Assault Amphibian Use
Abstract: During Phase I a design concept for a collinear, broadband high isolation dual antenna system for use with the Assault Amphibian Vehicle was developed. This dual antenna system used inductive loading techniques to provide on-the-horizon, omnidirectional vertically polarized radiation in an antenna less than 2/3 the size of the existing single monopole and needs no coupler or tuner to cover the 30 to 90 MHz frequency range. In Phase II this approach will be implemented in a prototype antenna. Other configurations which may also meet various performance, profile, and system requirements will be evaluated for possible prototyping.

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Phone: (703) 471-0600
Topic#: 90-278 ID#: 41023
Office: NCCOSC
Contract #: N66001-93-C-7005
PI: Joseph R Jahoda
Title: Improved Direction Finding Techniques
Abstract: All RF Systems have undergone tremendous miniaturization during the last few decades. However, the size of RF components, such as duplexers, filters, and molators, have undergone some improvement, while the antennas have undergone none. Through the use of dielectric/ferrite antenna loading as proposed by Astron, there is now the possibility of achieving over 50% antenna miniaturization at little loss of efficiency. In addition, by introducing a series of Astron's innovative techniques, broadband operation over the HF or VHF is feasible. The low impedance traveling wave antenna innovations permit the placement of antennas closer without introducing additional coupling and decreasing re-radiation.

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Phone: (703) 471-0600
Topic#: 90-282 ID#: 90N47-009
Office: SPAWAR
Contract #: N00039-94-C-0049
PI: Joseph R. Jahoda
Title: Small Ship UHF Antennas
Abstract: Three innovative dielectrically loaded miniature UHF/SATCOM antennas were proposed and evaluated during the Phase I program. The high gain helical array antenna has been selected for application in an innovative fixed array (40 pounds), to achieve the performance of two pedestal mounted, servo controlled, 50 inch "Barrel" antenna, AS-3018/W SC-1 (600 pounds total weight). The array can be split to mount on one or two masts, on small or large ships. Very significant cost savings are made possible in initial cost, maintenance, relocability, spares and training, and over 45 square feet of ship "real estate" and 540 pounds of weight will be saved.

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Topic#: 90-095 ID#: 93N0A-156
Office: NAWCWAR
Contract #: N62269-93-C-0234
PI: Tamar Peli
Title: High Speed Detection and Discrimination for Multi-sensor Systems
Abstract: This Phase II proposal is aimed at continuing the development of morphology-based detection and discrimination algorithms for multi-sensor system. The proposed program builds on the results of Atlantic's Phase I SBIR program. In Phase I we developed morphology-based algorithms for the detection, discrimination and classification of objects of military significance. The morphology-based IR ATR system was applied to land imagery and was able to detect low-contrast targets while maintaining very low false alarm rates. We achieved reliable separation between natural and man-made objects based on fractal measures. We demonstrated the potential of morphology-derived measures of texture and structure for target classification. The technology developed and demonstrated in our Phase I SBIR program offers substantial potential for improving detection and classification performance in a variety of sensor domains, and provides a solid foundation for a unified multi-sensor/multi-spectral ATR architecture. Our proposed work in Phase II is to refine and extend the developed algorithms

for IR imagery to other scenarios and sensors of importance to airborne Navy missions, and characterize the performance of the developed algorithms against sets of imagery containing targets embedded in realistic backgrounds. In addition we propose to develop background texture metrics based on fractal analysis for augmenting and maintaining data bases and for ATR algorithm development and performance evaluation. The design of a top-level multi-sensor processing architecture for a selected operational application will lay the ground for a follow-on real-time hardware development in a Phase III program.

AZAK CORP.
21032 DEVONSHIRE, SUITE 213
CHATSWORTH, CA 91311
Phone: (818) 882-3137

Topic#: 87-113 ID#: 93N37-041
Office: NAWCMUGU
Contract #: N68936-93-C-0023
PI: Dr. Judd Q. Bartling

Title: Infrared Random Signal Processor "Brass Board" that Reduces or Eliminates Background/Clutter Interference

Abstract: This proposed Phase II constructs an infrared random signal processor "brass board" using the results of a Phase I feasibility study (Navy Contract N-00019-88-C-0314). Two subphases are proposed. One subphase calls for constructing the factoring (analog to digital) capability. The other subphase constructs the joint adaptive filter and combines both subsystem into the final random signal processor. The proposal contains two different infrared random processing "brass boards." This dual proposal arose from the uncertainty of the customer's needs. One system uses a Michelson like interferometer (intermediate infrared band) and the other is all reflective (optical to submillmeter). Although two systems are proposed only one system will be constructed.

BARRON ASSOC., INC.
ROUTE 1, BOX 159
STANARDSVILLE, VA 22973
Phone: (804) 985-4400

Topic#: 91-297 ID#: 91N3E-036
Office: ONR
Contract #: N00014-93-C-0074
PI: Dr. S. Eugene Parker, PhD

Title: Machinery Diagnostics Using Polynomial Neural Networks

Abstract: Health monitoring systems are used to indicate degradation and impending failure of components. The Phase II work proposed herein addresses the problem of health monitoring in helicopter transmissions, concentrating on "through the part" faults. Unlike the more easily detected "soft" bearing faults, "through the part" gear faults produce no debris. The difficult problems of novel faults and vibration signatures that are unique to each aircraft and even to each transmission rebuild will also be addressed. Data from actual helicopter transmissions will be used to test, improve, and verify the results, to the extent that a flight text program is justified for Phase III. The algorithms explored in Phase I appear sufficiently promising to address successfully all of the above transmission conditions.

BOULDER MICROWAVE TECHNOLOGIES, INC.
4216 PIEDRA PLACE
BOULDER, CO 80301
Phone: (303) 492-2433

Topic#: 91-275 ID#: 91N37-184
Office: NAWCMUGU
Contract #: N68936-94-C-0023
PI: David C. Chang

Title: Omnidirectional Circularly-Polarized Conformal Microstrip Antennas

Abstract: A computer-aided simulation/design tool for designing omnidirectional, circularly-polarized wraparound microstrip antennas is proposed. Continuing on our Phase I effort, the goal of this project is to provide antenna designers with a practical tool for obtaining an optimal design quickly and efficiently using a personal computer. Pertinent design factors such as curvature of the mounting surface and mutual coupling between patches will be accounted for in the proposed design tool. This Phase II proposal outlines the work to be done on the implementation and validation of such a tool. Sample prototypes for missile telemetry application will be designed and built for demonstrative purposes.

CAPE COD RESEARCH, INC.
P.O. BOX 600
BUZZARDS BAY, MA 02532
Phone: (508) 759-5911

Topic#: 91-077 ID#: 91N2D-003
Office: NSWCDDWO
Contract #: N60921-94-C-0001
PI: Brian G. Dixon, PhD

Title: Advanced Aircraft Coating Removal

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Abstract: The Phase I research demonstrated the feasibility of developing and implementing a novel technology for the removal of aircraft topcoats in an environmentally benign fashion. This innovative "thermorelease" chemistry allows for the use of conventional topcoat formulations and epoxy primers on both metallic and composite substrates. The primary objective of the Phase II program is to develop and optimize the thermorelease primer technology to the point of practical application. More specific program objectives are to determine the parameters that control the thermorelease process, establish the benign nature of the products that result from it, and evaluate the adhesion and physical properties of primer-topcoat formulations on both aluminum and composite substrates.

CEMCOM RESEARCH ASSOCS, INC.
1919 HALETHORPE FORMS ROAD
BALTIMORE, MD 21227
Phone: (410) 247-0012

Topic#: 90-268 ID#: 41206
Office: NFESC
Contract #: N47408-93-C-7357
PI: Sean Wise

Title: Development of CBC/PTC Composite Wall Materials to Prevent Sympathetic Detonation Between Weapons Storage Cells
Abstract: A project is proposed to develop cost effective, high porosity, moderate strength cement based materials that can be used in high performance magazine construction for both structural and shock absorbing purposes. The material will need to have a compressive strength of 2500 psi, pore content of less than 60%, have ingredient costs less than $200/yd, and be easily processed. The required strength and high pore content are the most difficult to reconcile but this should be achievable if the pore size is kept to a minimum. Costs will be kept to a minimum by only using raw ingredients that are within the cost constraints imposed. Processing, while not optimized in this proposal, will only use equipment commonly available in the construction industry. The focus of the project will be to have a material that can be placed in the field but methods that are more appropriate for pre-fabricated sections will also be considered. The materials produced will be tested for their structural suitability with the assistance of Construction Technology Laboratory who will conduct creep and shrinkage studies, examine the development of the bond between reinforcing steel and the porous structural material then designing and testing of some simple structural elements.

CFD RESEARCH CORP.
3325-D TRIANA BLVD
HUNTSVILLE, AL 35805
Phone: (205) 536-6576

Topic#: 90-239 ID#: 41001
Office: NAWCWAR
Contract #: N62269-92-C-0204
PI: Dr Andrzej J. Przekwas

Title: Drag Reduction on an Ejection Seat During High Speed Ejection
Abstract: Aircraft emergency escapes at 600+ KEAS expose the pilots to forces beyond physically tolerable limits. This project proposes the development/adaptation and validation of existing Computational Fluid Dynamics (CFD) capabilities to conduct aerodynamic analyses on typical ejection seat configurations. In Phase I a three-dimensional mesh generator was developed to construct meshes for the seat and occupant, and an existing CFD code, REFLEQS, was adapted for aerodynamic analysis of ejection seats. A demonstration and validation study showed the feasibility of using these codes for aerodynamic analysis of a seat with occupant. The predicted CFD results showed good agreement with wind tunnel test data. In Phase II, the grid generator and CFD code development and adaptation will be completed. A Mechanical Computer Aided Engineering Program (MCAE) such as I-DEAS will be utilized for surface definition of the seat and occupant, and the grid generator will be automated for ejection seat applications. The CFD code enhancement will include adding an advanced time-accurate shock capturing scheme and an advanced turbulence model for flows with recirculation. The CFD code will be validated against a series of test cases from at least two wind tunnel models. Several design concepts will be assessed and analyzed with the CFD tools. The developed and adapted software will be integrated into a mini-supercomputer workstation for efficient use of the CFD technology. The integrated software and hardware system will be delivered to NADC.

CHARLES RIVER ANALYTICS, INC.
55 WHEELER STREET
CAMBRIDGE, MA 02138
Phone: (617) 491-3474

Topic#: 91-152 ID#: 91N2D-335
Office: NSWCDDWO
Contract #: N60921-94-C-0030
PI: Dr Alper K Caglayan

Title: A Hybrid Neural Network/Expert System Approach to Multiple Target Recognition
Abstract: Under Phase I, we demonstrated the feasibility of a hybrid artificial neural network (ANN)/knowledge base (KB)

approach to multiple target recognition. Specifically, we developed a hybrid MTR architecture composed of ANN and KB classifiers and decision makers, and conventional signal processing, and showed that a hybrid classifier out performs the individual ANN and KB classifiers comprising the hybrid system. Under Phase II, we propose to develop a full-scale research prototype hybrid MTR system. Specifically, we propose to expand the MTR simulation fidelity to incorporate operational realism for a shipboard air defense system, enhance the Phase I MTR architecture using additional ANN paradigms and KB inference protocols, implement the hybrid MTR system using CASYS, our in-house CASE tool for real-time intelligent systems, demonstrate the performance of the enhanced MTR system in recognizing long-range high altitude and short-range low altitude threats, and assess its real-time operational requirements. The major innovations in our proposed approach include a hybrid approach to MTR, distance metrics for the selection of training data, 3D invariant ANN features, the interpretation of ANN outputs using reasoning under uncertainty, and the MTR software implementation in CASYS allowing automatic embedment into Ada source code.

COMMONWEALTH TECHNOLOGY, INC.
5875 BARCLAY DRIVE
ALEXANDRIA, VA 22310
Phone: (703) 719-6800

Topic#: 91-306 ID#: 91N07-035
Office: NSWCCRN
Contract #: N00164-93-C-0180
PI: Robert A. Hunsicker

Title: Design, Development, and Fabrication of Battery Chargers for Field Deployment

Abstract: Five chargers will be developed for recharging NiCad and Lead Acid batteries. These chargers will implement results of Phase I work regarding battery temperature control, charging protocol, power sources, and the battery charging requirements of the individual Marine and the Marine company in the field. Two of the five chargers will be miniature diesel engine/generator powered units for the individual Marine with one battery or three batteries to recharge daily. The third will be a portable charger (by light vehicle) powered by a diesel engine/generator and applicable to a Marine company. This charger will have a capacity for 48 batteries. The final two will be trailer-mounted with 48 battery capacities. One of these will be powered by a diesel engine/generator. The other will be powered by a diesel-fueled thermopile. All of the battery chargers will recharge either BB-590/U NiCad or BB-490/U Lead Acid batteries. The three chargers with 48 battery capacities will also recharge other standard issue NiCad batteries. All will incorporate temperature-controlled chambers to bring the batteries to thermal equilibrium before charging and to store the batteries after charging.

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

Topic#: 92-090 ID#: 92N1F-003
Office: NFESC
Contract #: N47408-93-C-7356
PI: Dr. Jerry L. Martin

Title: Impact Mechanism for Seawater Rock Drill

Abstract: An innovative seawater hydraulic rock drill is proposed. This rock drill would incorporate a unique pistonless impact mechanism developed in Phase I of the project. This impact mechanism has demonstrated impact energies exceeding 10 J (7.64 ft-lb) at cycle rates in excess of 30 Hz. The mechanism eliminates all heavily loaded sliding parts and promises high reliability in seawater. A rock drill based on this design should easily exceed the drilling rates of the Hd-20 drill, while exhibiting good compatibility with the NCEL power supply and excellent reliability. During Phase II, Creare will further develop components of this impact mechanism. These components will be engineered for long life in seawater. A single proof-of-concept drill will be fabricated and used as an engineering test-bed to optimize components and cycle parameters. Drilling rates in various rock samples will be measured. At the end of the project, Creare will deliver a proof-of-concept drill to NCEL for further testing. In Phase III, Creare will seek industrial partners to commercialize this water-driven drill design for use in mining applications.

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Topic#: 91-101 ID#: N91-101-5
Office: NAVSEA
Contract #: N00024-94-C-4058
PI: W Dodd Stacy

Title: Innovative Stirling Cycle Refrigerator

Abstract: We propose an innovative Stirling cooler for shipboard refrigeration. The machine will use flexible metal diaphragms to replace pistons, thereby eliminating the friction, wear, contamination, and seal leakage problems that limit the reliability and

service life of present Stirling coolers. The use of helium as the working fluid makes this cooler environmentally benign, and the modular design allows simple matching of cooling capacities. Performance predictions are 43% of Carnot for this 100°F application. This figure incorporates estimates of the pressure drop, conductive losses, mechanical and hydraulic efficiencies, and the effect of irreversible heat transfer. During Phase I we produced a numerically modelled thermodynamic design; thermal, fluid flow, and mechanical analyses; experimental validation of the design code at ambient temperatures; and preliminary designs for both prototype and commercial versions of this refrigerator. The thermodynamic basis and diaphragm reliability were experimentally demonstrated in previous work. In Phase II we will produce a one ton prototype refrigerator that demonstrates fabrication techniques, refrigerator performance and operating characteristics, and further validates our proprietary design code for use in adapting this machine to different capacities and temperatures. The prototype will be delivered to the Navy for independent performance testing at the conclusion of Phase II. This prototype independent verification of performance will be instrumental in the commercialization and demonstration of this dual use technology.

CREE RESEARCH, INC.
2810 MERIDIAN PKWY, SUITE 176
DURHAM, NC 27713
Phone: (919) 361-5709

Topic#: 91-292 ID#: 91N3E-021
Office: ONR
Contract #: N00014-93-C-0071
PI: Dr. John W. Palmour

Title: Development of 6H-SIC CMOS Transistors for Insertion into a 3500C Operational Amplifiers

Abstract: In many military and commercial applications, it is desirable to locate electronic components in high temperature environments to monitor or control a system or process more accurately. Application areas include jet and turbine engines (both aircraft and marine), nuclear reactors, deep well drilling, chemical processing and automotive. In many applications, analog circuits will be needed to provide an interface to high temperature sensors or actuators. These circuits will be required to provide amplification or other conditioning of low level sensor signals, and the transmission of signals over long cables in noisy environments. Complimentary metal-oxide-semiconductor (CMOS) field-effect transistors (FETs) are one of the basic electronic devices that serve as building blocks for the entire electronics industry. They are used in operational amplifiers, power controllers, digital integrated circuits, and other amplification and switching applications. CMOS operational amplifiers (opamps) are widely used in sensor amplifiers, comparators, A/D and D/A convertors and a host of other applications. The primary temperature limitation of present electronic devices results from inadequacies of the inherent properties of the semiconducting materials from which the devices are fabricated. Silicon carbide possesses a unique combination of properties, not available from other more common semiconductors, which allow it to operate in certain severe environments, including high temperature. As such, it is being examined throughout the world for employment in temperature, radiation and EMP resistant electronics, high frequency/high power devices as well as blue LEDs and UV photodetectors. In Phase I, the feasibility of producing CMOS SiC devices which operate to 300 degrees C was demonstrated and device modeling and circuit simulation of a high temperature SiC opamp was performed. For the Phase II program, it is proposed to develop a hybrid 6H-SiC CMOS opamp rated at 300 degrees C.

DAEDALUS ENTERPRISES, INC.
P.O. BOX 1869
ANN ARBOR, MI 48106
Phone: (313) 769-5649

Topic#: 91-014 ID#: 91N48-041
Office: CSSDDNSW
Contract #: N16331-93-C-0053
PI: Randall W. Zywicki

Title: Large Area Fast Spectroradiometer

Abstract: The U.S. Navy and Marine Corps have identified the need for a fast field-portable spectroradiometer. This capability will allow Marine Corps and Navy personnel to detect, from a cluttered background, targets ranging from mines to tanks and rocket launchers. The background clutter can range from rocks and small bushes that clutter minefield scenes to dense foliage that conceal large vehicles. Multispectral scene analysis can be used on the spectroradiometer scene data to detect targets in camouflaged or concealed backgrounds. During Phase I effort, a Large Area Fast Spectroradiometer (LAFS) was designed and the feasibility of producing an operational prototype was demonstrated by computer simulation and experimental measurement of the key optical technologies. This innovative design combines a high throughput holographic imaging spectrograph with a high frame rate electronic camera system, broadband primary optics and a scanning system to form a high performance imaging spectroradiometer. During the Phase II effort, an operational, field portable prototype will be developed, manufactured and tested. The prototype will be capable of measuring a 256 point spectra over 256 x 256 spatial points in a scene, in a 400-1100 nm wavelength band. Data acquisition will be accomplished in 1 second, and will be stored to digital tape within 30 seconds.

DANIEL H WAGNER ASSOC., INC.
STATION SQUARE TWO
PAOLI, PA 19301
Phone: (215) 644-3400
Topic#: 91-126 ID#: N91-126-2
Office: NAVSEA
Contract #: N00024-93-C-4060
PI: David P Kierstead

Title: Passive TMA Using Iterated Kalman Filters and Gaussian Sums

Abstract: Daniel H. Wagner, Associates (DHWA) has recently completed Phase I of a Small Business Innovation Research (SBIR) project (Topic N91-126) to develop mathematical techniques and algorithms which extend the state of the art in long-range, passive, target motion analysis (TMA). Our Phase-I effort demonstrated the feasibility of an approach based on an iterated Kalman smoother (IKS) and weighted sums of Gaussian (WSOG) density functions. Our main goals for Phase II are to develop and implement an operational tracker which significantly extends the state of the art in passive TMA, and to demonstrate the improvements in an operational setting. Specifically, we propose to: further develop the IKS/WSOG approach to passive TMA; implement an operational IKS/WSOG-based tracking algorithm as part of the Anti-Submarine Warfare Tactical Decision Aid (ASWTDA), which is currently being maintained and developed by the Naval Undersea Warfare Center (NUWC) detachment, New London; and perform extensive laboratory and at-sea testing of the resulting tracker. Having developed the IKS/WSOG tracker, and demonstrated it in an operational setting, we will seek Phase-III applications for the IKS and WSOG techniques. The techniques are applicable to a wide range of nonlinear estimation problems.

DANIEL H WAGNER ASSOC., INC.
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Phone: (215) 644-3400
Topic#: 91-185 ID#: 91-2D-324
Office: NSWCDDWO
Contract #: N60921-94-C-A301
PI: Walter R Stromquist

Title: An Information System for ECM/ESM Contacts

Abstract: Wagner proposes to develop an information system for the processing of localization and identification data from ESM/ECM, acoustic, and other sources. MUNIPS will combine the best features of our MATCH multi-hypothesis tracking and correlation system and our Monte Carlo Computer Assisted Search (CAS) and Surveillance Planning System (SSPS), but MUNIPS will be much more powerful than either of these two systems. Using the MUNIPS approach to processing all of the available data concerning targets of interest will allow the user to extract the maximum amount of information concerning target location from the complex "sea" of available data. The MATCH correlation uses multiple hypothesis methods. The SSPS Monte Carlo tracker will be used to compute contact association scores using non-Gaussian detection data, "negative information" from unsuccessful search and the presence of land, and information concerning probable target tactics. MUNIPS will accept reports from onboard sensors and from any available ashore or afloat links. It will only process positive information automatically, but will also process any available negative and motion information automatically.

DANIEL H. WAGNER, ASSOC., INC.
STATION SQUARE TWO
PAOLI, PA 19301
Phone: (215) 644-3400
Topic#: 91-054 ID#: 91N47-448
Office: SPAWAR
Contract #: N00039-94-C-0012
PI: Bernard J. McCabe

Title: Fluctuation Processes for Use in Acoustic Detection Models

Abstract: Operations analysis of naval engagements requires a model for the detection process, and in particular, for passive acoustic sensors. Such models depend in turn on having a model for acoustic fluctuations, a term which typically describes all residual uncertainty in the sonar equation components. This project will develop a rationale for an acoustic fluctuation process which is a composite of processes which represent uncertainties and variations in component processes that include: transmission loss, background noise, target radiate noise, and recognition differential. Phase II will involve identification of models and data bases to represent sonar equation components, and a validation of their composite using at-sea data. Each component will be fit to standard stochastic process models and the results tested for goodness-of-fit. Plans will also be made to fill gaps in the data base by interpolation and extrapolation of the parameters in the fitted model. The ultimate goal is to produce a physically sound, computationally tractable, and validated model. Efforts will concentrate on passive SOSUS performance.

DCS CORP.
1330 BRADDOCK PL
ALEXANDRIA, VA 22314
Phone: (703) 683-8430
Topic#: 90-106 ID#: 40929
Office: NAVAIR
Contract #: N00019-93-C-0172
PI: Abraham Isser
Title: Marine Attack Helicopter NTS Training System
Abstract: Develop the Target Identification/Sensor Performance (TISP) Part-Task Trainer for the AH-1W Night Targeting System. For further information contact Ms. Nodgaard at (703) 692-7390 x6309.

DELTA INFORMATION SYSTEMS, INC.
300 WELSH RD - BLDG 3
HORSHAM, PA 19044
Phone: (215) 657-5270
Topic#: 90-374 ID#: 41553
Office: NAWCMUGU
Contract #: N00123-93-C-0148
PI: Alan R Deutermann
Title: Electronic Optical Vector Scoring System
Abstract: This document is a technical proposal to develop an Electronic Optical Vector Scoring System (EOVSS) for accurately measuring the trajectory of a missile, relative to a target during the final phase of a missile attack on a target. The proposed EOVSS system uses multiple TV cameras on the target aircraft. It is proposed to design, fabricate, and test a complete EOVSS including an airborne sub-system and ground-based subsystem. The airborne subsystem consists of a high frame rate TV camera, a video compressor and a transmitter. The ground-based subsystem consists of a receiver, decompressor, and display. The airborne equipment will be package in a pod suitable for aircraft mounting. A test program is described which includes both laboratory and flight-line tests.

DIGITAL SYSTEM RESOURCES, INC.
12450 FAIR LAKES CIRCLE
FAIRFAX, VA 22033
Phone: (703) 263-2800
Topic#: 91-133 ID#:N91-133-1
Office: NAVSEA
Contract #: N00024-94-C-4045
PI: F H Bloch
Title: Development of Software Environment and Demonstration of an Advanced Processor Architecture
Abstract: Phase I of this project has produced results strongly supportive of new directions in processor architecture driven by commercial off-the-shelf (COTS) technology. There are two dimensions to the system cost reductions inherent in this new direction. First, there is the lower hardware cost and faster development time inherent in the latest commercial technology. But more importantly, there is the reduced system complexity with subsequent software costs inherent in the new architectural approach utilizing COTS technology. In Phase I, we are showing that the new generation of very high performance processors coupled with the very large data buffering capabilities of new memories and the high data transfer bandwidths of standard fiber optic buses will reorient and greatly simplify the scheduling and control of submarine combat control and acoustic systems. This reduces the system complexity with a corresponding reduction in lines of code required. Coupled with the major cost savings of COTS technologies in both hardware and software this new architecture, based on distributed configurations of open architecture, will yield dramatic reductions in both size and cost of future systems. The Phase II tasks will both demonstrate these capabilities and assess the ease of both existing application migration and new application development under this architecture.

DIGITAL SYSTEM RESOURCES, INC.
12450 FAIR LAKES CIRCLE
FAIRFAX, VA 22033
Phone: (703) 263-2800
Topic#: 91-139 ID#:N91-139-1
Office: NAVSEA
Contract #: N00024-93-C-4123
PI: David W Murray
Title: Mitigating the Problems of Migrating AN/UYS-1 Applications to the AN/UYS-2
Abstract: The objective of this Phase II SBIR is to demonstrate that innovative techniques can be used to economically support DoD unique system software migration onto an open system architecture with COTS hardware and software. This will be demonstrated by migrating the AN/BQQ-5E TB-29 Towed Array String. We will convert the design and functionality of the Towed Array String and utilize previously created test scenarios during the integration and test phase. This system will be capable of at-sea testing. The innovative techniques to be used for the software migration are: elimination of DoD-unique software requirements, uncoupling of application software from specific hardware, and use of advanced software engineering

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technologies including High Order Languages, Software Reuse, and creation of new CASE tools when applicable and beneficial to this effort. The effort should create new techniques, and possibly tools, for migrating Combat System software. The evaluation will provide a measure of the cost-effectiveness of this approach. Phase II provides demonstration work and techniques for determining what software is required to be migrated to an open system architecture and how large an effort is needed.

EIC LABORATORIES, INC.
111 DOWNEY STREET
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Phone: (617) 769-9450
Topic#: 91-259 ID#: 91N37-106
Office: NAWCMUGU
Contract #: N68936-94-C-0045
PI: Martin W. Rupich
Title: Switchable Polymer Microwave Absorber
Abstract: It is proposed to develop a conductive polymer laminate that can be switched between microwave opaque and transparent states by application of small DC electrical current. The laminate device will have a lightweight polymer construction and will be capable of being fabricated in a variety of sizes. The program will be divided into two parts. The first part of the program will involve a detailed characterization and optimization of the microwave and electrochemical properties of potential polymer composites and electrolytes developed during the Phase I program. The second pard of the program will be the development and characterization of an operational single element microwave shutter meeting or exceeding the performance specifications of the Naval Air Warfare Center.

ENERGY/MATTER CONVERSION CORP.
9100 A CENTER STREET
MANASSAS, VA 22110
Phone: (703) 330-7790
Topic#: 91-303 ID#: 91N40-208
Office: ONR
Contract #: N00014-93-C-0224
PI: Dr. Robert W. Bussard
Title: Research on Clean, Small-Scale, Inertial-Electrostatic-Fusion (IEF) for US Navy Advanced Alternative Energy Systems
Abstract: A new and unique means of advanced alternative energy generation is proposed for Phase II study and experimental research, based on promising results of Phase I work. This utilizes inertial-electrostatic-fusion (IEF) in which electric potentials cause fusion ions to move in spherically-convergent flow through a dense reactive core region. IEF systems promise high power output from small devices, with monoenergetic particle energies at core center. This allows use of a unique resonance cross-section in the fusion of protons and boron-11. These fuels give only helium ions as products, which can be converted directly to electrical power (no thermal cycles) by expansion against biased grids. Such a system has no active nuclear radiation, and can be maintained in a normal fashion at shutdown. Phase I study showed the size and scale of a baseline 100 MWe clean fusion-electric power system applicable to Navy shore-based or shipboard uses, replacing oil-fired power systems. The proposed program will carry out modeling design of this baseline system, and will conduct two classes of critical laboratory experiments to (1) prove the pB11 resonance fusion and to (2) demonstrate the electron diamagnetic confinement effects and low electron losses required for successful IEF systems. A Phase III program will be outlined to carry success in the proposed Phase II work through a demonstration IEF power system, at or above power breakeven conditions.

ENGINEERING GEOMETRY SYSTEMS
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SALT LAKE CITY, UT 84111
Phone: (801) 575-6021
Topic#: 91-296 ID#: 91N3E-045
Office: ONR
Contract #: N00014-93-C-0120
PI: Glenn W. McMinn
Title: A Flexible Concurrent Design System for Rapid Prototype Manufacturing
Abstract: Engineering Geometry Systems is proposing research toward a system to reduce the time and cost of producing prototype parts for use in hydrodynamics experiments through a concurrent feature-based approach to manufacturing in which design and manufacturing information is embedded within part features. The research will be performed in three areas. First, formulation of fundamental feature-based manufacturing algorithms suitable for use by a CAD system end user. While existing feature-oriented systems address only design concerns or at best will extend feature-based technology to address manufacturing a broad class of real world parts and encapsulate this information in user-oriented concurrent features. Second, the investment casting manufacturing process will be pursued using layered manufacturing within a feature-oriented process planning environment. Third, new techniques for solid simulation of 5-axis tool paths will be explored. These explorations will use the

Alpha_1 geometric modeling system, a powerful design and manufacturing system developed at the University of Utah as the technological foundation. Alpha_1 will insure full system functionality for this work even though the proposed research is directed towards several specific goals.

ESSCUBE ENGINEERING, INC.
950 N. KINGS HIGHWAY, SUITE 206
CHERRY HILL, NJ 08034
Phone: (215) 364-4053
Topic#: 91-192 ID#: 91N0A-060
Office: NAWCWAR
Contract #: N62269-94-C-1200
PI: William M. Nally
Title: Tactical/Operator Aids
Abstract: During Phase I of this SBIR effort, ESSCUBE identified over 30 Tactical Operator Aids (TACAIDS) for Advanced Active ASW Search Systems such as IEER (Improved Extended Echo Ringing). These are all reported in the Phase I Functional Requirements Document. Some of these were partially or wholly developed in the S-3B Active Block Upgrade Program for IEER. Under a Phase II effort, three of these TACAIDS (that were not previously developed for EER) will be developed. These TACAIDS will provide improved capability in detection, classification and localization for IEER systems and will have application for the P-3C, LAMPS MK III and ASWOC/ASWM when IEER is implemented in these platforms. The Phase II program will consist of implementation of the three TACAIDS selected using simulated inputs and the initial evaluation of these by engineering and operational personnel. The final deliverables will be PPSs and software written in 'C' suitable for transition to S-3B and later to other ASW platforms.

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Phone: (407) 894-5090
Topic#: 90-237 ID#: 40999
Office: NAWCWAR
Contract #: N62269-93-C-0217
PI: Dr Robert S Kennedy
Title: Development of a Non-intrusive Cognitive Workload Measurement Device
Abstract: The accelerating tempo of military aviation increases the task demands and work-related stresses imposed on pilots. Several subjective techniques are available for studying these problems, but these techniques generally depend on the self-report of users which are employed after the task is over. A need exists for objective methods which can follow time-course changes as work is performed and to develop biocybernetic approaches to task allocation. In Phase I, we conducted electrophysiological recordings of the action of the eye while subject attended to and performed on tasks with different visual demands and task difficulty (complexities). A software system for scoring of the electrophysiological responses was mechanized and implemented on a desk-top computer and is now fully up and running. Because of within-subject changes correlated at a statistically meaningful level with the visual task demands and with the mental workload, this approach holds promise as a method for calibrating individuals against known visual and mental task loading so that laboratory-based systems like NADC's reconfigurable cockpit can be used to study adaptive function allocation. In Phase II, this task load assessment system would be further developed to: (1) run in real-time; (2) be fully portable; (3) create algorithms for partition between mental task loading versus visual task demands; (4) create field manuals and data analysis packages for use by systems developers to objectively assess workload; (5) be field tested at a Navy development laboratory in their R&D programs.

ESSEX CORP.
1040 WOODCOCK RD - STE 227
ORLANDO, FL 32803
Phone: (407) 894-5090
Topic#: 90-330 ID#: 41408
Office: NAVAIR
Contract #: N00019-92-C-0157
PI: Dr Robert S Kennedy
Title: Development of a Flight Simulator Visual System Recording/Evaluation Device
Abstract: Develop a flight simulator visual system recording/evaluation device. For further information contact Ms. Nodgaard at (703) 692-7390 x6309.

FLAM & RUSSELL, INC.
506 PRUDENTIAL ROAD, P.O. BOX 999
HORSHAM, PA 19044
Topic#: 89-076 ID#: 93N14-393
Office: NAVAIR
Contract #: N00019-93-C-0146

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Phone: (215) 674-5100 PI: Richard P. Flam
Title: Microwave Imaging Technology for Nondestructive Inspection on Composite Structures
Abstract: Conduct a design development and test program to produce a specification for a Microwave Imaging System for nondestructive inspection of composite structures. For further information contact Ms. Nodgaard at (703) 692-7390 x6309.

FORMAL SYSTEMS DESIGN & DEVELOPMENT Topic#: 90-318 ID#: 41402
158 N ROSS ST Office: ONR
AUBURN, AL 36830 Contract #: N00014-93-C-0079
Phone: (205) 887-3379 PI: Michael H Goldsmith
Title: Embedded Transputer-based System Design
Abstract: Formal Systems proposes to develop tools and design approaches for building reliable real-time distributed systems, importing loading-edge Formal Methods technology from Europe. Timed CSP, an ONR funded theory, is the leading contender for success in formalizing and reasoning about real-time distributed systems. It benefits from well understood links with the untimed theory of CSP (Communicating Sequential Processes), allowing much untimed analysis to be promoted to the real-time domain; and from a direct route to implementation through occam and the Transputer. The key developers of this theory (at Oxford University) are made available through Formal Systems UK affiliate. Two factors will accelerate the widespread acceptance of this technology: successful application to substantial real problems, and tool support. This proposal addresses both needs. Tools will be extended to handle Timed CSP, to relate CSI and occam, and to aid the transition to VLSI implementations. As a demonstrator for the technology, giving focus to the theoretical and software tool development, we have a real-world application: a fault-tolerant real-time scheduler for the Charles Stark Draper Laboratory's Transputer Fault-Tolerant Processor. This problem combines internal real-time concurrency (for fault tolerance) with a hard real-time interface to the application processes.

FOSTER-MILLER, INC. Topic#: 91-163 ID#: 91N2D-125
350 SECOND AVENUE Office: NSWCDDWO
WALTHAM, MA 02154 Contract #: N60921-94-C-A305
Phone: (617) 890-3200 PI: W E Schroeder
Title: Visual Trackball System
Abstract: The goal of the Phase II Visual Trackball program is the design, build and test of a Visual Trackball system which will Integrate with the AEGIS workstation. The VT system will handshake with AEGIS workstation through a serial or parallel port, passing screen location data and other parameters for the purpose of acquiring, tracking, and locking (hooking) targets. To meet this goal, the following objectives are established: (1) the design and build of two prototype Visual Trackball Systems, (2) the completion of a final drawing package suitable for transitioning the system from design into full scale engineering development (FSED), (3) completion of final system specifications, (4) completion of a final demonstration with the Visual Trackball System integrated with an AEGIS Workstation. To meet the listed objectives, the Foster-Miller team will conduct a system task and other analyses to determine all operational requirements for the VT system and then follow a design process to develop a system which meets the stated requirements. The process will include the development of design-to specifications hardware and software designs. Foster-Miller will complete the build of the first bread-board system which will be integrated with an AEGIS workstation for preliminary analysis and evaluation. Inputs from the initial evaluation will be used to re-design the VT system prior to the build of the second system, which will undergo final demonstration and evaluation.

FOSTER-MILLER, INC. Topic#: 91-173 ID#: 91N2D-214
350 SECOND AVENUE Office: NSWCDDWO
WALTHAM, MA 02154 Contract #: N60921-94-C-A303
Phone: (617) 890-3200 PI: Dr Arthur R Nelson
Title: Optically Activated Holograms for Fiber Optic Switching
Abstract: Foster-Miller has investigated a non-mechanical, holographic approach to optical switching and demonstrated in Phase I an all-solid-state fiber optic switch. With this technique, a hologram is created in Polaroid DMP-128 film and then infused with liquid crystals, whose effective index of refraction can be modified with an applied voltage. A number of different switch functions are possible with this technique, including optical bypass for fiber optic Local Area Networks and optical interconnects

for computing applications. During Phase I, the switching function was demonstrated with optical fibers and graded index (grain) rod lenses to collimate the light. In Phase II it may be possible to eliminate the lenses in the fiber switch design by incorporating the lensing function in the holographic film. The optimized switch design would consist only of optical fibers and the holographic film in an appropriate compact enclosure, clearly superior to mechanical switches in reliability, immunity to shock and vibration, and manufacturing costs. In addition to the inherent simplicity and ruggedness of the holographic switch design, the low power consumption makes it feasible to construct an optically activated switch. During design, the low power consumption makes it feasible to construct an optically activated switch. During Phase I, optical control of the switching function was demonstrated using a photodetector to control the application of a voltage from a small battery. The low current draw of the liquid crystal based switch also allows direct powering using SI or GaAs solar cells, which is not possible with mechanical switches.

FOSTER-MILLER, INC.
350 SECOND AVENUE
WALTHAM, MA 02254
Phone: (617) 890-3200
Topic#: 90-242 ID#: 41004
Office: NAWCWAR
Contract #: N62269-94-C-0503
PI: Ted E Kirchner
Title: PBO ALFS Dipping Sonar Cable
Abstract: Airborne Low Frequency Sonar (ALFS) cables made with current state-of-the-art materials made precise depth control difficult, threaten helicopter safety during retrieval due to excessive stretch, and have poor reliability resulting in frequently lost sonar transducers. A new cable using a new ultrahigh modulus/high strength liquid crystal ordered polymer fiber will minimize stretch while dramatically reducing cable diameter and weight. The extremely low elongation of these fibers allows for the reliable design of a fiber optic cable which further reduces cable size and weight. The test results from our successful Phase I program demonstrate the ability to transfer the superior quantities of this fiber to a rope or cable construction. The proposed Phase II program will respond to detail performance requirements obtained from the Navy and our Phase II team member, Hughes Undersea Systems Division. We will develop the ALFS cable conceptual designs resulting from the Phase I program into thoroughly tested/verified cable assemblies which will be delivered to NAWC.

FOSTER-MILLER, INC.
350 SECOND AVE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 90-362 ID#: 41502
Office: NSWCDDWO
Contract #: N60921-94-C-0005
PI: Dr Lawrence H Domash
Title: New Organic Photorefractive Nonlinear Optical Materials
Abstract: Photorefractive crystals such as barium titanate have been used in laboratory demonstrations of many of the most dramatic and potentially useful phenomena of nonlinear optics, including optical phase conjugation and laser beam amplification. Unfortunately, these inorganic crystals are fragile, difficult to grow, expensive, and limited in speed, size and optical quality. Polymers or polymer based composites with phototrefractive properties promise large elements of low cost, highly uniform, processible materials, and could make many applications of nonlinear optics much more practical. Phase I studies considered a number of innovative approaches to organic photorefractives and identified two highly promising synthesis and processing paths to produce polymers which combine the requisite properties of electro-optic effect, photoconductivity, and absorptive trap states. In particular we suggest a number of copolymers including highly conjugated backbones with photo-sensitive and electro-optic pendants with very promising photorefractive response. To maximize the outcome of Phase II research, the first year will conduct detailed laboratory experiments along two promising paths, copolymerization and guest-host polymers. At the end of the first year, one path will be selected and by the end of Phase II a practical, processible photorefractive polymer will be demonstrated.

GENERAL SCIENCES, INC.
205 SCHOOLHOUSE ROAD
SOUDERTON, PA 18964
Phone: (215) 723-8588
Topic#: 91-171 ID#: 91N2D-193
Office: NSWCDDWO
Contract #: N60921-93-C-0179
PI: Dr Peter D Zavitsanos
Title: High Temperature Boron-titanium Chemistry with Water
Abstract: The results of the Phase I program were encouraging in terms of demonstrating the high energy release when titanium

and boron react to form titanium diboride via the intermetallic reaction. Hydrogen release was also demonstrated when the intermetallic reaction was carried out in the presence of water. The mechanism appears to involve reaction between hot TiB2 and with the evolution of hydrogen. The proposed Phase II program is directed towards exploiting prompt intermetallic reactions triggered by explosive detonation of mechanically induced high shear and/or shock environments. The program involved laboratory work which will identify the mechanism(s) leading to prompt reactions and further oxidation reactions leading to more energy release. Incorporation of oxidizers and other compounds leading to gas generation will be explored. Advanced studies would include the design of fragments and/or pellets containing the reactive elements and compounds that could be projected/reacted into the target medium.

HNC, INC.
5501 OBERLIN DRIVE
SAN DIEGO, CA 92121
Phone: (619) 546-8877

Topic#: 91-337 ID#: 91N32-081
Office: NSWCDDWO
Contract #: N60921-94-C-A306
PI: Andrew L. Diamond

Title: A Biologically Inspired Hierarchical Neural Network System for LADAR Object Classification

Abstract: LADAR object classification suffers from the problem that the portions of objects of interest that touch the ground or other surrounding objects are often indistinctly separated from those other objects by the sensor-thus causing difficulties with classification. This project is developing computationally efficient image analysis techniques classification based upon results from neurobiological research. In Phase I of the project we demonstrated the efficacy of biologically inspired hierarchical neural network methods for carrying our noise suppression, boundary completion, and object segmentation. We also developed a detailed architecture for the complete LADAR object classification system to be built during Phase II. In Phase II we will extend the capabilities demonstrated during Phase I and add additional system elements, including: a neural network based false alarm filter to eliminate a high percentage of target-like clutter; a neural network based classifier for unobstructed objects, and a biologically-inspired robust feature matching system for classification of partially obstructed targets. Our goal is to detect and correctly classify all targets that have more than 25% of their distinctive portions exposed to viewing by the sensor. Phase II will also produce a fully integrated demonstration system for carrying out LADAR object classification.

HORIZON TECHNOLOGY GROUP, INC.
4001 N. NINTH STREET, SUITE 15
ARLINGTON, VA 22203
Phone: (703) 525-0001

Topic#: 91-092 ID#: 91N14-214
Office: NSWCDDWO
Contract #: N60921-93-C-0168
PI: Dr. Philip Mauger

Title: Ultra-high Sensitivity Integrated Hydrophone Sensor

Abstract: A limited pilot production capability will be established to micro-machine low-cost, hydrophone sensors from single-crystal silicon. Fifty product wafers will be processed to provide over 1,000 sensor die. Micromachining methods and test procedures shall be enhanced to demonstrate low-cost fabrication, testing, and calibration. The sensors will be packaged in 1/2"-dia. housings together with micropower electronics and a serial data interface. Two different type sensors, with 14- to 16 bit resolution, will be delivered for underwater testing at NSWC and NAWC: A Low-Frequency Pressure Sensor, with a 0.0003 to 1 Hz bandwidth, and a Hydrophone with a 10Hz to 10kHz bandwidth. The sensors will incorporate the new, low-voltage, AC detection electronics developed during Phase I. Twelve sensors of each type will be delivered for testing. Both sensors shall be capable of airborne deployment and withstand explosive shock. Clusters of 16-hydrophones can be integrated into larger, light-weight, low-power arrays. A cluster of sensors can operate for 18,000 hours from a small 3V battery. A cluster-node electronics module will be delivered to sample the outputs of the sensors by sequentially switching "on" power to each unit. Based upon Phase I sensor and micropower electronics performance, major cost savings are expected for large acoustic arrays at both the component and system levels.

HSE, INC.
1340 MOREHEAD
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Phone: (313) 995-2523

Topic#: 90-158 ID#: 40942
Office: NSWCDDWO
Contract #: N60921-92-C-0103
PI: Dr John Shewchun

Title: Infrared/Millimeter Wave Detectors Using High Temperature Superconductors

Abstract: Based on a highly successful Phase I program, we now propose to develop a superior performance detector/mixer

utilizing Y1Ba2Cu3O7-X superconductor thin films laser abiated onto LsAlO3 or one of its homologs, or buffered BaAs. The use of GaAs affords the opportunity to incorporate our device directly into active microwave integrated circuits. The conversion of radiation by our device into a detectable DC signal is due to the non-linear characteristic present when the superconductor is induced to switch from its superconducting state to its normal state about a suitable current bias point and is not bolometric in nature. Our Phase I data indicate that it should be possible to produce an I-V characteristic with an extremely sharp turn-off as I is forced to exceed Ic. This would allow an extremely high performance mixer, possibly superior to that produced with Josephson tunneling SIS structures. A proposed NSN model for electrical conduction will be developed to guide the research and development. A new technique for measuring surface resistance by de-convoluting Smith Chart data will be developed. Our measurements to date indicate that we can fabricate a device with far superior detectivity, responsivity and much lower NEP than any conventional Schottky or p-n junction device. Indeed, NEP is already below 100 dbm. In addition, we propose to do experiments to determine the radiation resistance of our devices, which we believe to be quite high.

I-KINETICS, INC.
19 BISHOP ALLEN DRIVE
CAMBRIDGE, MA 02139
Phone: (617) 661-8181

Topic#: 90-119 ID#:N90-119-1
Office: NAVSEA
Contract #: N00024-94-C-4068
PI: Dr. Bruce H. Cottman

Title: An Extensible Architecture for Integrating Distributed Heterogeneous Database Systems

Abstract: An organization's efficiency and productivity depend on its ability to access and utilize all of its information resources. Unfortunately, information systems evolve in response to specific, independent administrative, managerial or engineering problems. An organization's resources are typically isolated islands of disparate processing, analysis and database management systems. This proposal specifies a development framework for deploying very large, cohesive information systems composed from distributed, heterogeneous, in-place subsystems. Open Views will consist of a set of high-level development tools for achieving uniform integration of heterogeneous applications and data sources distributed across different vendor platforms. It also supports the integration of emerging technologies with existing systems, such as multimedia processing and knowledge-based systems. The approach is based on an explicit object-oriented representation of both the data specifications, services and client entitlements of a distributed information system. One major advance expected from Open Views is the unification of a wide range of stand-alone subsystem access security mechanisms. Other key innovations of this proposal are: (1) integration of existing applications and software; (2) universal resource authentication/security service; (3) explicit, changeable system descriptions allowing runtime reconfiguration; (4) and uniform object-oriented programming interfaces across heterogeneous environments.

INNOVATION ASSOC., INC.
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ANN ARBOR, MI 48106
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Topic#: 92-002 ID#: 92N40-029
Office: NCCOSC
Contract #: N66001-94-C-7010
PI: Frederick Schelor

Title: AUM/UUV-a Virtual Environment for Undersea Telepresence

Abstract: Time-delays and limited sensory feedback of remote telerobotic systems caused by low-bandwidth transmission links tend to disorient teleoperators and dramatically decrease the operator's performance. To address this problem, Innovation Associates designed a Virtual Environment for Undersea Telepresence (VEUTel) system. To overcome the problems associated with low bandwidth feedback, VEUTel totally immerses the operator in a virtual reality simulation of the remote telerobotic environment. VEUTel intercepts operator commands and provides instantaneous graphical simulation of the effect of the command on the telerobot, while relaying the commands to the remote telerobot. During Phase I, Innovation Associates demonstrated the feasibility of VEUTel by implementing and demonstrating software that allows the pose of objects in the remote environment to be tracked and used to synchronize the orientation of objects in the virtual environment. Innovation Associates also designed a prototype virtual reality interface which allows the operator to directly and naturally control the remote manipulator, and developed a baseline telerobotic kinematic and dynamic simulation of the NR&D manipulator.

INNOVATIVE TECHNOLOGY ASSOC.
12450 FAIR LAKES CIRCLE, SUITE 500
FAIRFAX, VA 22033

Topic#: 89-053 ID#: 89N47-007
Office: SPAWAR
Contract #: N00039-94-C-0050

66

Phone: (512) 453-8186 PI: Ben R. Breed
Title: Use of Clutter to Determine Own-ship's Doppler and the Characteristics of the Transmission Channel
Abstract: Phase I addressed the development and selection of algorithms to solve two current problems in long range active sonar systems, namely the estimation of own-ship's Doppler and characterization of the acoustic transmission channel. As a result of the Phase I effort two Doppler algorithms and a class of transmission channel algorithms were selected, analyzed, and recommended for development. Synthetic data was used in Phase I to evaluate the prospective algorithms. The synthetic data was made as realistic as possible within the constraints, in order to simulate real world effects. The Phase II effort will demonstrate that the algorithms and processing techniques found in Phase I will work on real sea data with real clutter. A second and third objective is to further develop two concepts, namely a procedure for automatically rejecting threshold crossings which are not moving with respect to the bottom, and the formation of an inverse filter to deconvolve the channel time spread function from received signals. A final objective is to estimate performance gains to be expected when all of these algorithms are implemented on an operational system.

ISERA GROUP
3463 STATE ST - STE 246
SANTA BARBARA, CA 93105
Phone: (805) 682-7940
Topic#: 90-264 ID#: 41015
Office: NTSC
Contract #: N61339-94-C-0008
PI: Craig Bloxham
Title: Final Design and Implementation for the Tours System
Abstract: The primary objective of the Phase II tours development effort will be to further define, expand upon, and program the design strategies developed in Phase I of the project, in order to produce a high quality and fully-functional PC-based decision support software for the scheduling of Navy training. The system will be written in the Ada programming language. Intended for use at essentially any type of Navy training facility, by personnel at any level of computer literacy, the Tours software will be designed and coded in a highly user-friendly format. The package will also feature a choice of scheduling methodologies, representing varying degrees of computer influence and optimization in the training scheduling process. To ensure that all data requirements are met and all scheduling objectives and constraints are specified prior to actual scheduling, the Tours software will be structured according to an easy-to-follow system architecture that will guide the user through the schedule development process from start to finish.

J.K. RESEARCH
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BOZMAN, MI 59715
Phone: (406) 586-8744
Topic#: 91-079 ID#: 91N2D-005
Office: NSWCDDWO
Contract #: N60921-94-C-0029
PI: Kenneth Runnion
Title: Biotechnological Processes to Strip Polyurethane Paint from Naval Aircraft
Abstract: Certain microorganisms are capable of degrading polyurethane coatings. This feat is accomplished by enzymes normally produced by these organisms. But microbial paint stripping, an environmentally compatible alternative to chemical and physical paint stripping, is unacceptably slow. The rate of polyurethane deterioration can be markedly enhanced by using the stable enzymes of thermophilic microorganisms. During Phase I research, thermophilic microorganisms were isolated from Yellowstone Park and screened for their ability to remove polyurethane coatings from test coupons. One hundred fifty-seven cultures were tested of which forty-one were positive in two rounds of testing to remove polyurethane coatings from aluminum test coupons with the ASTM method for measuring adhesion by tape test. The polyurethane removal activity was not identified, but it seems to be inducible, has a molecular weight greater than 10,000 and was not associated with the waste. Phase II research will continue testing the polyurethane degrading cultures. The objective is to increase and define the polyurethane degrading activity. Other assay procedures will be developed to compliment the coupon tests. Surface analysis techniques will be utilized to characterize the activity. Optimization of fermentation parameters will lead to a viable process as alternative polyurethane removal method.

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Phone: (618) 529-4469
Topic#: 90-363 ID#: 41503
Office: NSWCDDWO
Contract #: N60921-94-C-0021
PI: Jefferson F Lindsey

Title: Polarization Insensitive Radomes for High Speed Missiles
Abstract: The results of the Phase I study predict the possibility of a new class of streamlined radomes having low boresight errors, high transmissions and low polarization distortion over a 30 to 40 percent bandwidth with the addition of an inductive layer in a proven A-sandwich radome. The objective of Phase II will be to demonstrate the predictions through measurements and to develop a computer model to account for inductive layers in predicting radome performance. Flat panel measurements will be performed initially and this will be used to determine the design for streamlined radome measurements. The results are expected to demonstrate the performance and provide a computer tool for the design of improved tactical radomes.

LNK CORP.
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RIVERDALE, MD 20737
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Topic#: 92-001 ID#: 92N40-007
Office: NSWCDDWO
Contract #: N60921-94-C-0024
PI: Dr. Srinivasan Raghavan

Title: A Synergic Expert-Neural Network System to Identify Relocatable Targets using Multi-Sensor Fusion
Abstract: Intelligent and advanced ATR capabilities will be strongly desired in future for targeting applications during unmanned missions with missiles such as TOMAHAWK or manned missions with multi-mission aircraft such as F/A 18. Different sensors and feature data sources provided different types of information about the terrain features. Also, different computational paradigms offer different advantages which when combined together in an efficient way offer the strength of a unified framework. The primary goal of the proposed work is to develop a prototype hybrid multi-source integration system for ATR applications. The prototype makes use of a three-tier hybrid architecture developed in Phase I for identifying relocatable targets by integrating information from multiple sensors using a synergistic framework of neural networks, expert systems and fuzzy logic. The first level of this system addresses issues related to data representation and registration of multiple sources. The second level achieves feature extraction and partial recognition results using neural networks. The third level consists of a decision making expert system with fuzzy logic reasoning to reach a collective decision from multiple sources using an object-oriented representation of the target. The proposed Phase II effort directly supports the on-going programs associated with automated targeting. For example, for the TOMAHAWK program the prototype can help achieve better targeting accuracy through intelligent integration of multiple sensors and cartographic sources, and for the F/A-18 program this prototype development can help significantly reduce the information assimilation load on the pilots. The Phase II work will serve as a foundation for a stand-alone hardware supported ATR system development in Phase III.

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Phone: (703) 684-7117

Topic#: 90-085 ID#: 40911
Office: NAVAIR
Contract #: N00146-93-C-0018
PI: Charles S Green

Title: Aircraft and Engine Preservation Developing of State-of-the-art Navy Program
Abstract: Controlled Atmosphere Storage of Naval Aircraft to reduce the corrosive effects of high humidity. It should have the capability to incorporate both O and I level technical directives, keeping the aircraft at fleet standards, and the capability to remove the aircraft from storage on short notice.

LOGIX CORP.
2361 JEFFERSON DAVIS HIGHWAY
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Topic#: 91-138 ID#: N91-138-1
Office: NAVSEA
Contract #: N00024-93-C-4125
PI: John A Roeder

Title: Automated Missile Engagement Planner
Abstract: LOGIX Corporation proposes the development of an automated missile engagement planner (AMEP) prototype for Phase II. The AMEP introduces expert system processing to the engagement planning process. The effort encompasses the entry of the engagement planning rules extracted from the Naval Weapons Publications during Phase I, the development of a syntax translator, the development of an Engagement Plan processing shell, and multiple methods of rule entry and modification. The development will be on a TAC-3 desktop computer using Government off-the-shelf (GOTS) software.

MAINSTREAM ENGINEERING CORP.
200 YELLOW PLACE
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 91-307 ID#: 92N07-069
Office: NSWCDDWO
Contract #: N60921-93-C-A349
PI: Clyde Parrish
Title: Man-Portable Micro-Climate Cooling System
Abstract: Our Phase I effort successfully demonstrated that we can produce the required cooling for a man-portable micro-climate cooling (MPMC) system based on an adsorption refrigeration system. We identified several factors that influence the cooling rate, i.e., desiccant type, surface condition of the desiccant, quality of the vacuum in the system, adsorption bed temperature, and design of the first prototype adsorption bed and the initial design of the prototype evaporator/chiller, both of which would be constructed as part of the Phase II effort. In view of Mainstream's long-term commitment to the design and development of long-life, micro-climate heating and cooling systems for military, aerospace, and commercial applications, our past record of successful performance, and the testing of Mainstream's man-portable micro-climate cooling system merits demonstration in a Phase II effort.

MARITIME APPLIED PHYSICS CORP.
6856 EASTERN AVENUE, N.W.
WASHINGTON, DC 20012
Phone: (202) 726-7787
Topic#: 91-226 ID#: 91N02-502
Office: NSWCCARD
Contract #: N00167-94-C-0020
PI: Mark S. Rice
Title: Hydrofoil Small Waterplane Area Ship (HYSWAS) Demonstrator
Abstract: The objective of the proposed Phase II work is to construct a 27-foot manned demonstration craft that has two functions. The first function is to demonstrate the operational characteristics and advantages of a HYSWAS hull, albeit at a small size. The second function is to provide a hull that can be modified to serve as an advanced test platform for U.S. Navy autonomous and/or remote controlled picket functions such as mine countermeasures. The manned HYSWAS demonstrator will provide a scaled-demonstration of HYSWAS capabilities. The proposed craft does not have geometric silitude with large HYSWAS designs since it has a relatively "high" strut to obtain sea state 4 seakeeping in a small hull. Not withstanding this difference, the hull will demonstrate all of the major functional capabilities that are characteristics of large and small HYSWAS hulls.

MASSA PRODUCTS CORP.
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Phone: (617) 749-4800
Topic#: 90-244 ID#: 41192
Office: NUWC
Contract #: N66604-94-C-0477
PI: George H. Cavanaugh
Title: Directional Flextensional Transducer
Abstract: A 600 Hz Class IV Flextensional Transducer Array capable of operating in both the omnidirectional and directional modes will be studied and a 900 Hz High Power prototype and the five additional elements for array testing will be constructed under Phase II. The design is based on U.S. Patent 4,754,441. A 4 kHz underwater transducer was built and tested during the Phase I contract, confirming the theory of operation. The measured accelerometer response had a reduction in front-to-back ratio of greater than 25 dB as predicted. The directionality is achieved by exciting the drive into both extensional and bending modes, thus resulting in additive motion on one side of the shell and canceled motion on the second side. During the Phase II program, a high power 900 Hz prototype element will be designed, fabricated, and tested, then additional array elements will be fabricated and tested in a directional line array

MAXDEM, INC.
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SAN DIMAS, CA 91773
Phone: (909) 394-0644
Topic#: 91-069 ID#: 93N14-397
Office: NAVAIR
Contract #: N00019-93-C-0176
PI: Matthew Marrocco, PhD
Title: Thermally Stable, Low Dielectric Polyquinolines for Advanced Radome Application
Abstract: Maxdem's PQ-100tm polyquinoline has a unique combination of electrical and mechanical properties including: extremely low dielectric constant and dissipation factors, excellent thermooxidative stability, very low moisture uptake, excellent dielectric properties at elevated temperature and humidity, and excellent retention of mechanical properties up to 500°F. during

Phase I new derivatives of PQ-100tm were developed specifically for radomes. These resins are designed to be used with conventional fabrication techniques. During Phase II the new resins will be used to fabricate and test a prototype radome. The radome is expected to have improved radar transmissivity and much better performance at high temperatures and humidity. We will also investigate the possibility of a fiberless radome based on Maxdem's rigid-rod polymer technology. Fiberless radomes would have greatly improved dielectric performance, would be easier to fabricate, and would have higher reliability than current quartz fiber reinforced radomes

MEGADYNE
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HERNDON, VA 22070
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Topic#: 90-001 ID#: 93N14-394
Office: NAVAIR
Contract #: N00019-93-C-0208
PI: Marc Rody

Title: Miniature High Frequency Power Supply for the V-22 AN/AYK-14 Mission Computer

Abstract: The V-22 Osprey, a vertical lift aircraft developed by the US military, uses an AN/AYK-14 upgrade that provides an ideal opportunity to upgrade the power supply. Advances in power supply technology have improved size, efficiency and reliability. New power supply technologies were developed during a Phase I effort. During Phase I, a new type of Class "E" switching power supply was designed. New technologies have increased power density by an order of magnitude. The system is modularly expandable from 500 watts to 2 kilowatts in increments of 500 watt cards. The modular design provides increased redundancy, load sharing and increased maintainability. In addition, the upgraded system provides a 50 ms ride-through for power transients or failures. Phase II would build and test a power supply specifically tailored to the V-22 needs and culminate in a completely manufactured power supply that would be applicable to the AN/AYK-14. In addition, the fundamental components could be used for other AN/AYK-14 platforms.

METRON, INC.
11911 FREEDOM DRIVE
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Phone: (703) 787-8700

Topic#: 91-111 ID#: 91N1A-120
Office: NSWCDDWO
Contract #: N60921-94-C-0004
PI: Lawrence D Stone

Title: Discrete Non-linear ASW Data Fusion for Shallow Water Tracking and Surveillance

Abstract: The Phase I work has demonstrated the feasibility of performing active shallow water tracking of non-nuclear submarines using a combination of normal mode propagation theory with the data fusion and tracking algorithm called Nodestar (Non-linear Discrete Submarine Tracking Algorithm) developed by Metron for NRL. Recently the Navy has begun to emphasize Contingency and Limited Objective Warfare (CALOW) operations. These operations will require naval forces to operate close to enemy shores in shallow waters with adverse acoustic environments. Naval forces will often occupy restricted operating areas of protracted periods, a fact that greatly simplifies the encounter problem for non-nuclear submarines and dramatically increases the Navy's need to detect and track these submarines. Because of the low radiated noise produced by these submarines while operating on their batteries, the Navy can no longer depend on passive acoustic methods to detect and track them. This indicates the use of active acoustics. However, shallow water environments produce a multiplicity of paths from source to target to receiver because of the number of bottom and surface reflections that are possible. These multiple paths produce multiple possibilities for the range and depth of a target detected by an active ping and lead to great difficulty in localizing a target with active acoustics in shallow water. The matched mode acoustic processing developed by NRL correctly accounts for the complexities and ambiguities of acoustic propagation in shallow water. Using matched mode processing, we are able to calculate likelihood functions for the location of a target given a detection. A likelihood function from a detection by single sensor produces very ambiguous information about the target's location. Using Nodestar we are able to combine information from multiple sensors at a single time period and integrate over multiple time periods to resolve these ambiguities into a tracking and a localization solution suitable for torpedo attack.

MICROCOM CORP.
965 THOMAS DRIVE
WARMINSTER, PA 18974
Phone: (215) 672-6300

Topic#: 91-327 ID#: 91N14-410
Office: NAWCMUGU
Contract #: N00123-93-C-0253
PI: Charlie Rosen

Title: Dual Transponder for Ranging and Data Communication

Abstract: The TACTS/R-Cubed Transponder shall be a design that combines the electrical functions of the AIS Transponder assembly, AIS Digital Interface Unit (DIU), and R-Cubed AN/URY-3 into a single, multi-functional unit. The design of the TACTS/R-Cubed Transponder is to yield a fully transparent Transponder which will be mechanically compatible with an F18 internal package and pod configuration, and fully compatible with existing R-Cubed and TACTS/ACMI based ranges. This unit will require no modifications to existing TACTS/ACMI ground systems. Specification NAWCWPNS-RE-EL-947-92, dated 27 May 1992, will be used as a goal for the electrical and functional requirements for the R-Cubed portion of the transponder. Specification Number SP494-IC (System Specification for Aircraft Instrumentation Sub-System, P-4A AIS), dated 20 April 1982, will be used for the electrical and functional requirements for the TACTS portion of the transponder. Functions of the Transponder which are selectable, will be switched via a mutually agreed upon uplink message command. Non-Volatile Memory (NVM) will be provided in the TACTS/R-Cubed Transponder to store and use the last used transponder format after power down and power up. A scanning capability will be provided which is activated after a time interval where the TACTS/R-Cubed transponder has not received a message or has not detected frequency use at the frequency currently selected. The mechanical design requirements must satisfy both the F18 internal package and pod configurations.

MICROCOM CORP.
965 THOMAS DRIVE
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Phone: (215) 672-6300
Topic#: 91-328 ID#: 91N14-407
Office: NAWCMUGU
Contract #: N00123-93-C-0252
PI: Charlie Rosen
Title: Data Relay System
Abstract: This Statement of Work (SOW) defines the tasks to be performed by Microcom Corporation, for the design, development, and demonstration for an increased data throughput on the TACTS/R-Cubed Transponder to Naval Air Warfare Center (NAWC). The technical scope is the design and development of: a. Fourfold increase in data throughput of a TACTS Transponder. This would increase the data capacity from 198 kbits to 800 kbits. b. Threefold increase in data throughput of a R-Cubed Transponder. This would increase the data capacity from 293 kbits to 960 kbits. c. Design the capability for backward compatibility to existing R-Cubed and TACTS/ACMI based ranges. Microcom assumes the electrical design can only be performed on the TACTS/R-Cubed Transponder. This design feature would provide a capability to increase the data throughput for a TACTS/R-Cubed Transponder as well as backward compatibility with existing stations.

MIKROS SYSTEMS CORP.
3490 U.S. ROUTE 1, BLDG 15
PRINCETON, NJ 08540
Phone: (609) 987-1513
Topic#: 92-083 ID#: 92N32-122
Office: NAVSEA
Contract #: N60921-94-C-0043
PI: Dr. Joseph R. Burns
Title: Development and Test of a Prototype System for Long-range Underwater Communication of Tactical Data
Abstract: The proposed program will develop a dual-mode acoustic/RF modem which will allow distribution of tactical data between U.S. Navy surface platforms and submerged submarines. The objective is to allow submarines to coordinate operations with surface forces without nearing the surface and risking detection. The program is based on the results of two Phase I SBIR programs by Mikros Systems Corporation and Datasonics, Inc. The Mikros Phase I program investigated DSP techniques for underwater communication and developed a preliminary design concept for an RF/acoustic modem. Datasonics performed operational testing of an RF/acoustic modem and long-range underwater communication testing. Successful completion of the program will benefit the U.S. Navy by providing reliable long-range (up to 50 mni) communication of tactical data underwater, allowing submarines to become an integral part of the Link-11 network.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45431
Phone: (513) 426-3111
Topic#: 89-211 ID#: 89N13-501
Office: NAWCFTEG
Contract #: N00612-94-C-0059
PI: Herbert L. Hirsch
Title: Infrared Scene Generation Model
Abstract: The proposed Phase II effort consists of upgrading a version of IRGENR, an existing IR scene simulator, for real-time operation, then integrating the upgraded IRGENR with the Compu-Scene image generation system at NATC. The result will be an IR Scene Generator, which will function simultaneously with the normal visual scene generator to produce IR imagery

video. The final system will include LOWTRAN for atmospheric effects, and will produce intensity variations for dynamically changing IR surfaces in real time. The integrated system will be operationally and functionally consistent with normal Compu-Scene operation, permitting the addition of moving models through normal Compu-Scene workstation interaction. The program includes validation against FLIR imagery, to ensure an accurate and correct simulation of IR scenes.

NAVMAR APPLIED SCIENCES CORP.
65 W. STREET ROAD, SUITE C-200
WARMINSTER, PA 18974
Phone: (215) 675-4900
Topic#: 91-198 ID#: 91N0A-043
Office: NAWCWAR
Contract #: N62269-93-C-0541
PI: Philip Yanni
Title: Synthetic Generation of Dynamic Infrared Scenes
Abstract: The objective of this SBIR task is to demonstrate near-real-time generation of thermally correct dynamic infrared scenes. The system will thermally model backgrounds and targets, and will include atmospheric, sensor, platform and display effects. It will be the first low-cost, comprehensive modeling system to display real-time IR scenes. Based on the results of Phase I efforts, it is now possible to integrate several diverse models and an existing 3-D motion editor into a low-cost IR Scene Generation System for multi-purpose applications. Applications will include Sensor Design/Test, Mission Planning, Pilot Training, Automatic Target Recognition (ATR), and Mission Rehearsal. The Phase II development effort will enhance the models defined in Phase I and integrate them into a dynamic Synthetic Scene Generation (SSG) System. The system will use off-the-shelf graphics hardware, thereby significantly reducing the cost of the system. The accuracy of the thermal, atmospheric, and sensor models either modified or developed by Navmar Applied Sciences Corporation, in conjunction with low-cost portable hardware, will enable using the system both in the lab as a sensor design tool and on-site in the battlefield as a mission planning tool. Significant emphasis will be placed on developing a system with the accuracy required while retaining dynamic capability.

OMNITECH ROBOTICS, INC.
6448 SOUTH PARFET WAY
LITTLETON, CO 80127
Phone: (303) 933-0239
Topic#: 92-012 ID#: 92N07-080
Office: MARCOR
Contract #: DAAH01-94-C-0010
PI: David W. Parish
Title: Standardized Teleremote Kit for Marine Corps Vehicles
Abstract: A standardized teleremote control kit for converting a variety of USMC and other vehicles was designed in phase I. The Phase II effort is focused on developing the teleremote kit, and integrating it with two USMC vehicles for operational testing. This standardized teleremote kit offers significantly improved flexibility, performance, scaleability and cost effectiveness through the use of several innovative new approaches including high integration actuators, scaleable serial I/O and actuator busses, and modern open system architecture design methodologies. The kit provides a comprehensive teleremote conversion capability, and preliminary applications engineering was conducted for applying the standardized teleremote kit to a variety of engineering vehicles for mine breaching applications.

OPTIVISION, INC.
1477 DREW AVENUE, SUITE 102
DAVIS, CA 95616
Phone: (415) 855-0200
Topic#: 87-104 ID#: 93N14-39
Office: NAVAIR
Contract #: N00019-90-C-0135
PI: Alexander A. Sawchuk
Title: Data Signals Control Signals and Protocols for Fiber Optic Crossbar Networks
Abstract: Conduct research and development for design, fabrication, test and demonstration of optical parallel interface bus networks and backplanes. For further information contact Ms. Nodgaard at (703) 692-7390 x6309.

PACIFIC-SIERRA RESEARCH CORP.
12340 SANTA MONICA BOULEVARD
LOS ANGLES, CA 90025
Phone: (213) 820-2200
Topic#: 90-353 ID#: 93N0A-166
Office: NAWCWAR
Contract #: N62269-93-C-0507
PI: Edward C. Field, Jr.
Title: Shallow Water Anti-submarine Warfare (ASW) Sensor: ELF Detection
Abstract: The detection of ELF signatures from submarines is potentially attractive for shallow water ASW. By using

frequencies above about 1 Hz, such detection avoids geological noise, which can severely limit magnetic anomaly detection (MAD) in shallow water. Moreover, in shallow water a submarine cannot avoid ELF detection by diving deep, a tactic that might work where the ocean depth greatly exceeds the ELF skin depth. ELF detection is difficult, because it must be accomplished in the presence of strong atmospheric noise. Phase I of this project identified five methods that might suppress such noise. Three of those methods--radiometry, polarization rejection, and directional rejection--offer the potential for many decibels of signal-to-noise (SNR) improvement, but are largely untested at ELF, where underlying data are scarce. Phase II will: 1) extend existing models of ELF noise to include correlation, polarization, and directionality, and 2) demonstrate noise rejection methods that will improve ELF detectability. In order to accomplish those goals, Phase II will include theoretical modeling, experiment design, and interpretation/measurement of needed noise data.

PACIFIC-SIERRA RESEARCH CORP.
2901 28TH STREET
SANTA MONICA, CA 90405
Phone: (310) 314-2325
Topic#: 90-387 ID#: 41828
Office: NAWCFTEG
Contract #: N00612-93-C-8312
PI: Dr Till Liepmann
Title: Dynamic Laser Threat Illuminator System
Abstract: Successful completion of this Phase II effort will result in delivery of two products. First, a turn-key, portable laser warning receiver (LWR) test station for evaluating LWR sensitivity, wavelength response, dynamic range, field-of-view, and vulnerability at the unit or sensor level. Second, a preliminary design and cost estimate for a LWR threat simulator capable of system level testing of on-aircraft-mounted receivers in a hangar environment. The portable, dynamic laser threat illuminator system (DLTIS) will exercise test unit(s) over a wide range of wavelengths (488 to 10,600 nm) under computer controlled, repeatable conditions. It will mimic all current laser threats (range finders, target designators, beam rider illuminators, blinders, and OA systems). The simulator design once implemented will enable illumination of a stationary, full size aircraft by projecting a movable spot of laser light into a large, non-radar absorbing projector screen. This concept will permit testing sensor sensitivity, coverage (accounting for airframe reflections and obscurations) and direction of arrival testing while simulating maneuvering flight. Atmospheric turbulence, scatter, and absorption effects can also be simulated. The simulator will be designed for eventual integration into NATC's offensive sensors laboratory component of the Aircraft Combat Environment Test and Evaluation Facility.

PHOTOMETRICS, INC.
4 ARROW DRIVE
WOBURN, MA 01801
Phone: (617) 938-0300
Topic#: 89-180 ID#: 92N33-609
Office: NAWCLKE
Contract #: N68335-94-C-0008
PI: Dr. Patrick J. McNicholl
Title: Remote Wind Sensing
Abstract: We propose to construct and test an eye safe pulsed doppler lidar system capable of mapping the wind field about Navy aircraft-bearing vessels. This system will utilize recent advances in both pulsed and cw laser technology to obtain sufficient resolution and accuracy to detect and characterize wind formations dangerous to incoming and departing aircraft. The operational range of the proposed system is approximately 1 km. The objective of this program is to produce a fully operational and tested system complete with trackable scanner.

PHOTONIC SYSTEMS, INC.
1800 PENN STREET, SUITE 4B
MELBOURNE, FL 32901
Phone: (407) 984-8181
Topic#: 91-264 ID#: 91N37-202
Office: NAWCMUGU
Contract #: N68936-94-C-0014
PI: Dennis R. Papa
Title: DMD IR Background Scene Generator
Abstract: Effective ground testing of infrared sensors requires a system capable of generating realistic IR scenes in the 3 - 5 and 8 - 12 micron region of the electromagnetic spectrum. In order to accurately develop and evaluate devices under test the scene generating system must simulate as close as possible the actual IR image seen by the sensor in the field. The Naval Weapons Center (NWC) is currently testing IR sensors with a scene generation system that uses a moving variable aperture. This proposal addresses the need for an IR scene projection system that will produce time-varying scenes derived from IR video imagery for the NWC hardware-in-the-loop scene generation system. Our system employs the Texas Instruments Deformable Mirror Device.

We call this system the DMIRS (DMD IR Scene) projector. PSI proposes to extend the Phase I SBIR work under a Phase II SBIR program to fabricate, test, characterize, and deliver a 3 - 5 micron transportable DMIRS projector. The DIRS projector will configured with state-of-the-art optoelectronic components custom designed to achieve maximum system performance for this application.

PHOTONICS TECHNOLOGIES
100 TECHNOLOGY DRIVE, SUITE 265
BROOMFIELD, CO 87108
Phone: (303) 465-6493

Topic#: 91-191 ID#: 91N0A-027
Office: NAWCWAR
Contract #: N62269-93-C-0553
PI: Dr. Greg R. Olbright

Title: Optical Pattern Recognition System 2D Arrays of Semiconductor Optical Neurons

Abstract: Optical neural networks, pattern and target recognition, and digital optical computing have developed to the point where viable parallel optical processor architectures such as optical associative and digital optical processors have been described in detail. To date few systems demonstrations have been reported due to the unavailability of optical switching devices which function as two-dimensional arrays. However, the results of our Phase I contract entitled, "Optical Neuron on a Chip," demonstrated the feasibility of fabricating two-dimensional arrays of optical switches having high gain, high on/off contrast, cascadability, acceptable switching requirements, and high pixel densities. Building on our Phase I results, wherein we fabricated an optical neuron using standard semiconductor processing techniques, in this proposal we describe a straightforward approach to developing an optical pattern recognition system based on a long sought after 2D photonic switching array. The 2D arrays also promise to revolutionize several additional technologies such as: optical communications, digital optical computing, optical memory, image restoration, and potentially night vision and helmet-mounted/heads-up/direct-view visual displays. During the Phase II project we will: (1) develop and demonstrate a second generation high-performance optical neuron (digital/analog photonic switch), (2) demonstrate a 2D array of optical neurons targeting array sizes to 512x512, (3) develop advanced optical neuron designs such as ultra-high sensitivity optical neurons for applications in night-time target recognition and night vision, and (4) design a system to perform optical pattern recognition/classification for automated target recognition applications. Development of the design of the pattern recognition system will involve the Optoelectronic Computing Systems Center at the University of Colorado (OCS; an NSF Engineering Research Center with state-of-the-art expertise in optical neural networks) for system modelling and integration. The Phase II program aims at laying the foundation from which to build a fully functional state-of-the-art automated target recognition system in Phase III.

PHYSICAL RESEARCH, INC.
25500 HAWTHORNE BLVD - STE 230
TORRANCE, CA 90505
Phone: (206) 881-3078

Topic#: 90-176 ID#: 40951
Office: NSWCDDWO
Contract #: N60921-93-C-0066
PI: Gerald L Fitzpatrick

Title: Advanced Magneto-Optic/Eddy Current Techniques for Detection of Hidden Corrosion Under Aircraft Skin

Abstract: Magneto-optic/eddy current technology has been recently developed for rapid inspection of surface breaking cracks initiating near rivets in aluminum aircraft alloys. Experimental evidence indicates that this technology can be extended to include rapid detection and imaging of subsurface cracks and corrosion. With this new technology planar eddy current induction methods excite electromagnetic fields in the workpiece, which are detected with a magneto-optic sensor, producing direct, real-time imaging of defects. The magneto-optic sensor responds to static or time varying magnetic fields normal to the inspection surface. These fields are produced when cracks or other defects, including corrosion, interact with the induced electric currents. The magneto-optic sensor responds to frequencies from 0 (DC) to well over 500 kHz. The lower frequencies, 0 to about 10 kHz, should be useful for imaging and detection of subsurface cracks and corrosion, while the higher frequencies are useful for inspection of surface cracks. Direct observation of the magneto-optic sensor using polarized light and an analyzer reveals real-time images of defects. This new technology offers the advantages of rapid coverage of large areas, higher sensitivity to small cracks, more direct detection and classification of defects, and simple, inexpensive recording of the entire inspection.

PHYSICS MATHEMATICS & COMPUTERS, INC.
PO BOX 787
SOCORRO, NM 87801

Topic#: 91-162 ID#: 91N2D-099
Office: NSWCDDWO
Contract #: N00024-94-C-A302

Phone: (505) 835-2951 PI: Patrick Buckley
Title: Integrated Computing System for Vulnerability Analysis
Abstract: Many vulnerability codes are of the dusty deck FORTRAN variety. This research proposes to move two of these codes, FASTGEN and COVART, to a modern graphics workstation, and to integrate them with a graphical user interface system. The resulting software will work in the interactive mode, as opposed to the batch mode, and will utilize industry standards such as UNIX, X-Windows, and SQL databases.

POLATOMIC, INC. Topic#: 90-064 ID#: 40891
2201 WATERVIEW PKWY - #1.712 Office: NAWCWAR
RICHARDSON, TX 75080 Contract #: N62269-93-C-0503
Phone: (214) 690-2292 PI: Robert E Slocum
Title: Sensor for Amplitude Modulated Electromagnetic Field (AMF) Buoy
Abstract: A novel high performance sensor is proposed for detection and localization of magnetic targets of interest for ASW (Anti Submarine Warfare). This sensor can be utilized on surface, buoy or airborne ASW platforms. In Phase I a concept was defined for a laser pumped atomic oscillator magnetometer. A Phase II technical plan was developed for design, fabrication and evaluation of a Concept Demonstration Model which can achieve a sensitivity of 0.1 pT/vHz in the frequency band up to 1 KHz. In order to establish the feasibility of a laser pumped magnetometer, we demonstrated in Phase I optical pumping of a resonance cell with a miniature tunable laser. We experimentally characterized the noise and resonance signal of the laser which will be used as an optical pumping source in the Concept Demonstration Model. Advanced technical approaches were defined for a room temperature laser pumped sensor which can approach the sensitivity of a liquid helium cooled SQUID (0.01 pt/vHz).

RD INSTRUMENTS Topic#: 91-293 ID#: 91N3E-073
9855 BUSINESSPARK AVENUE Office: ONR
SAN DIEGO, CA 92131 Contract #: N00014-93-C-0120
Phone: (619) 693-1178 PI: Blair Brumley
Title: Integrated Navigation System Development
Abstract: The purpose of Phase II of this proposed project is to develop and demonstrate a flexible, modular integrated navigation system capable of determining true geographic-frame 3 axis platform position, orientation and velocity as a function of time over a wide range of time scales. The proposed approach is to provide a near optimal yet robust processing algorithm to merge navigation input from various sources, primarily an inertial navigation system and Doppler and/or correlation velocity sensing sonar, but optionally other velocity or position references. During Phase II we will use a medium-quality inertial navigation system (INS) in conjunction with BroadBand Doppler and correlation sonar velocity logs and differential GPS. The data gathered from field tests will be used to further develop and realistically test the algorithms selected in Phase I under various combinations of sensor unavailability, with particular emphasis on cases with extended periods between position fixes, appropriate to many autonomous underwater vehicle mission. The developed algorithm will be implemented in a modular, portable, easily reconfigurable, software package designed to be easy to use and understand. Integrated navigation based on velocity-aided inertial sensors promises improved accuracy in all navigation variables compared to an unaided INS; particularly striking is the improvement in velocity accuracy.

REKENTHALER TECHNOLOGY ASSOC. CORP. Topic#: 91-291 ID#: 91N27-011
P.O. BOX 5267 Office: ONR
SPRINGFIELD, VA 22150 Contract #: N00014-93-C-0242
Phone: (703) 418-8411 PI: Jeffrey Brush
Title: Applications in Signal Processing
Abstract: This Phase II SBIR Proposal results in a near-real time breadboard digital signal processing (DSP) system for detection and classification (D/C) of SONAR transient signals for the Navy. The D/C algorithms will exploit RTA's advances in nonlinear dynamics (NLD) methods for time series analysis, modeling, and forecasting to yield D/C performance at signal-to-noise ratios (SNRs) at projected 5 to 10 dB lower than current methods. The optimal algorithm(s) will be implemented on a reconfigurable DSP system for demonstration against real-world data sets. In the Phase III effort, RTA will work with a suitable Navy

contractor to manufacture the required add-on technology to retrofit existing SONAR workstations.

RGS ASSOC., INC.
CRYSTAL PARK TWO, SUITE 104
ARLINGTON, VA 22170
Phone: (703) 769-5867
Topic#: 91-150 ID#: 91N1A-383
Office: NSWCDDWO
Contract #: N60921-93-C-0149
PI: Dr Richard G Stieglitz
Title: NAVSEA Integrated LSA Process Model
Abstract: During Phase II, RGS will refine the Process Model developed in Phase I to show how CALS standards and CITIS capabilities will be applied to create a cost-effective environment for acquiring, designing and supporting ships and ship systems with a smaller Program Office work force. The Phase II effort will produce: A Process Model to show how CALS and CITIS capabilities can be applied to design, construct, modernize and support ships and ship systems; PC-based automated tools (including a product locator capability) to support the Process Model and exchange data/products under CALS standards and implement the Integrated Weapon System Data Base (IWSDB) concept; An efficient approach for building and using LSA Records (LSARs) that are logically integrated on the basis of ESWBS, but may physically exist in distributed information systems at government and industry sites; A method for developing Government Concepts of Operations (GCOs) to invoke CALS requirements in acquisition and support contracts; and Feedback from demonstrating the Process Model and automated tools on a current ship acquisition or modernization project. We will maintain active liaison with on-going CALS efforts in standards development, implementation of the IWSDB concept and workflow techniques, and industry and government integration in a CITIS environment to ensure the Process Model and automated tools are consistent with emerging JCALS technologies.

SCIENTIFIC COMPUTING ASSOCS, INC.
246 CHURCH STREET
NEW HAVEN, CT 06510
Phone: (203) 777-7442
Topic#: 91-005 ID#: 91N40-005
Office: NCCOSC
Contract #: N66001-94-C-7004
PI: Dr. D Gilmore
Title: LINDAR for Networks of Shared Memory Multiprocessors
Abstract: The Navy, DOD, and the civilian economy can be made more effective and efficient by the aggressive use of high performance computing. Clusters of commodity, RISC microprocessors, including shared-memory multiprocessor versions, offer the potential of very high aggregate performance at very low hardware costs. The catch is the cost and time required to develop the required parallel applications software for these clusters. We propose a novel solution to the parallel software crisis; the Trellis Visualization System which generalized and extends current scientific workbench technology, eg. Khoros and AVS, to handle general computing problems in the parallel cluster environment.

SECURE SOLUTIONS, INC.
9404 GENESEE AVENUE
LA JOLLA, CA 92037
Phone: (619) 546-8616
Topic#: 91-061 ID#: 91N47-458
Office: SPAWAR
Contract #: N00039-93-C-0099
PI: Jeff Vignes
Title: Placement of Network Security Services for Secure Data Exchange
Abstract: The placement of security services within the OSI Reference Model has always been controversial. The objective of this study is to recommend how to place network security services within the various layers of the OSI Reference Model for both LANs and WANs in manner that addresses Navy threats. The Phase II effort will consist of: (1) Work with NRaD, NRL and NSWC to provide a demonstration of security services most suited to Navy systems (2) Using methodology developed in Phase I, identify layers in which specific security services should be used for Naval missions (3) Extend Phase I study to analyze end-to-end encryption (E3) and traffic flow security (TFS) options (4) Conduct requirements definition/systems engineering studies to define Navy mission-specific security needs for LAN security (5) Develop design documentation for LAN security products that meet Naval mission-specific security requirements (6) Work with SPAWAR to brief potential vendors of LAN security products to attract Phase III funding support (7) Participate in Navy, US Government and International working groups to develop recommendations for selecting security services in Navy systems, with particular emphasis on the Copernicus Architecture.

SIG-PRO SYSTEMS, INC.
1121 BALDWIN ST
SALINAS, CA 93906
Phone: (408) 443-6555
Topic#: 90-256 ID#: 41200
Office: NAWCMUGU
Contract #: N00123-93-C-0079
PI: Lonnie A Wilson
Title: New ESM Classification and ID Techniques
Abstract: The basic objective is to develop EW system technique to solve critical emitter ID problems, which are created by frequency agile radars, pulse doppler radars, overlapping radar parameter sets, linear chirped frequency codes, non-linear frequency codes and phase coded radar waveforms and high density radar emitter environments. New radar emitter ID techniques will be implemented, evaluated and technical feasibility demonstrations performed to handle these modern EW radar emitter ID problems. A new Breadboard Unique Parameter Processor (UPP) will be developed for Navy EW ID applications. The Breadboard UPP System implementation is envisioned as a PC based system with the required digital signal processing capabilities to perform enhanced EW identification signal processing functions. Critical technical feasibility demonstrations will be performed using the Breadboard UPP System. These technical feasibility demonstrations will include S/N ratio threshold, multipath considerations, bandwidth requirements, emitter ID performance, emitter ID robustness and stability properties and radar emitter ID ambiguity resolving capabilities.

SILHOUETTE TECHNOLOGY, INC.
10 WILMOT STREET, P.O. BOX 1479
MORRISTOWN, NJ 07960
Phone: (201) 539-2110
Topic#: 91-199 ID#: 91N0A-030
Office: NAWCWAR
Contract #: N62269-93-C-0548
PI: Eugene Dwyer Ph.D.
Title: Image Sensor Enhancement and Interpretation Unit
Abstract: Unenhanced FLIR imagery is sometimes difficult to quickly read and interpret. Using image processing hardware and image processing techniques, Silhouette proposes a system to enhance the FLIR image data for better readability. This enhanced signal can be analyzed for feature extraction and pattern recognition. These recognition features can be used to automatically identify navigational way-points in the FLIR imagery, and as an aid in terrain avoidance.

SILICON DESIGNS, INC.
1445-NW MALL ST
ISSAQUAH, WA 98027
Phone: (206) 391-8329
Topic#: 90-223 ID#: 41180
Office: NAWCMUGU
Contract #: N68936-93-C-0091
PI: John C Cole
Title: An Electronic Retard Sensor for Bomb Fuzes
Abstract: Although conventional mass-spring retard sensors are inexpensive, their poor reliability usually requires the use of two devices in parallel to assure switch closure. The use of two devices, however, has an adverse affect on S&A safety. G-Switches used as retard sensors in the FMU-139 bomb fuze are currently a major problem area in that program. Their poor reliability is due primarily to imperfections in the machined surfaces, contamination, and tolerance stack-up which cause high contract resistance or lack of operation altogether. Silicon Designs is currently producing an accelerometer that combines a capacitive sense element and integrated sense electronics on hybrid substrate in a single IC package. Because our current accelerometer's hybrid-based construction and laser-trim calibration method is too costly, we are currently redesigning the calibration circuits so all circuit functions can be integrated onto a single custom IC. We have also developed an acceleration threshold detection circuit that can be integrated with the sense electronics. We propose to develop a low-cost electronic retard sensor based on these technologies and resulting electronic retard sensor would be very reliable due to its fabrication using IC technology.

SIPPICAN, INC.
7 BARNABAS RD.
MARION, MA 02738
Phone: (508) 748-1160
Topic#: 91-009 ID#: 91N40-105
Office: NUWC
Contract #: N66604-94-C-0572
PI: Mark Manning
Title: Compact High-Power Propulsion System
Abstract: The Phase I effort determined an efficient motor and propulsor as well as a water-activated (seawater) battery approach for use in small UUVs. The Phase II effort would follow up the Phase I research with the goal of developing and demonstrating

a multiple speed capable vehicle for ASW training. The use of non lithium technologies for the battery subsystem was researched in Phase I to enhance cost and operator safety when working with the UUV. This could also improve the marketability of these devices for shallow water and littoral ASW training operations, where the possibility of accidental recovery of depleted lithium batteries may be a safety hazard. The proposed platform for the Phase II evaluation would be based around the MK-39 Expendable Mobile ASW Training Target (EMATT) for these tests would significantly reduce design risks, enhance cost savings through shared technology, and would allow a final in-water demonstration. Phase III funding could rapidly transition the concept into a production mod. After proving feasibility in Phase II, a scale up to a 6" diameter, longer vehicle may also be performed on advanced funds as desired by the Navy demands.

SIPPICAN, INC.
7 BARNABAS ROAD
MARION, MA 02738
Phone: (508) 748-1160
Topic#: 92-080 ID#: 92N32-096
Office: NAVSEA
Contract #: N60921-94-C-0017
PI: Mr Mark Whalen
Title: Ocean Environment Sensor
Abstract: The Phase I effort analyzed various humidity, air, and seawater temperature, wave slope and direction sensor technologies, data-links, and buoy packaging and deployment technical concepts. These sensor technologies, measuring conditions at the air/ocean boundary, would be used in the development of a low-cost, ship or aircraft/helicopter deployable ocean environmental sensor (OES) buoy. The OES buoy would support improved radar-ducting and Infra-Red background temperature predictions as a tactical decision aid in ship defense against radar and IR guided anti-ship missiles (ASM's). Investigations were conducted in Phase I to determine optimal wire based, RF data-link, and atmospheric sampling approaches for the OES buoy. Additionally, various deployment options were investigated (aircraft, ship, Chaff launch, etc.) with their corresponding impacts on performance and shipboard integration feasibility. The proposed Phase II effort takes the various sensor and other key subassembly design concepts and validates their performance using existing Sippican designed buoy hardware in multiple bay tests. The effort in the remainder of the phase integrates the optimal sensor and deployment approaches into prototype buoys, for demonstration tests in Buzzards Bay. An ARGOS data link direct to a ship and indirectly through a satellite link will be demonstrated.

SSG, INC.
150 BEAR HILL ROAD
WALTHAM, MA 02154
Phone: (617) 890-0204
Topic#: 89-212 ID#: 89N13-500
Office: NAWCFTEG
Contract #: N00612-94-C-8404
PI: Harold A. Graham
Title: Dynamic Scene Simulation for FLIR Testing
Abstract: The development of a dynamic IR scene projector for use in ground/laboratory testing of imaging IR systems is proposed. The Phase I program developed test system requirements and showed the feasibility of the concept for testing IR systems. The proposed Phase II program encompasses the design and fabrication of an operating prototype of 128 x 128 pixels. The simulator display will have a scene update ratio of 15 Hz and a maximum pixel temperature of approximately 400 degrees celsius. Other operating parameters will be determined during the design phase of the program in conjunction with NATC. The prototype system includes a variable temperature vacuum enclosure/dewar, drive electronics and an enhanced PC type computer for address and control of the individual pixels and for presenting simple scenes. Testing of the scene simulator will be accomplished by use of a single channel comparison radiometer and an 8 - 12 um TV compatible IR camera.

SUPERCONDUCTOR TECHNOLOGIES, INC.
460 WARD DRIVE, SUITE F
SANTA BARBARA, CA 93111
Phone: (805) 683-7646
Topic#: 90-342 ID#: 93N0A-157
Office: NAWCWAR
Contract #: N62269-93-C-0233
PI: Roger Forse
Title: HTS Switched Multiplexer
Abstract: The three channel multiplexer that was demonstrated in Phase I of this project showed the advantages of using printed high temperature superconductors for microwave multiplexers. In Phase II, we plan to design a switched multiplexer incorporating the optical switching technique demonstrated in band reject filters at STI and as a series switch at NOSC San Diego. The critical parameters to be demonstrated are sharp filter skirts and high selectivity for narrow multiplexer channels

and low insertion loss.

SYNECTICS CORP.
111 E CHESTNUT ST
ROME, NY 13440
Phone: (315) 337-3510
Topic#: 90-091 ID#: 41140
Office: NAVAIR
Contract #: N00019-92-C-0198
PI: Arnold H Lanckton
Title: Digital Image Verification System (DIVS)
Abstract: Develop a digital image verification system. For further information contact Ms. Nodgaard at (703) 692-7390 x6309.

SYNETICS CORP.
540 EDGEWATER DRIVE
WAKEFIELD, MA 01880
Phone: (703) 848-2550
Topic#: 91-035 ID#: 91N47-214
Office: SPAWAR
Contract #: N00039-93-C-0061
PI: Richard Fastring
Title: Local Area Network (LAN) Security
Abstract: A unique, state-of-the-art, multi-node, multi-user Wide Area Network (WAN) is proposed herein for test and evaluation which will enable sensitive or classified data to be transmitted between selected U.S. Navy laboratory locations. Open architecture packet communication techniques, and commercial off-the-shelf (COTS) hardware and software will be employed which will allow encrypted data to be transmitted between users via a general purpose public network rather than dedicated secure point-to-point links. The advantages of electronic key distribution, and other security features, will be evaluated as part of this Phase II effort. Completion of Phase II will provide sufficient information for making a decision to deploy the system for operational use.

SYNETICS CORP.
540 EDGEWATER DRIVE
WAKEFIELD, MA 01880
Phone: (703) 848-2550
Topic#: 91-300 ID#: 91N40-345
Office: NSWCDDWO
Contract #: N60921-93-C-0063
PI: William J. Both
Title: Reverse Engineering of Assembly Code
Abstract: SYNETICS proposes to build on its Phase I research and analysis of ULTRA assembly code reverse engineering by designing, developing and implementing an Assembly Design Extractor (ADE) Program. This is to be fully tested and refined program which will extract ULTRA-16 and ULTRA-32 design information within a Naval Surface Warfare Center Dahlgren Division (NSSCDD) Software Reverse Engineering System (SRES). ADE will be designated to extract ULTRA design information from an NSWCDD On-Line Tools (OLTOOLS) tree and deposit the data into an Extended Elementary Statement Language (EESL) tree structure. This will automate not only software documentation but also the process of converting ULTRA to Ada. SYNETICS will then assist the NSWCDD in integrating the ADE program with a CMS-2 extractor and other components of the SRES. The final goal is an interactive ULTRA and CMS-2 software reverse engineering capability along with automated conversion of those assembly codes to Ada. SYNETICS will employ the Shipboard Gridlock System with Automatic Correlation and the AEGIS Tactical Executive System tactical computer programs as a test bed for the ADE development and as the SRES integration testing. SYNETICS will apply its direct recent experience in SGS/AC development to this test and analysis process. This will make it possible for the Navy to make rapid strides toward a comprehensive software reverse engineering capability and an automated Ada conversion methodology.

SYSTEM PLANNING CORP.
1500 WILSON BLVD.
ARLINGTON, VA 22209
Phone: (703) 276-6953
Topic#: 90-145 ID#: N90-145-1
Office: NAVSEA
Contract #: N00024-94-C-4065
PI: Lynwood A Cosby
Title: Ultra-wide Band Modular Solid-State Transmitter Array for Naval Electronic Warfare
Abstract: The objective of the program is to demonstrate innovative approaches to the provision of compact, flush-mounted, ultra-wideband (UWB), active phased arrays suitable for modern naval platforms requiring maximum integration of tactical systems operating in the UHF/VHF and microwave bands. The basic concept calls for a single UWB phased array that can

provide a decade bandwidth in a single aperture with effective radiated power (ERP) suitable for EW and other tactical systems that must coexist in an electronic combat environment. This Phase II effort comprises three principal tasks: (1) the evaluation of electronically small array elements that can be compacted for both power adding and arraying and that operate uniformly over extended bandwidths, (2) the design, construction, and testing of both planar and spherical/parabolic geometries that demonstrate compatibility of the selected array element types and efficient utilization of the aperture over wide frequency ranges for maximum radiated power, and (3) the design, construction, and test of complementary feed networks capable of exciting the array elements for beamforming and steering over the desired UWB frequency ranges. Novel approaches will be taken to the design and construction of the UWB structures necessary to reduce dielectric loading and improve radiation resistance and efficiency. The program will conclude with delivery of both linear - and parabolic-array prototype structures in 2 x 16 element formats along with appropriate test results. Recommendations for follow-on technology insertion to significantly improve capabilities of current systems will also result from this effort. Finally, recommendations will be made for future tactical systems applications where UWB or multifunction apertures are appropriate.

SYSTEMS & PROCESSES ENGINEERING CORP.
1406 SMITH ROAD
AUSTIN, TX 78721
Phone: (512) 385-0081

Topic#: 91-176
Office: NSWCDDWO
Contract #: N00024-94-C-A304
PI: George Q. Phan

ID#: 91N2D-224

Title: Optical Time Domain Reflectometer (OTDR) for Fiber Optic Communications Networks

Abstract: Systems & Processes Engineering Corporation (SPEC) has successfully developed, designed and simulated a highly integrated OTDR ASIC using advanced GaAs circuit technology. The Phase I results show that enhancement/depletion mode DCFL GaAs technology provides high performance, high integration, and low power dissipation. The technology allows any PC or workstation to be used as a reconfigurable OTDR terminal for the detection and location of connectors, breaks, faults and splices, and to monitor on-line and in real-time the overall health of an active on-board fiber optic network. The Phase II Program significantly advanced GaAs ASIC and Optoelectronic Multi-Chip Module technologies, while responding to military, domestic and international demand for a compact, low cost, very high resolution OTDR. In Phase II, SPEC will complete the detailed design, layout, fabrication, test, and demonstration of a PC/workstation compatible Printed Circuit Board (PCB) incorporating the OTDR ASIC and associated discrete components (laser diode, photodiode, ADC, transimpedance amplifier, and interface logic). Upon completion of Phase II, SPEC will provide an Optoelectronic Multi-Chip Module design, which will be fabricated and marketed through Phase III commercialization sponsorship from Teradyne Inc.

SYSTEMS CONTROL TECHNOLOGY, INC.
2300 GENG ROAD
PALO ALTO, CA 94303
Phone: (415) 494-2233

Topic#: 91-237
Office: NTSC
Contract #: N61339-94-C-0018
PI: William Hart

ID#: 91N34-018

Title: Development of a Simulator Cuing Fidelity Evaluation Package

Abstract: With the ever-declining defense budget and simultaneous increase in weapon system complexity; the importance of simulation in system development and training is constantly increasing. In an aircraft simulator, the pilot can perform many mission and flight training tasks that are very expensive or sometimes impractical to perform in flight. However, in recent years, the complexity and capability of simulation systems procured has, in many cases, exceeded the capability of the procuring agencies to test, validate, support or update the simulations. The simulation evaluation system (SIMES) is designed to be a system that is a portable, comprehensive instrumentation system tailored to a flight simulator. The SIMES includes instrumentation to test statically and dynamically the performance of visual systems, motion systems, g-seats, anti-g suits, and seat shakers, and has provisions for aural cuing, cockpit environment and biomedical system instrumentation. Equally important, it has an almost completely unobtrusive interface to the host computer or computers with the capability to simultaneously interface to any I/O computers. This gives the test engineer access to all the sensors already incorporated in a simulator. This system is suitable for acceptance testing, fidelity enhancement, and simulation sickness studies.

TECHNICAL RESEARCH ASSOCS
410 CHIPETA WY - STE 222
SALT LAKE CITY, UT 84108

Topic#: 90-247
Office: NUWC
Contract #: N66604-94-C-0471

ID#: N90-247-2

Phone: (801) 582-8080 PI: Dilip N G Roy
Title: Live Plankton Characterization in Fluid Flow
Abstract: Marine plankton characterization, that is, determining the physical properties and hydrodynamic interactions of the plankton with their fluid environment, is an important problem in all oceanic investigations. The primary difficulties in characterizing the plankton are their highly non-spherical shape and the requirement that their living characteristics be obtained. The proposal aims at determining i) mass density, ii) compressibility, iii) drag coefficient of the plankton, and iv) their motions in boundary layers, all in their fluid ambient. Moreover, v) methods are proposed for creating plankton free regions. For i - v except (iv), acoustic levitation will be used which has features that are particularly attractive for plankton characterization. These are: i) absence of sphericity problem; ii) studying swarms of plankton without isolating them from their natural biological environment; iii) non-intrusive character and high accuracy (less than 1% is normal). The proposed determinations of drag coefficient and creation of plankton free regions are entirely novel. A variation of specklegram interferometry and Fourier plane image analysis are proposed for studying plankton alignment/tumbling in boundary layers.

TECHNO-SCIENCES, INC. Topic#: 90-351 ID#: 41497
7833 WALKER DR - STE 620 Office: NRL
GREENBELT, MD 20770 Contract #: N00014-93-C-2170
Phone: (301) 345-0375 PI: William H Bennett
Title: Algorithm Development for Weapons System Allocation
Abstract: Techno-Sciences (TSI) proposes to design and implement an Automated Aircrew Scheduling System. The scheduling system will incorporate constraint directed reasoning with stochastic operations research ideas, and will leverage existing software from another resource allocation system. Constraint directed reasoning allows for the explicit representation of the relationship between scheduling constraints and unsatisfied (mission) demand. It also provides a mechanism for relaxing active constraints in a rational way. The actual scheduling algorithms we use are Dynamic List Policies and are motivated by the stochastic nature of the availability and demand models.

TECSEC, INC. Topic#: 91-057 ID#: 91N47-444
1953 GALLOWS ROAD Office: SPAWAR
VIENNA, VA 22180 Contract #: N00039-93-C-0227
Phone: (703) 509-9069 PI: Ronald K. Frazer
Title: Investigate Techniques to Develop Highly Trusted Security Features for Workstations
Abstract: The Phase II effort will model TECSEC's Information Object Oriented Cryptography within a network architecture for the management of media storage protection as well as for protecting information exchange. During the course of the implementation and analysis, a merger of various security features and cryptographic key management techniques will form the essence of a highly trusted security model for workstations in a network applicable across two operating systems. In addition to the model, the effort will address the impact of Object Oriented key management upon a defined operational scenario and upon security personnel such as the COMSEC custodian. Current efforts to secure information are designed to prohibit access to information (i.e. compromise), to prohibit modification of data, or to defend against denial of service. By using new key management tools, the above efforts may be expanded to offer flexibility and a more free flowing information environment.

TETRA CORP. Topic#: 90-062 ID#: 40889
4905 HAWKINS ST NE Office: NSWCDDWO
ALBUQUERQUE, NM 87109 Contract #: N60921-93-C-0010
Phone: (505) 345-8623 PI: William M Moeny
Title: Airborne Laser Generated Low Frequency Sound for ASW Application
Abstract: The detection and localization phases of airborne ASW have, in the past, relied heavily on passive sonobuoy systems. As modern nuclear submarines are made quieter, interest is growing in alternative active adjuncts to the passive sonobuoys. This Phase II proposal is to develop the Laser Generated Sonar (LGS) Technology to generate sound with optimal parameters for submarine detection and localization and for other Naval applications. Tetra Corporation has invented the technology for generating from an airborne pulsed CO2 laser, long acoustic pulses able to propagate for long distances. The objective of the Phase I program was to determine the feasibility of using pulsed lasers to generate low frequency sonar for airborne ASW

applications and then to scale those results to an operational aircraft scenario. The Phase I experiment and modeling results have demonstrated the feasibility of the concept and laid the foundation for technology development in Phase II. Phase II will conduct key experiments to determine performance parameters and will develop key technologies to the point that an at-sea test of the LGS system can be undertaken in Phase III. This SBIR Phase II represents the first known effort to design into laser performance the specific characteristics matched to ASW and other related underwater acoustics applications. It is entirely possible that LGS will revolutionize airborne ASW.

TEXAS RESEARCH INSTITUTE, INC.
9063 BEE CAVES ROAD
AUSTIN, TX 78746
Phone: (512) 263-2101

Topic#: 88-120 ID#: N88-120-1
Office: NAVSEA
Contract #: N00024-93-C-4124
PI: Alan V Bray

Title: Technology for Making Underwater Connectors Resistant to Cathodic Delamination

Abstract: The objective of the Phase II SBIR is to develop a non-conductive coating (NCC) for underwater connector back shells to eliminate the cathodic delamination failure mode. Cathodic delamination is the primary life limiter for submarine cable/connector systems in Fleet use. The Phase I results demonstrate a doubling of boot to back shell bond life, clearly showing feasibility of the approach. Phase II will develop this approach using silica based coatings with specifically matched adhesives, and demonstrate this technology in the AN/WLR-9 HF cable/connector system. The Phase II effort will produce a complete set of AN/WLR-9 HF connectors, demonstrate their enhanced life through accelerated life testing, provide documentation sufficient for procurement of NCC back shells by the Navy, and adapt the current molding and handling procedures for AN/WLR-9 HF cables systems to the NCC design. NCC materials and processes will undergo an intensive production engineering development culminating in detailed manufacturing QA/QC procedures, an NCC modified AN/WLR-drawing package, and a vendor qualification plan for both NCC back shells and full AN/WLR-9 HF connectors. The phase II results will be adaptable to other Fleet cable connector systems without further NCC/adhesive materials development.

THE CHARLES EBERT CO., INC.
26001 HOOVER AVE., SUITE H
NATIONAL CITY, CA 91950
Phone: (619) 477-6412

Topic#: 90-321 ID#: 90N02-001
Office: NSWCCARD
Contract #: N00164-94-C-0029
PI: David W. Johnson

Title: Equipment Support Structural Concepts

Abstract: New concepts have been developed to interlock composite structural members to form strong, rigid, and lightweight structures. The resulting structures can be assembled in minimum time using interlocking joints without the use of hardware. The joints and structural members can be permanently bonded to provide additional rigidity, damping, and strength. This concept can use standard composite structurals which have well defined characteristics and moderate costs. The method encourages modular construction which allows a variety of structure sizes and shapes. A need has been established for composite based equipment foundations on ships and submarines. There is noted difficulty in joining the structural members by using conventional methods. This effort is intended to demonstrate the feasibility of constructing a composite equipment support structure that fulfills the Navy's space, weight, strength, shock, noise, and vibration requirements. The structure will be designed to take advantage of the material properties to mitigate shock loads and attenuate noise and vibration. Finite element analysis will be used to refine the design and to predict the failure modes. The test platform will use composite pultruded structural shapes which are machined to form the specialized joints. The finished product will be fabricated and assembled and delivered for shock test and evaluation during Phase II.

THIN FILM CONCEPTS, INC.
ONE WESTCHESTER PLAZA
ELMSFORD, NY 10523
Phone: (914) 592-4700

Topic#: 92-004 ID#: 92N40-036
Office: NCCOSC
Contract #: N66001-94-C-7005
PI: Dr. Leslie Weinman

Title: Stability of Hi-Layer and Tri-layer Contacts to High Temperature Superconductor

Abstract: Stable, chemically inert, low resistivity contacts are required to take advantage of devices being developed utilizing high Te oxide superconductors. The usual disruption in the oxidation state obtained with non-optimum metallization to the superconductor results in a significant degradation of the contact. Current contact technology utilizes noble metals such as Ag,

or Au for the interconnections found in most integrated systems. We have recently filed a patent entitled, "Bi-layer and Tri-layer low resistance contact to high Te oxide superconductors," and have demonstrated in Phase I that low resistance multilayer contacts can be fabricated in general purpose laboratory sputtering equipment without utilizing ultra-high vacuum chambers. During Phase II we will develop bi-layer and tri-layer contact technology to reduce resistivities to 10(-8) to 10(-10) ohm-cm^2 and to optimize the metal connections for either thin film interconnects, wirebonds, or solder attachment. A study of the optimum structures for long term electrical, thermal and mechanical stability will be made.

TPL, INC.
100 VIA FLORENCE
NEWPORT BEACH, CA 92663
Phone: (505) 291-5651
Topic#: 91-104 ID#: 91N1A-079
Office: NSWCCRN
Contract #: N00164-94-C-0046
PI: H M Stoller
Title: A Study of the Reuse/reformulation of Navy Gun Propellants
Abstract: Agricultural applications for surplus Navy gun propellants were evaluated in Phase I. In vitro rumen culture tests demonstrated the ability of unadapted rumen microbes to digest nitrocellulose and extracted nitroguanidine. This indicates that a feed supplement for ruminant animals (cattle and sheep) could be produced from reprocessed gun propellants. Nitrogen release to sorghum was demonstrated for single base propellant pellets, nitrocellulose, extracted nitroguanidine, and a TB propellant water extract. This indicates that a slow nitrogen release fertilizer could be produced from reprocessed gun propellants. The feasibility of using surplus gun propellants in a novel oil and gas well stimulation process was also demonstrated. It is proposed to develop an animal feed supplement and a fertilizer product from reprocessed gun propellants. The work will be conducted in collaboration with New Mexico State University. Material specifications will be developed for both applications through comprehensive in vitro culture and green house pot tests, respectively. Procedures will be developed and verified to produce reprocessed propellants that meet these specifications. Toxicological and nutritive assessment tests will evaluate the animal feed supplement product. Field application and nitrogen release rate studies will evaluate the fertilizer product. Commercialization strategies will be formulated for both agricultural products. The investigation into use of gun propellants for oil and gas well applications will continue.

TRIANGLE RESEARCH & DEVELOPMENT CORP.
P.O. BOX 12696
RES. TRIANGLE PARK, NC 27709
Phone: (919) 781-8148
Topic#: 91-322 ID#: 91N14-481
Office: NAVAIR
Contract #: N00019-93-C-0211
PI: Richard A. McKinney
Title: Water Survival Training System for the V-22 Osprey
Abstract: The design requirements for the V-22 specifically state that the "design of the aircraft for emergency water landings shall emphasize prevention of crew and passenger injury and ease of egress from the aircraft." (From Mawhinney's "V-22 Scale Model Flotation Test Review," February 1989 report to the Navy.) This requirement implies that the crew and passengers must be trained in escape procedures. To be most effective, this training should be tailored for the V-22 in the event of a water landing. The Phase II effort proposed here will continue the work begun in the Phase I program to develop a water survival training program for the crew and passengers of the V-22 aircraft. The Phase II effort will follow the requirements of MIL-STD-1379D and any other pertinent specifications. The effort will include the development of training manuals, films, syllabus, and other training materials, as well as the design and development of any additional equipment that is required by the Navy.

VERSATRON CORP.
103 WEST NORTH STREET
HEALDSBURG, CA 95448
Phone: (707) 433-3000
Topic#: 92-015 ID#: 92N07-051
Office: NSWCCARD
Contract #: N00167-93-C-0050
PI: John Speicher
Title: Electrical Rotary Motion Actuator
Abstract: This project will address the fabrication and test of an electric rotary motion actuator for use on amphibious assault vehicles (AAVs) or similar vehicles. This system will greatly enhance the survivability and reliability of such systems through a modular approach to vehicle control. This approach allows the modern concept of modular vehicle system control, such as is used on aircraft, to be applied to AAVs. Several innovative features will be incorporated in the design. These are: - A

compact, high torque, low inductance motor. - A compact, high power density PWM electronic motor. - A motor to driver interface designed for high power thruput. - A very compact high strength gear reduction system. These features will be designed, analyzed via computer simulations and a layout of the mechanical system will be generated. The drive electronics will be packaged in an envelope compatible with the system. The resulting deliverable engineering model mock-up will demonstrate the packaging of a 12,000 lb-in output torque, 180 degree rotation system less than 8 inches in diameter and weighing less than 50 pounds. Power for the system will be supplied by 270 VDC power bus. Control commands will be input via the vehicle bus and could be proportional or bi-stable, depending on the overall system requirements. Alternately, a simple high/low logic command or an analog control signal could be used as input commands.

VERSATRON CORP.
103 WEST NORTH STREET
HEALDSBURG, CA 95448
Phone: (707) 433-0678

Topic#: 92-156
Office: NAWCMUGU
Contract #: N68936-94-C-0105
PI: John Speicher

ID#: 93N37-047

Title: High Power Density Actuators

Abstract: Ever increasing threat evasive maneuverability, employed to countermeasure anti-air missiles, demands higher performance control actuators. The technologies developed through this SBIR can increase the actuator delivered power by a factor of 3 or more and increase the intercept envelope for air-to-air, surface-to-air and tactical missiles while significantly reducing control section size. Additionally, meeting the need for ballistic missile defense requires high power, high band-width actuators with high slew rates at light loads. The high power density actuator being developed in Phase II has many innovative features which allow achieving the performance cost effectively. These include: A high power density, high voltage pulse width modulated (PWM) driver. A compact, very high speed brushless motor. Low cost, reliable Mil-spec electronic components, no Hybrids. Lower healing in driver and motor due to high ratio gearing. Unique mechanical packaging and high efficiency gearing No stops, continuous rotation option. Low inductive times constant motor allowing efficiency at high speed. Improved power delivery, more battery energy delivered to output. These benefits allow a more flexible missile system addressing a wide range of mission requirements. This need for high power density also applies to thrust vector control system such as vertical launch TVC and future generation unmanned aircraft. Development efforts will be based on our previous experience with high performance electromechanical actuator systems. During Phase I we demonstrated important steps in achieving the high power density required for a 9 inch diameter airframe high performance missile tail fin actuator system. Nevertheless, a factor of 3 to 4 separates us from our power delivery goal. We intend to close this gap during Phase II. We will further refine the design layouts of Phase I and design, build, test and deliver an engineering unit demonstrator beyond anything previously achieved with rates up to 1000 degrees/see in the presence of torques up to 2000 lb-in.

VERSATRON CORP.
103 WEST NORTH STREET
HEALDSBURG, CA 95448
Phone: (707) 433-3000

Topic#: 91-242
Office: NAWCMUGU
Contract #: N68936-94-C-0116
PI: John Speicher

ID#: 91N37-012

Title: 6-Inch Integrated Aero/Thrust Vector Control (TVC)

Abstract: Ever increasing threat evasive maneuverability, which is employed to countermeasure anti-air missiles, demands higher performance control actuators with TVC capability. The technologies developed through this SBIR can increase the intercept envelope for air-to-air tactical missiles while significantly reducing control section size. The integrated aerofin and TVC allows extreme angles of attack during launch intercept maneuvers with greatly reduced aerofin surface profiles for compact internal carriage. In Phase I we presented a breakthrough solution to the control problem of a 5.5 to 6 inch missile. We propose to continue this development of the Integrated Aerofin Thrust Vector Control (IATVC) 5.5 inch diameter actuation system and deliver a tested state-of-the-art engineering unit. The resulting actuator, compared to other missile actuation systems of this size, demonstrates: A breakthrough differential yoke plate design for both aero and TVC with 4 motors total. A total system comparable in cost to aerofin only systems. A very compact package (1/2 the length of typical aerofin only systems). A delivered power of 1.0 HP per axis (2-3 times existing systems). The proposed IATVC does not reduce missile range by incurring additional drag in the rocket exhaust as do tab or vane TVC approaches. These benefits provide for a more flexible missile system which can meet a wide range of mission requirements. This need is especially critical for defending against anti-ship and other next-generation missiles anticipated as well as future manned and unmanned aircraft. This system greatly enhances the performance, agility and package density of small diameter missiles. Such a system does not presently exist in the U.S.

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inventory of elsewhere.

VESTAR, INC.
650 CLIFFSIDE DRIVE
SAN DIMAS, CA 91773
Phone: (714) 394-4124
Topic#: 91-313 ID#: 91N1C-013
Office: NAVMED
Contract #: N00014-93-C-0123
PI: Kevin R. Bracken
Title: Lyophilization of Liposome Encapsulated Hemoglobin
Abstract: Vestar proposes to continue the development work started in Phase I which established the technical feasibility of lyophilizing liposome encapsulated hemoglobin (LEH). This will be done utilizing essentially the same equipment, personnel, and facilities as in Phase I. Work will be centered on establishing acceptable excipient concentration ranges, defining freeze rate effects, selection of final lipid formulation, setting of product specifications, scale up of volume as required for in-vivo tests in small animals, and evaluation of product stability. This development activity will occur under GMP conditions when necessary, but the primary focus will be establishment of a lyophilized product as defined by existing analytical methods and evolving product specifications. Because of limited availability of raw recombinant hemoglobin (rHb), no large increase in experimental run volume is planned. That will be reserved for Phase III.

XEMET, INC.
18804 NORTH CREEK PKWY - #110
BOTHELL, WA 98011
Phone: (206) 486-0973
Topic#: 90-250 ID#: 41197
Office: NUWC
Contract #: N66604-94-C-0470
PI: Richard B Minch
Title: Quiet High-performance Super-heated Steam Valve
Abstract: A new class of high performance valves is proposed which has negligible acoustic emissions below 25 Khz under extremely adverse operating conditions, e.g. flow rates of 16,000 (lbs/sec)/sq-in, temperatures of 1600 F and pressures of 1000 psi. In addition, the acoustic emissions above 25 Khz are very low, being less than 40 dB Re 10*E-12 watt and showing no spectra peaks, i.e. the acoustic signature is very uniform and of low intensity. Under less adverse operating conditions, the valve will be even quieter. The valve is able to respond from fully open to fully closed in less than 0.1 second and is continuously adjustable at all intermediate flow settings. Because of its design it exhibits very good erosion resistance with ordinary valve materials, making it very cost effective from both materials and fabrication standpoints. The valve is compact and lightweight. Several alternative designs are proposed. Fabrication and test plans are proposed and commercial applications beyond steam-throttling are discussed, including chemical processing, Hydraulic control systems, and engine components.

XYBION ELECTRONIC SYSTEMS CORP.
8380 MIRALANI DRIVE
SAN DIEGO, CA 92126
Phone: (619) 566-7850
Topic#: 91-012 ID#: 91N48-003
Office: CSSDDNSW
Contract #: N61331-93-C-0052
PI: Charles C. Ross
Title: Development of Extend-Red Response for a Digital Controlled Gated Intensified Camera
Abstract: This proposal is for the development and construction of a Digitally Controlled Intensified Camera (DCIC) with extended NIR photocathode response. The primary innovations of the DCIC are the extended spectral sensitivity (0.55 to 1.1 micrometer) of the intensifier and its digitally controlled architecture. This instrument will be capable of synchronous and non-synchronous operation in order to support laser range-gated imaging at 1.06 micrometers. The camera's various functions will be digitally controlled by a personal computer or data terminal. The DCIC will be robust in design and construction to allow for its use in harsh environments. It will also be conducive to relative or absolute calibrations. The DCIC's electronic architecture will use elements from Xybion's Intensified Multispectral Camera (IMC), previously developed with funding from a Department of Commerce SBIR contract. Field Programmable Gate Array (FPGA) devices will be used to allow flexibility in development and to allow future improvements to be implemented without regard to hardware modifications. The 16-bit microprocessor within the DCIC will support fast operation and future enhancements. This project includes the development of hardware, firmware, and software with the appropriate documentation. The prototype DCIC will be delivered near the conclusion of this project.

(85)

YARDNEY TECHNICAL PRODUCTS, INC.
82 MECHANIC ST.
PAWCATUCK, CT 06379
Phone: (203) 599-1100

Topic#: 91-007 ID#: 91N40-077
Office: NSWCDDWO
Contract #: N60921-93-C-0062
PI: J. Roberto Serenyi

Title: Development of Sliver-Zinc Cells of Improved Life and Energy Density

Abstract: This SBIR Phase II program is proposed as a continuation of the Phase I effort which demonstrated significant improvements to the cycle life and energy density of 12Ah silver-zinc cells through the introduction of newly developed additives to the negative electrodes and/or coatings to the separators. The effect of those additives and coatings was to sharply decrease the magnitude of the "shape change" of the negative electrodes for a 68% longer cycle life and to open the possibility of using very thin separator materials for a 62% higher energy per unit volume. The Phase II work will seek to build upon that foundation, with the following main objectives: (1) to demonstrate that improvements beyond those mentioned above are possible, (2) to extend those improvements to all sizes of silver-zinc cells, including those used for torpedo, target and unmanned underwater vehicle propulsion, and to "dry charged" cells, (3) to develop manufacturing procedures adaptable for the production of pilot plant or larger quantities of cells containing the additives and/or coatings, and (4) to develop adequate quality control procedures to insure the reliability of the cells and the reproductibility of the test results.

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Topic#: 92-058 ID#: 92PL2-027
Office: PL1
Contract #: F29601-93-C-0183
PI: Charles Thomas

Title: Parallel Neural Network Toolbox for Supercomputers and Application to Satellite Communications

Abstract: Parallelized versions of the neural network algorithms in their Neural Network Toolbox will be written in the Ada programming language, installed, and tested on a supercomputer designated by Phillips Laboratory. An X-windows user interface will be written to allow easy portability to other environments that support Ada and X-windows. Also, an option will be to install one of the neural network paradigms on a massively parallel computer specified by Phillips Laboratory. Various neural network paradigms from the Toolbox will be investigated for their suitability in enhancing the performance of the MD-1296A UHF SATCOM Modem. The goal of this application of neural network technology is to develop, simulate, test and implement a modem that will be the forerunner of a new generation of such neural-network-based modems. The final task for this project will be to design the architecture for a prototype "next generation" neural network-based modem.

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Topic#: 92-178 ID#: 92WL9-024
Office: WL9
Contract #: F33657-93-C-2270
PI: Robert M. Pap

Title: Methods for Reducing Plasma Effects on the NASP

Abstract: This project will examine the use of the Adaptive Critic neural network for control of the flight of the National Aero-Space Plane to reduce plasma effects. Ionization in the shock layer as encountered by the NASP can seriously affect communications to and from the vehicle. Total "black-out" of some communications signals is a possibility for NASP. There is a variety of factors which may be manipulated in order to minimize plasma production. Ionization due to shock wave is a function of velocity, altitude, angle of attack, aircraft materials, aircraft configuration, and many other factors. Rather than investigate a hardware approach, we have chosen to investigate the modification of the vehicle's trajectory and orientation with a neural network to reduce plasma effects.

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TORRANCE, CA 90505
Phone: (310) 370-2551

Topic#: 90-151 ID#: 39756
Office: PL1
Contract #: F29601-93-C-0170
PI: T K HASSELMAN

Title: Global Control of Suspension Forces for Microgravity Simulation

Abstract: The proposed research will demonstrate global control of a multi-cable distributed suspension system supporting a 30 foot free-free test article, weighing approximately 150 lbs, and having a fundamental frequency of approximately 0.5Hz. The test article has two motors which drive two 12 ft. appendages. These motors will be used to generate vibration inputs and slewing maneuvers while the test article is suspended with simulated free-free boundary conditions. The sluing maneuvers will test the medium amplitude motion capability of the suspension system by moving one of the attachment points up to 3 ft. The suspension system utilizes a unique Tri-Cable design developed by EMA. This design eliminates the need for large overhead clearance by replacing the long single cables of unidirectional suspension systems with triads of short cables. This arrangement also allows for the application of three-dimensional control forces to the test article which are used to compensate for gravity induced stiffness.

ADAPTIVE TECHNOLOGY, INC.
309 CURTIS STREET
SYRACUSE, NY 13208
Phone: (315) 475-1121

Topic#: 92-102 ID#: 92WL2-036
Office: WL2
Contract #: F33615-93-C-1284
PI: Donald R. Miedaner

Title: Multiple, Integrated, Electronically Steered Arrays (ESA) Radar Performance Enhancement

Abstract: Adaptive Technology, Inc. (ATEK) is pleased to submit this SBIR Phase II proposal to design, implement and install a flexible, modular signal generation and processing system referred to as the GP-3 system in a roof top facility at Wright Laboratory (WL). This system will be interfaced with an APG-70 radar. This system will be capable of supporting ground tests

57

at the WL roof top facility and airborne tests on the Air Force's Advanced Radar Test Bed (ARTB) implemented in a C141A aircraft.

ADROIT SYSTEMS, INC.
209 MADISON STREET
ALEXANDRIA, VA 22314
Phone: (703) 684-2900
Topic#: 92-146 ID#: 92WL6-131
Office: WL6
Contract #: F33615-93-C-2348
PI: Thomas R.A. Bussing
Title: A Novel Very-low-cost Airbreathing Propulsion System
Abstract: Airbreathing propulsion systems which currently operate in the high subsonic regime are expensive and complex. A novel propulsion system, based on a Pulse Detonation Engine (PDE), has been developed to overcome these limitations. The development is based on an extensive literature search, fuel combustion analysis, performance modeling, and a detailed design assessment. The proposed propulsion system has many highly desirable features including operational simplicity, storability, and a very low unit cost. It can propel both manned and unmanned vehicles (e.g., stand-off munitions) over a wide range of Mach numbers from low subsonic to high supersonic. The Phase I results indicated a PDE propulsion system was feasible and could significantly out-perform existing subsonic and supersonic airbreathing propulsion systems. A Phase II effort consisting of experimental fuel detonation testing, experimental PDE component testing, theoretical and computational PDE optimization, and preliminary PDE prototype system design is proposed. The Phase II effort would provide the fuel detonation initiation/mixing data and detailed PDE component designs required to build a practical full scale engine prototype. Phase II could also lead to the development of commercial detonation products, such as power generators, that save many hundreds of millions of dollars in annual energy production costs.

ADTECH SYSTEMS RESEARCH, INC.
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BEAVERCREEK, OH 45432
Phone: (513) 426-3329
Topic#: 92-016 ID#: 92AFO-032
Office: AFOSR
Contract #: FQ8671-93-01444
PI: Som R. Soni
Title: Synthesis and Thermal Stability of NLO Chromophores
Abstract: Nonlinear optical materials are required for a variety of potential Air Force applications including optical signal processing (switches, modulators, and guided wave devices), and new laser sources (optical parametric oscillators and harmonic generators). However, presently available materials are unsatisfactory for many applications due to small nonlinearities, poor optical clarity, long response times, difficulty in processing for devices, and other factors. Proposed efforts which address molecular chromophore constituents that have been aligned with a strong electric field (poled) represent a promising approach to materials with large second-order optical nonlinearities. Whether such material combines the processability, mechanical strength, and typically excellent transparency characteristics of glassy organic polymers with the almost infinite molecular tailorability and high innovative techniques for preparing new materials or for improving the growth or processing of known materials will be investigated. NLO materials developed in the Northwestern University is in high demand and will be synthesized for industrial applications. Nonlinear optical materials will be examined only for the purpose of evaluating and demonstrating the properties of the material(s). Phase I of this program demonstrated the proposed growth or processing techniques and potential applications. This Phase II will develop advanced nonlinear materials and relevant processes to demonstrate potential. In Phase III, advanced nonlinear optical materials will be optimized for specific applications.

ADVANCED FUEL RESEARCH, INC.
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Phone: (203) 528-9806
Topic#: 91-096 ID#: 91WL3-021
Office: WL3
Contract #: F33619-92-C-1132
PI: Philip W. Morrison, Jr
Title: Process Monitoring and Control During Plasma Processing of Semiconductors
Abstract: The overall goal of this Phase II research is the development of Fourier Transform Infrared (FT-IR) spectroscopy for process monitoring and control of the plasma processing of semiconductors. The Phase I research has shown that a combination of emission, transmission, and reflection spectroscopy yield the following process information: 1) film temperature, thickness, refractive index, and composition and 2) gas temperature and composition. All of the measurements are performed in situ during deposition using a single instrument specially modified for this research. In situ attenuated total reflection spectroscopy yields

high signal to noise spectra of films 100-200 A thick. IR fiber optics are now commercially available that will allow improved sensitivity to very thin films and permit multiplexing of the FT-IR to multiple sensing points and/or reactors. The Phase II research will extend the above research by equipping the FT-IR with automatic data acquisition models to interpret IR spectra and other incoming data, and interfaces to allow process control. In support of this, Advanced Fuel Research, Inc. (AFR) will continue to work with Texas Instruments (TI) and the Microelectronics Manufacturing Science and Technology (MMST) program to develop the design of a prototype spectrometer for field testing at MMST. The prototype will have a series of hardware and software modifications to improve the sensitivity of the FT-IR, allow automatic data acquisition, and use IR fiber optics. Laboratory experiments at AFR will demonstrate a control loop based on the FT-IR and provide the IR data to develop the process control models and strategies. An initial field test will be on TI's metrology module. Other research will focus on using the FT-IR for in situ monitoring and control. Candidates include the DESIRE photolithography process or the TEOS oxide plasma deposition. Two longer field tests will demonstrate the on-line FT-IR monitor under manufacturing conditions. Finally this Phase II research will develop a design that can be then be built and permanently installed in Phase III (preferably at MMST).

AEGIS RESEARCH CORP.
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Phone: (205) 534-2772
Topic#: 92-163 ID#: 92WL0-085
Office: AD
Contract #: F08630-93-C-0122
PI: William F. Waite
Title: Laser Radar Scene Projector
Abstract: This proposal addresses the design, fabrication, test, and delivery of a Laser Radar Scene Projector (LRSP) capable of testing the performance of real imaging laser radar (LADAR) seekers under the most realistic conditions possible. The basis for the LRSP design will be a LADAR seeker capable of range and intensity imaging and based on Md:YAG laser technology. The LRSP will consist of the following components: (1) a computer which stores and retrieves angle-angle-range and angle-angle-intensity ladar images; (2) an electronics module which converts the stored range and intensity images into electronic pulses whose delay and amplitude recreates the UTT's "video" signals; (3) a CW Nd:YAG laser and an interchangeable modulator system which converts the "video" signals to 1.06 um laser pulses whose amplitude and timing realistically simulates the returned optical signals from the real scene; (4) an optical coupler interface which redirects the laser pulses into the UUT in such a way that the pulses appear to come from the appropriate scene azimuth and elevation location, (5) a simple UUT simulator for test and diagnostics purposes; and (6) appropriate interfacing between all system elements.

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Phone: (508) 663-9500
Topic#: 92-086 ID#: 92PL5-001
Office: PL4
Contract #: F19628-93-C-0202
PI: Dr. Andrew Freedman
Title: Stratospheric Ozone Perturbation by Sub-micron Alumina Particles
Abstract: We propose to continue studies on the effect of submicron Al2O3 particles emitted by rocket launch vehicles on stratospheric trace chemistry and ozone depletion. The Phase I project indicated that both CFC's (chlorofluorocarbons or freons) and halons (bromofluorocarbons) will decompose on 0 -alumina with moderately high efficiency (> 10-3), probably leading to the release of photochemically active halogen containing species to the gas phase. Initial stratospheric impact assessments indicate that alumina particle buildup in the lower stratosphere may lead to a significantly increased rate of ozone destruction. The proposed studies will focus on producing a quantitative model to predict the effect of the release of alumina particles into the stratosphere on ozone levels. The results of these efforts will be folded into comprehensive atmospheric corridor and 2-dimensional global models which will provide a quantitative assessment of the effects of various levels of alumina particle loading on the stratosphere.

AEROSPACE DESIGN & DEVELOPMENT, INC.
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NIWOT, CO 80544
Phone: (303) 530-2888
Topic#: 92-011 ID#: 92CEL-119
Office: WL4A
Contract #:
PI: DR H. L. GIER
Title: Combined Supercritical Air System for Breathing and Body Cooling

Abstract: The use of supercritical cryogenic storage of air will permit the supply of breathing air for personnel engaged in emergency or hazardous materials activities. Because the air storage is at cryogenic temperature (less than 180 degrees C) there is considerable cooling available for the user as the air is used. This combination of the breathing air supply and personnel cooling is unique in this development process. This is the Phase II proposal for the development of SCAMP cooling unit prototypes as defined by previous efforts. The storage dewar is completing development on a Phase II SBIR from NASA/Kennedy. The air must be warmed from the cryogenic storage temperature to a temperature which is acceptable for breathing. This warming of the air provides considerable cooling for the user. Phase I was devoted to the analytic determination of the cooling available compared to the cooling required, to the distribution of that cooling, and to the definition of system and components. Phase II is to be directed to the prototype development of a breathing/cooling system and its integration into the protective suit of a fireman. Phase III would be the initial production of cooling units for the USAF.

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Topic#: 92-157 ID#: 92WL0-004
Office: AD
Contract #: F08630-93-C-0069
PI: Dr. Leslie A. Yates

Title: A Comprehensive Automated Aerodynamic Data Reduction System for Aeroballistic Ranges

Abstract: Aeroballistic ranges provide invaluable data for designing air deliverable munitions and armament. Present methods for obtaining aerodynamic coefficients for these munitions are cumbersome and time consuming. Data reduction involves a long sequence of individual steps which can take from several days to weeks. Because of the slow turn around time, errors are not corrected during the test. The inexperience and rapid turnover of personnel also contribute to lower data quality. The objective of this proposal is the development of a comprehensive automated data reduction system. With this system aeroballistic ranges will function more like wind tunnels, that is, preliminary data analysis will be completed within a day thus allowing timely corrections to scheduling, test parameters, and system calibration. An executive system will control the entire data reduction process. Individual elements will be written into modules that can be replaced or updated as technology improves; they can also be exercised independently for analysis procedures. The comprehensive system will be user friendly with graphically oriented input and output. These changes to aeroballistic range operations will improve overall data quality. During Phase II, a production prototype of the comprehensive automated data reduction system will be developed.

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Topic#: 92-169 ID#: 92WL0-047
Office: AD
Contract #: F08630-93-C-0061
PI: Dr. Saeed Farokhi

Title: Inflatable Smart Missile Wing Design Evaluation

Abstract: Five areas of active missile wing research and development will be pursued. The first section will develop the detailed design of the smart inflatable missile fin (based on the AIM-9E) and establish the manufacturing principles. Several prototype shape-memory-alloy (SMA) missile fins will be constructed to prove the concept experimentally on the bench and in the wind tunnel. Basic research on pyrotechnic coatings and welding techniques will be conducted on SMA plate specimens. The second R&D component will explore pitch control of conventional fins by using SMA torque elements. Experimental torque rods will be constructed and tested for frequency response, power consumption and actuator fatigue (among other tests). The third portion of research will explore SMA root actuators for deployment of conventional fins. Experimental SMA root actuators will be tested. The fourth portion of research will explore variable-camber SMA actuated missile fins. More experimental specimens will be built and tested statically and in the wind tunnel. The final portion of research delves into the numerous civil applications of this technology including automobile and general aviation crash protection systems, inflatable SMA space trusses and inflatable solar arrays. The Phase II investigation will conclude with a feasibility analysis of the technologies under investigation.

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Topic#: 92-031 ID#: 92ES2-044
Office: ES2
Contract #: F19628-93-C-0217
PI: Ms. Kendra Moore

Title: C4 Systems Assessment for the Air Mobility Command

Abstract: Phase I of this research demonstrated the feasibility of using advanced Petri net technology to analyze the performance of large-scale C4 systems. Phase I involved data collection, model construction, and system-wide performance analysis for the Air Operations Center elements involved in the production of an Air Tasking Order. Phase I demonstrated that the existing software tool to support Petri net modeling of C4 systems is mature, and permits efficient modeling, analysis, and simulation of large systems. The Phase I effort also suggested some software enhancements that would ease model maintenance and reuse. Phase II will make three specific enhancements to the software, and demonstrate their utility to C4 system planners and managers at the AMC. The enhancements include hierarchical data definitions, encapsulation of model elements, and simulation performance optimization. The demonstrations will address airlift planning organizational structure and ADANS/DGSS/IPS integration. The Phase II software product will be made available in commercial markets.

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Topic#: 92-055 ID#: 92PL2-006
Office: PL7
Contract #: F29601-93-C-0140
PI: Dr Sol W. Gully

Title: Evaluation of a Testbed for Adaptive Optics Control Systems Using Modern Multivariable Control-Theoretic Methodologies

Abstract: This proposal will define recent stability-robustness and performance-robustness methods for multivariable feedback control theory and use these concepts to form the basis of practical testing techniques, and eventually testing hardware, for evaluating performance properties of adaptive optics systems. The key to the development of the testing methodology and hardware is the experimental calculation of the singular values versus frequency of relevant (sensitivity and closed-loop) transfer function matrices associated with the adaptive optics feedback control system. An automated testing procedure involving an integrated set of test hardware and software will be developed. This test hardware will inject a vector of sinusoidal test signals, with appropriate relative amplitudes and phase-shifts, at suitable points in the adaptive optics loop and record the resultant steady-state sinusoids (amplitude and phase) at the system sensors for a range of frequencies. The software will translate this sinusoidal information into the appropriate singular values for evaluating stability margins, tolerances to structured and unstructured modeling errors, and performance-robustness using the so-called structured singular value methodology (u analysis). Furthermore, through the use of the Extended Kalman Filter methods, we will determine if it is possible that simpler experimental data can be used to drive a complete multi-input/multi-output dynamic model of the closed-loop adaptive optics system to estimate parameters directly related to stability margins.

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Topic#: 91-091 ID#: 91WAA-079
Office: WL2
Contract #: F33657-93-C-2266
PI: Mark Wetzel

Title: Reconfigurable, Real-time, Coherent Radar Simulator

Abstract: The objective of the Reconfigurable, Real-Time Coherent Radar Simulator Phase II effort is to design, implement, test and demonstrate a high fidelity radar waveform simulator for evaluating electronic warfare technology in realistic dense environments. Feasibility was established in Phase I through analysis, requirements definition and preliminary design concepts. Phase I focused on identifying the key waveform fidelity requirements, required hardware/software modifications and signal timing interfaces. The Phase II program will include a final design, CEESIM 8K hardware/software modifications and a series of capability demonstrations to validate the high fidelity waveform capability for a dense environment.

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Topic#: 92-107 ID#: 92WL2-088
Office: WL2
Contract #: F33615-93-C-1326
PI: Harold J. Screven

Title: Programmable Emitter Signature Generator

Abstract: The objective of the Programmable Emitter Signature Generator Phase II effort is to design, implement, test and demonstrate a high fidelity radar unintentional modulation on pulse (UMOP) signature generator for evaluating electronic warfare technologies, that utilize these signatures, in realistic dense environments. Feasibility was established in Phase I through

analysis, requirements definition and preliminary design concepts. Phase I focused on identifying key modulation fidelity requirements and evaluated a potential hardware solution. The Phase II program will include a final design, CEESIM 8K hardware/software modifications and a series of capability demonstrations to validate the high fidelity modulation capability for a dense environment.

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Phone: (716) 631-0610
Topic#: 91-254 ID#: 91PM-017
Office: WL2
Contract #: F33615-93-C-1217
PI: Douglas C. Reif
Title: Simulator Networking
Abstract: The progress in computer technology has yielded new opportunities for modeling and simulation. Advances in critical technologies such as communication networks and high performance computers provide solutions to problems previously considered too complex. The Defense Modeling and Simulation Office (DMSO) has been created to develop and promote these technologies. Distributed Interactive Simulation (DIS) is a methodology for networking geographically dispersed simulators and is rated among the most promising technologies by DMSO. It has been used extensively by the Army for training, testing, and evaluation, and efforts are underway to extend its use to other branches of the armed forces. Although DIS capability has been implemented in several aircraft simulators, there has been little rigorous analysis of its ability to perform aerial combat and air mission support roles. Recent Air Force interest in the DIS concept presents an opportunity to investigate the ability of DIS to support combat involving fast, highly-maneuverable aircraft. Amherst systems proposes to add DIS capability to the Integrated Test Bed (ITB) facility aircraft simulator at Wright-Patterson AFB. The ITB is highly qualified to support testing in this area. The ITB can simulate F-15E, A-7D, and C-130 aircraft, and other airframes could be supported at modest cost. The Flight Dynamics Laboratory, also at Wright-Patterson AFB, is in the process of adding DIS capability to some of their experimental flight simulators. Since the ITB and the Flight Dynamics Laboratory are closely located, there is a unique opportunity to perform basic research with DIS in a timely and cost effective manner. Amherst Systems will support coordinated testing using DIS with the ITB and the Flight Dynamics Laboratory. The ITB will then be used in a joint services training exercise in a close air support mission, applying knowledge gained from the tests.

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Phone: (612) 784-4995
Topic#: 92-018 ID#: 92AFO-050
Office: AFOSR
Contract #: FQ8671-93-01506
PI: Dr M. Asif Khan
Title: Novel BN-AlxGa;-xN Based Heterostructure Field Effect Transistor Devices for High Temperature (350 C) Electronics Applications
Abstract: The goal of our program is to develop a high temperature MESFET device for integration with high temperature sensors for DoD applications. The key to our technical approach is a BN-ALx-GA1-xN heterojunction. The technology to deposit the insulating BN layer and BN-AIN-GaN heterostructures was developed under the Phase I effort. In the past we have successfully fabricated GaN based MESFET devices with transconductance as high as 23 mS/mm (4 micron gate length with a 10 micron channel opening). We have also established the feasibility of using the AlxGa1-xN material system for FET and sensor devices with operation temperatures in excess of 350 C. Our Phase II program plan calls for depositing the epilayer structure for a heterostructure field-effect-transistor device. We have selected a BN-AlxGa1-xN MESFET as a demonstrator. We propose a very unique device configuration with a self aligned gate. Our plan is to use "W" as the ohmic and the gate metal there by allowing high temperature operation. The devices resulting form the Phase II program will be characterized for their high temperature performance. We also plan to demonstrate a prototype integrated circuit based on discrete components and the transistors developed in the program. We also plan to develop a model describing our transistor device at high temperature (350 C). Our modeling and simulation will be undertaken both at the material and device levels.

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Phone: (505) 883-3636
Topic#: 92-157 ID#: 92WL0-081
Office: AD
Contract #: F08630-93-C-0062
PI: Mrs. R. Kathryn Tucker

Title: Finite Element Mesh Generation from a Solid Geometric Model
Abstract: The primary techniques for conducting vulnerability analyses of mobile or fixed targets are (1) probabilistic studies using simplified methodologies to model the entire system or problem and (2) first principles finite element or hydrocode calculations that model detailed physical interactions and study a specific problem or portion of a problem. Both types of analyses require a detailed target model. Because the target to be analyzed in a first principles calculation is often a portion of a target used in a probabilistic analysis, it is desirable to obtain input for both from the same geometric model. Under the Phase I effort the feasibility of generating a finite element mesh from the geometric solid and surface descriptions of a BRL-CAD solid model was demonstrated. A virtual volume mapping approach was developed using a ray-tracing approach. That mapping scheme is then translated into a geometric solid to generate a volumetric mesh of the solid. Under the proposed Phase II effort a hybrid approach is recommended that used the virtual mapping scheme developed under the Phase I effort for the interim of the solid and the surface representation of the solid obtained from the BRL-CAD NMG editor. Included in the C program translator will be a user friendly interface. Also graphics ties to AVS and PATRAN which were demonstrated in the Phase I will be expanded.

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Topic#: 92-167 ID#: 92WL0-109
Office: AD
Contract #: F08630-93-C-0084
PI: William L. Hacker
Title: Innovative Weapon Design for Improved Smart Fuze Sensing and Survivability
Abstract: The purpose of this effort is to design the fuze housing, liner, and weapon closure for a given hard target penetrating weapon that will be more survivable than the existing designs. This will be accomplished by first determining the loads that must be survived, evaluating the response of the existing components, redesigning the components and performing a design optimization, and then evaluating the new design. This procedure will then be incorporated into the weapon penetration and response system INTEGRA so that other weapon and fuze developers can take advantage of the approach.

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Phone: (513) 766-2020
Topic#: 92-066 ID#: 92PL1-015
Office: PL1
Contract #: F29601-93-C-0165
PI: Jyh-Ming Ting
Title: High Thermal Conductivity for Carbon/Carbon Composites for Space Radiators
Abstract: High performance space vehicles have created a demand for materials which have combined requirements for severe mechanical stress, thermal stress, and high thermal conductivity. The material for these applications is a carbon/carbon composite reinforced with vapor grown carbon fiber (VGCF). In a Phase I SBIR program, VGCF-reinforced carbon/carbon composites have been fabricated which easily establish new records for high mass-specific thermal conductivity. Based on these results, ultimate thermal conductivity in excess of 1000 W/m-K are anticipated when carbon/carbon processing for VGCF is fully developed. The Phase II technical objectives are to complete the composite optimization studies on VGCF carbon/carbon composites initiated in Phase I, and to translate this technology into the world's highest performance radiator through a design and prototype fabrication task. Preform fabrication will emphasize high fiber volumes with minimal fiber damage. Both liquid infiltration and chemical vapor infiltration methods for composite densification will be investigated to determine optimum matrix properties. Following optimization of composite processing, a radiator will be designed and fabricated as a deliverable. The accomplishment of these tasks will serve to qualify VGCF carbon/carbon composites for radiators used in numerous space and terrestrial applications.

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Phone: (513) 766-2020
Topic#: 92-137 ID#: 92WL6-049
Office: WL6
Contract #: F33615-93-C-2362
PI: Jyh-Ming Ting
Title: Novel Diamond/C/C Composites for Thermal Management
Abstract: A need for a significant level of research and development in thermal management materials for advanced packaging technologies has been identified. In a Phase I SBIR program, we have investigated a novel composite material, i.e.

diamond/carbon/carbon composite, which exhibits (1) thermal conductivity much greater than all the existing substrate materials, (2) tailable coefficient of thermal expansion (CTE) to match that of attaching components in electronic devices, (3) a high dielectric strength so that thin film metallization can be carried out on the surface, and (4) density much less than metals and ceramic materials. These results clearly establish the innovative DCC composite as a revolutionary dielectric substrate/heat sink materials. Remaining steps include the optimization of carbon/carbon composite processing and diamond deposition to obtain balanced physical, thermal, electrical, and mechanical properties, thin film metallization on DCC composites, fabrication of prototype IC package, and performance data bank establishment. In order to accomplish the steps needed to arrive at commercial viability of diamond/carbon/carbon composites, a Phase II research and development program is proposed. The proposed Phase II program would allow for a full development of a potentially revolutionary high performance dielectric substrate/heat sink material.

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Phone: (407) 894-6151
Topic#: 92-098 ID#: 92PL6-032
Office: PL6
Contract #: F29601-94-C-0007
PI: Dr. Robert Cavalleri
Title: Replacement Refrigerant and System Evaluation
Abstract: The current CFC refrigerants used in vapor cycle systems are scheduled to be phased out and replaced with refrigerants that are environmentally less hazardous. These new refrigerants are typically HFC's and HCFC's. These replacement refrigerants have little or no deleterious effect on ozone depletion. There is a requirement for military applications to replace the CFC refrigerants with these alternate refrigerants. During the switchover process, the oil and some of the cooling system components will require replacement or modification. A major component of any vapor cycle system is the compressor. A combined analytical and experimental effort will be conducted to develop a high performance integral compressor/electric motor unit that is not oriented to any of the existing CFC's and is versatile enough to be used with new refrigerants. Preliminary Phase I testing demonstrated that the compressor with either the alternate HFC-134a refrigerant or a prefluorocarbon is a viable system component that can be used to replace the current CFC based systems. This integral compressor unit is estimated to be one third the size and weight of a reciprocating compressor/motor unit. The development of this high performance integral compressor/motor unit technology will have a very favorable impact on reducing the size and weight of both military and commercial environmental control equipment.

ASTROPOWER, INC.
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Phone: (302) 366-0400
Topic#: 92-37A ID#: 92PL1-077
Office: PL1
Contract #: F29601-93-C-0188
PI: Margaret H. Hannon
Title: Lightweight, Light-trapped, Thin GaAs Solar Cell for Spacecraft Applications
Abstract: AstroPower has identified an innovative approach to successfully make the first ultra-lightweight, high performance, thin light trapping GaAs solar cell for advanced space power systems. The proposed structure can achieve 24.5% efficiency at AMO and IX conditions, corresponding to a power density of 330 W/m sq. A significant breakthrough lies in the potential for a specific power of 2906 W/Kg, 440% improvement over 4-mil silicon solar cells. In addition to being lightweight, the proposed GaAs solar cell can have increased radiation tolerance based on the thin device design. This device is supported by a 3-mil cover glass which has been attached to the front surface with a 1-mil silicon adhesive. The success of this Phase II effort will demonstrate the potential for a 1.65 micron thick space survivable GaAs solar cell with exceptional properties. Additionally, this new technology offers an alternative approach for obtaining multi-bandgap solar cells and high power output space solar power devices. The thin device structure can be applied to GaAs or AlGaAs top cells, thus offering a new dimension for multi-bandgap concepts in addition to this program.

ATHENA GROUP, INC.
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GAINESVILLE, FL 32605
Phone: (904) 371-2567
Topic#: 91-244 ID#: 91SDC-044
Office: WL0
Contract #: F08630-93-C-0072
PI: Michael P. Lewis
Title: Athena Sensor Arithmetic Processor (ASAP)

Abstract: The proposed Phase II ASAP project will research, develop, and prototype a new class of digital signal and image processor we refer to as the Athena Sensor Arithmetic Processor or ASAP. ASAP is based on Athena's patent-pending logarithmic residue number system (LRNS) processor technology, which has a significant advantage over other fixed-point arithmetic systems in terms of speed and area. Because an LRNS processor is small, many can be placed on a single chip, resulting in a technology we call an "array on a chip." The developed LRNS technology will be used to research new baseline signal processors as well as a 231x231 DFT which can operate at a sustained real-time rate of 100 frames per second. The resulting design will be tested using simulation and will be prototyped on a PC board. Low-cost continuation options are offered to allow expanded system capabilities, if desired by the sponsor.

ATMOSPHERIC & ENVIRONMENTAL RESEARCH
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CAMBRIDGE, MA 02139
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Topic#: 92-085 ID#: 92PL4-035
Office: PL4
Contract #: F19628-93-C-0095
PI: J.L. Moncet/R.G Isaacs

Title: Advanced Technology for Satellite Microwave Water Vapor Retrieval

Abstract: Operational approaches for the retrieval of temperature and moisture profiles from DMSP microwave and millimeter wave sounder data are based on exploitation of the spectral information content of the data alone. Regression retrievals are constrained to a solution space defined by the climatological variance (CV) of the ensemble for which the statistics are developed. Global statistics maximize the same space and variance. This increases the family of possible solutions. Temperature and moisture profiles are often retrieved for assimilation within meteorological applications models which themselves can provide information on the atmospheric state. An example is their use in numerical weather prediction (NWP) models. NWP models dynamically constrain the possible states of the atmosphere (i.e. forecasts of temperature and moisture profiles) through their model physics. This reduces the solution space for the retrievals from the CV of the regression statistics to that of the model forecast error variance (FEV). This reduces the family of possible solutions. Further constraints are possible through parameterization of the profile variances using empirical orthogonal functions (EOFs). The objective of this study is to explore the feasibility of employing physical constraints from meteorological applications models in a satellite data retrieval system consisting of retrieval approach and applications model physics. The desired outcome is to improve the accuracy of profiles with significant climatological variability such as water vapor.

BARRON ASSOC., INC.
ROUTE ONE BOX 159
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Topic#: 90-098 ID#: 90WL4-020
Office: WL4
Contract #: F33615-93-C-3612
PI: Roger L. Barron

Title: Neural Network Flight Control System Design for High Agility Air Combat

Abstract: Using simplified simulations, work under Phase I demonstrated a neural network flight control system (NNFCS) design approach for achieving optimum agility and flying qualities in air combat. This approach is built upon a refined analytical/algorithmic design process emphasizing an Intelligent Modeling Product used for computer-aided design from simulation databases. The key elements of this approach are: (1) derivation of optimum governing equations for two-point-boundary-value (TPBV) control of the aircraft nonlinear, time-varying dynamics; (2) synthesis of a polynomial neural network or networks for initializing the TPBV solution; and continuous in-flight estimation of significant force and moment parameters of the aircraft dynamic response. Phase II work will develop further the military-commercial dual-use Intelligent Modeling Product and design the NNFCS functionality for the VISTA/F-16 MATV aircraft with and without multi-axis thrust-vectoring. This NNFCS will be evaluated in pilot-in-the-loop simulation tests to be conducted by Lockheed Fort Worth Company under subcontract to Barron Associates, Inc.

BIHRLE APPLIED RESEARCH, INC.
400 JERICHO TPK
JERICHO, NY 11753
Phone: (804) 864-1180

Topic#: 92-122 ID#: 92WL4-016
Office: WL4
Contract #: F33615-93-C-0005
PI: John N. Ralston

Title: Development of an Optimized Vortex Controller for Chined Forebody Military Aircraft

Abstract: The objective of the Phase I task was to define whether vortex controllers could be integrated onto a realistic chine

configuration. This task successfully identified that properly applied pneumatic control can produce substantial levels of yaw control, insensitive to sideslip and rate excursions, as well as the beneficial aspects of this type of forebody on a military configuration. The proposed Phase II effort intends to extend this database by attempting to clearly identify the source of these forebodies' effects and how the vortex controllers influence them. This insight will provide the starting point for the design and demonstration of a conformal device, intended for the integration onto present and future low observable configurations. Using application guidelines developed in the initial investigation, this device will be optimized for a current chined military configuration, and a full static, dynamic and time dependent database will be compiled for a realistic simulation demonstration of the controllers' effectiveness. Beyond establishing a high level of confidence in the device's beneficial effects, this process will also attempt to define the database requirements for simulation of these devices in the future.

BIOELASTICS RESEARCH, LTD.
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Topic#: 91-123 ID#: 91ARO-002
Office: WL5
Contract #: F33615-93-C-5378
PI: R. Dean Harris

Title: Development of Rules for Folding of Biotechnology Produced Protein

Abstract: In general, proteins fold with hydrophobic residues buried, away from water. Reversible protein folding and assembly due to hydrophobic interactions result from inverse temperature transitions where hydrophobic folding and assembly occur on raising the temperature above a transition temperature, Tt. In warm-blooded animals, the temperature is not raised to drive protein folding and assembly; rather the temperature for folding and assembly is lowered from above to below physiological temperature. This is called the delta Tt mechanism and changes in many intensive variables can change the value of Tt and control the folded and/or assembled state. Folding can be shown to produce mechanical work, and each intensive variable of temperature, pressure, chemical potential and electrochemical potential has been shown to drive folding and assembly. Diverse free energy transductions, therefore can result from controlling the folded state of the protein by the delta Tt mechanism. This basic research project is to develop the rules for this recently described mechanism, and thereby to gain extraordinary control over the protein folding problem by biotechnology-produced proteins, for materials production and for the design of protein for a range of uses, e.g., as free energy transducers (sensors and actuators). The result of the project is to be a computer program for guiding users through their particular protein purification and folding problems. The technical objectives are to determine the effects (1) of amino acid ionization on disruption of the driving force for hydrophobic association, (2) of numerous organic and inorganic solutes on formation of higher order structures, (3) of hydrophobic domain size and intensity on the occurrence of independently folding domains, and (4) of hydrophobic domains on enhancing charge-charge interactions in hierarchical structuring; these are all elements of protein folding and assembly that can be quantified to become rules for controlling protein folding for protein-based material production and for protein-based free energy transduction.

BUSEK CO., INC.
19 KEARNEY ROAD
NEEDHAM, MA 02194
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Topic#: 92-015 ID#: 92AFO-045
Office: AFOSR
Contract #: FQ8671-93-01
PI: V. J. Hruby

Title: A High Thrust Density, C60 Cluster, Ion Thruster

Abstract: A C60 fullerene ion thruster represents a major advance in the evolution of electrostatic propulsion. It could provide up to a factor of 30 increase in thrust density over Xe thrusters as well as simultaneous reduction of relative losses by a factor of 5.5. Its basic feasibility has been experimentally verified during the Phase I program. A vaporization, discharge changer and simple acceleration grid were constructed. A set of unique experiments demonstrated: (1) controllable fullerene vapor generation, (2) stable discharge using tungsten cathode filament, (3) fullerene acceleration with beam ion energy cost of about 900 eV/ion at a mass utilization to 70%, (4) no detectable fullerene fragmentation due to vaporization, ionization and acceleration. In Phase II Busek will design and construct a laboratory model C60 thruster and fully characterize it. This includes characterization of a hollow cathode, the discharge chamber, and simple acceleration grid purveyance. Additionally, system level issues such as fullerene storage and vaporization concepts and spacecraft contamination issues will be addressed by McDonnel Douglas Space Systems Company (MDSSC). Stanford Research Institute (SRI) will perform fullerene analysis and assist Busek with fullerene physics. MDSSC will be our commercialization partner in Phase III.

CAMBRIDGE SCIENTIFIC, INC.
195 COMMON STREET
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Phone: (617) 484-3184
Topic#: 92-132 ID#: 92WL5-109
Office: WL5
Contract #: F33615-93-C-5387
PI: Debra J. Trantolo, Ph.D.
Title: Biopolymer-based Nonlinear Optical Materials
Abstract: Organic and polymeric materials have been of particular interest due to their promising potential applications in optical information processing and telecommunications. This interest has arisen from the promise of attractive combinations of optical, structural, and mechanical properties. Organic and polymeric materials can exhibit considerably high optical damage thresholds compared with inorganics because the former are not as susceptible to the formation of f-centers. In addition, the ability to prepare numerous derivatives of organics implies that properties can be tuned to meet specific requirements. Because of their processability into various forms, polymers seem particularly attractive for applications in nonlinear optics (NLO). Biopolymers have a controlled supermolecular structure and morphology and are promising polymer candidates for NLOM. This proposed project will establish the practicability of processing derivatized biopolymers, materials with known supermolecular structure, in electric fields in order to enhance material homogeneity and chromophore alignment, and optimize optical nonlinearity. The proposed work focuses on the particular importance of polymer processing in meeting the structure requirements of NLOM.

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Phone: (703) 848-0800
Topic#: 92-181 ID#: 92WL9-052
Office: WL9
Contract #: F33657-93-C-2338
PI: Dr. Harry L. F. Houpis
Title: Potential for Ozone Enhancement in Relation to Supersonic Flights
Abstract: Our SBIR Phase I project was directed at the identification of any material or process that would encourage the formation of ozone during X-30 flight tests. A broad-based investigation led to the determination and classification of several ozone enhancement schemes reflective of techniques used interior or exterior to the X-30 fuselage. Of these schemes, seven were judged to be excellent candidates for Phase II consideration. In addition, the idea of an assessment/enhancement "pathway" was presented where an optimized multisensor system is employed to provide environmental data on atmospheric conditions within range of the X-30 and to assist the operation enhancement devices. The principal objective of our Phase II SBIR project is to provide the Air Force with the best strategy and system pathway for enhancing ozone during flight tests. To meet this objective, four tasks will be undertaken: 1) Identification of key national experts and organizations that are interested in participating in this endeavor, 2) Software coordination and development for in-depth analyses and sophisticated computer simulations, 3) Derivation and refinement of ozone enhancement schemes, and 4) Design of an optimized sensor package directed at environmental assessment and enhancement scheme coordination.

CFD RESEARCH CORP.
3325-D TRIANA BLVD.
HUNTSVILLE, AL 35805
Phone: (205) 536-6576
Topic#: 92-014 ID#: 92AFO-040
Office: AFOSR
Contract #: FQ8671-93-01465
PI: Dr Anantha Krishnan
Title: Influence of Supercritical Conditions on Precombustion Chemistry and Transport Behavior of Jet Fuels
Abstract: Higher performance requirements of future military aircraft placing increasing heat loads on the fuel thus necessitating operation of the fuel in the supercritical regime. The goal of this project is to perform computations and experiments to address precombustion chemistry and transport behavior of jet fuels in the supercritical state. The Phase I study demonstrated the proof-of-concept of coupling detailed supercritical models with a general purpose Computational Fluid Dynamics (CFD) code capable of modeling fluid flow, heat/mass transfer and chemistry in complex geometries. The code was used to predict local transport rates form properties calculated as a function of local conditions. Experiments were conducted at the University of Iowa using Sulfur Hexafluoride as a surrogate fuel. The proposed Phase II work involves the incorporation of models to (i) simulate unsteadiness and turbulence in supercritical flows, and (ii) analyze thermal stability of jet fuels. These models will be incorporated into a time accurate CFD code with detailed submodels for supercritical transport of hydrocarbon fuels. Experiments will be conducted at the University of Iowa and the Wright Laboratory to obtain data for model development and validation. Pratt & Whitney and General Electric Aircraft Engines, Inc. will participate in the Phase II program by supplying data and information for model development.

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Topic#: 92-164 ID#: 92WL0-168
Office: AD
Contract #: F08630-93-C-0075
PI: Dr Alper K. Caglayan

Title: A Hybrid Neural Network/Knowledge Based Approach to Automatic Target Recognition

Abstract: In Phase I, we developed a hybrid approach to automatic target recognition (ATR) composed of image processing, knowledge base, and artificial neural network components using hybrid ATR architecture employing parallel feature and pixel processing channels. We demonstrated feasibility detection, classification, recognition, identification and characterization using LADAR sensor data. Here, we propose to develop a full-scale prototype of the hybrid ATR algorithm. In particular, we propose to compile a limited image database for hybrid ATR design and evaluation, automate the Phase I detection and segmentation process using LADAR 3D range and intensity data, expand the use of LADAR 3D range data to extracted features and subimages, refine the Phase I detection, classification, and recognition level ANN components, expand the identification and characterization levels, develop knowledge bases for decision fusion and exogenous information, evaluate the hybrid ATR algorithm performance using the image database, deliver the ATR algorithm software to Eglin AFB, and investigate the hardware implementation issues. The military significance of our Phase I work includes robust detection and neural classification, and recognition of high value targets and passive identification, friend or foe (IFF) capability for the new generation of precision guided weapons.

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Topic#: 90-171 ID#: 93AL -239
Office: AL
Contract #: F41624-94-C-6022
PI: Greg L. Zacharias

Title: Optimal Aircrew Task Allocation Method

Abstract: The primary objective of the Phase II effort is to develop a validated tool for crew task allocation in the rotorcraft cockpit, and demonstrate the developed tool in an example allocation optimization exercise. The basic approach, whose feasibility was demonstrated under the Phase I effort, relies on crew performance and workload metrics generated by a crew/system model which accounts for external world drivers, and crew's ownship and onboard systems, and the crew's internalized sensory/perceptual processing, situation assessment, and decision-making behavior. Model-based metrics for performance and workload support the evaluation of different procedure designs and task allocation, as part of a recursive process of task refinement and allocation optimization. To develop the current research package into a prototype design tool for the non-modeling cockpit design specialist, we propose a four task Phase II effort: 1) expansion of model and metrics beyond the scope considered under Phase I; 2) validation with empirical databases and real-time simulations; 3) demonstration and evaluation of a task allocation design exercise; and 4) specification of a full-scope computer aided engineering (CAE) cockpit design tool.

COHERENT TECHNOLOGIES, INC.
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Topic#: 91-064 ID#: 9110487
Office: WL2
Contract #: F33615-93-C-1333
PI: Paul Suni

Title: Fiber-based Laser Radar for Range/Doppler Imaging

Abstract: Remote sensing of vibrations using coherent laser radar has been identified as a means of identifying remote targets by analysis of characteristic vibration spectra. CO2 laser technology has been used in efforts up to the present. Recent advances in eye-safe solid-state 2 micron laser and laser radar technology make possible a more sensitive, compact, shorter wavelength alternative, highly compatible with the requirements of a ruggedized remote vibration sensor. Operation at this wavelength results in a minimum detectable vibration amplitude which is roughly one fifth that of comparable CO2 systems. In the Phase I effort it was analytically demonstrated that a short wavelength coherent laser radar has the inherent ability to sense surface displacement of a target object as small as a few microns and velocities of millimeters per second at ranges of several kilometers. It was argued that such measurements could in principle be made from a moving aircraft of ground or airborne targets. Experiments were also performed showing feasibility for a 1-2 W cw 2 micron laser having the required coherence. In this Phase II effort the motion detection capability of a 2 micron coherent laser radar will be experimentally demonstrated using a low-power 2 micron coherent laser radar. A 1-2 W 2 micron laser source having the required coherence will also be developed.

An assessment will be made of the potential of a laser radar diagnostic or detection adjunct to a passive IR and/or microwave radar ground or airborne target surveillance system. Anticipated Benefits: Numerous military and commercial applications exist for a compact, efficient eye-safe remote vibration sensor. Machine vibration analysis in industrial environments would directly benefit from the proposed instrument. Similar transmitters employing pulsed operation would find immediate use in helicopter wire avoidance, meteorological research, on-board windshear avoidance, pollution monitoring, and ground-based wind sensing systems.

COHERENT TECHNOLOGIES, INC.
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Phone: (303) 449-8736
Topic#: 89-092 ID#: 32873
Office: WL2
Contract #: F33615-93-C-1306
PI: SAMMY W HENDERSON
Title: Development of a 10 mJ/Pulse 200 Hz Diode Laser-Pumped 2um Transmitter for Coherent Laser Radar Systems
Abstract: Recent progress in solid-state laser research and development has shown that Thulim (Tm) - and Tm,Holmium (Ho)-doped Yttrium Aluminum Garnet (YAG) lasers are efficient sources of eye-safe radiation (~2 um). Most demonstrations to date have utilized flashlamp-pumped Cr,Tm,Ho:YAG lasers which are usually limited to operating at a few pulses per second and are inefficient. We propose to design and develop a modular diode-pumped 2 um coherent laser radar laboratory test bed system. The laser module will be very compact and capable of producing: >3 mJ/pulse at 100 Hz; >1.5 mJ/pulse at 500 Hz; and > 100 uJ at 10 KHz, and CW output power of > 1W. This 2-um coherent laser radar system will be capable of demonstrating short range wind measurements (~1 km) for application to aircraft air data systems and for fire control applications. The system will also be capable of hard target measurements of range and velocity to >10 km and for remote vibration sensing. This system would also serve as a test bed for more capable components as they become available, e.g. it would be capable of utilizing a 50-100 mJ/pulse 500 Hz laser when it is developed.

COMPOSITE DEVELOPMENT CORP.
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WEST WAREHAM, MA 02576
Phone: (508) 291-0880
Topic#: 92-070 ID#: 92PL3-009
Office: PL1
Contract #: F29601-93-C-0198
PI: STEPHERN C. NOLET
Title: Development of Pultrusion Technology for Production of Thin-Walled Tubes
Abstract: The use of advanced composite materials in high performance, light-weight structural applications has been well documented. Composite tubular members have been identified for numerous commercial, military and space-based applications. Specifically, thin-walled tubing (wall thicknesses between 0.25mm to 0.75mm) for stiffness critical applications promise tremendous performance advantages in terms of weight, damping and corrosion resistance. Economic barriers have impeded the use of these materials for such applications. Pultrusion processing provides the lowest possible cost for finished product manufacturing. Technology barriers have precluded the use of pultrusion as a process for the manufacturing of low-cost thin-walled composite tubes. The primary barrier determined in the Phase I research effort is excessive pulling loads. The Phase I effort has determined that manufacturing requires the development of highly accurate fiber placement equipment, techniques to reduce the pulling forces associated with tubular cross-sections, and methods of gripping thin-walled tubes to prevent crushing. The primary source of pull load in pultrusion is the bulk compression force of the fiber pre-form. During the Phase II effort, thin, stable off-axis reinforcement will be constructed by a process called "helical braiding". In-line helical braiding will result in reduced bulk compressive forces in the pultrusion die and lower pulling loads. Composite Development Corp. will demonstrate helical braiding to economically produce thin-walled tubes in diameters of 50mm, 25mm and 10mm as well as a rectangular tube 30mm x 20mm. A wall thickness of 0.75mm will be demonstrated with these specimens. The use of a traveling mandrel to further reduce pull loads and a novel gripping device will enable us to demonstrate the manufacturing of a 50mm tube with a wall thickness of 0.25mm.

COMPUTER SCIENCE AND APPLICATIONS
2 CLIFFORD DRIVE
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Phone: (904) 651-4991
Topic#: 92-157 ID#: 92WL0-030
Office: AD
Contract #: F08360-94-C-0006
PI: Clifford H. Allen, Jr.
Title: Electronic Combat Digital Simulation Workstation

Abstract: The Air Force Chief of Staff has directed program offices, operating commands, and test organizations to employ a disciplined test process throughout all phases of electronic combat (EC) systems development and modification. The EC test process consists of disciplined early evaluation to determine if the system under development will meet user needs followed by rigorous testing and evaluation to demonstrate that it performs as required. Full implementation of the EC test process requires the use of computer-aided simulation and analyses prior to each phase of testing to help design tests and predict test results. After each phase of testing, simulation and analysis are used to extrapolate test results to other conditions. DoD is also attempting to standardize digital modeling and simulation (M&S) capabilities with which to develop, test, and assess capabilities of weapon systems in their operational environment. the key to this DoD effort is the development of a modeling and simulation architecture (M&SA). The Joint Modeling and Simulation System (J-MASS) program developed a prototype standard digital M&SA under the Phase I J-MASS program with further enhancements to be accomplished under a Phase II development effort. The overall objective of the proposed SBIR Phase II Program is to develop and implement the Electronic Combat Digital Simulation Workstation (ECDSW) as recommended from the results of the SBIR Phase I feasibility study and demonstration. The ECDSW will be developed on the Sun SPARC station 10 using the J-MASS digital simulation architecture. The DoD will use the standard programming language, Ada, for modeling and simulation, and the USAFAWC GREEN FLAG EC model as a baseline Level II and Level III digital simulation model. Where applicable, the ECDSW will be compatible with other EC test facility unique M&SA with the objective of developing reusable software. Also, interchangeability of ECDSW non-real-time digital models with real-time digital models and techniques for the correlation of test results with digital model results will be of prime interest in developing the ECDSW.

CONCEPTUAL MINDWORKS, INC.
1732 GRANDSTAND
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Topic#: 92-020
Office: AL
Contract #: F41624-93-C-9015
PI: Dr Harold Longbotham

ID#: 92AL -209

Title: Computer Modeling of Laser Damage to the Eye

Abstract: Laser eye damage and its effect on a pilot's performance is of concern to the Air Force. In Phase I, we have shown that the decrease in acuity due to a laser lesion in the fovea region can be predicted by what is now called the "Geisler" model. The work in Phase II will use this model to produce a visualization tool for the effect on humans of laser eye damage. In addition, Phase II will extend the Geisler model to prediction of the change in signal processing characteristics of the retina due to a laser lesion.

CONDUCTUS, INC.
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Topic#: 92-015
Office: AFOSR
Contract #: FQ8671-93-01526
PI: Randy W. Simon

ID#: 92-594

Title: HTS S-N-S Technology for Digital Logic

Abstract: Josephson junctions are extremely high-speed electronic devices whose power consumption is order of magnitude less than semiconducting devices. Josephson junction-based integrated circuits (JJIC's) can be the basis of very high performance computation circuits and signal processing circuits such as shift registers, analog-to-digital converters, high-speed counters, phase shifters, and a variety of other functional units. The advent of high-temperature superconductivity provides the opportunity of developing high-performance electronics based on JJIC's that operate at temperatures near the boiling point of liquid nitrogen. Junctions of the superconductor-normal-superconductor (S-N-S) type now show promise as the basis of high-performance high-temperature superconductor circuit technology. The use of conducting oxide materials as normal layers in the junctions is the enabling development for this technology. This Phase II program has the goals to refine the S-N-S junction process developed under Phase I for use in digital circuits; to design, fabricate and test a family of digital logic gates using the S-N-S process, and to demonstrate a complex digital circuit (tentatively at least and 8-bit adder) whose complexity will depend upon the progress development.

CONTINUUM DYNAMICS, INC.
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PRINCETON, NJ 08543

Topic#: 92-009
Office: AL1
Contract #: F08635-94-C-0013

ID#: 92CEL-077

100

Phone: (609) 734-9282 PI: MILTON E. TESKE
Title: Microcomputer Model for Assessment of Fuel Dumping Impacts
Abstract: Fuel jettisoned by aircraft in flight may pose an environmental hazard. Recent decisions to convert from JP-4 jet fuel to the less volatile JP-8 means that the likelihood for significant ground-fall of jettisoned fuel is substantially increased. The proposed effort will provide a fully operational and user-friendly personal computer model to predict the fate of the released fuel. This work builds on the Gaussian line-source model called FSCBG, which was originally developed by Continuum Dynamics, Inc. for the USDA Forest Service and the U.S. Army to predict the dispersal of aerially released material. The baseline FSCBG model has been extended through the implementation of a multicomponent evaporation model and refined meteorology to yield a demonstrator model of fuel jettisoning, FJSIM, and the proposed Phase II effort will complete full-scale development of this code. Among the major Phase II objectives are: generalization of the existing dispersion model; refinement of the heat and mass transfer model within evaporating droplets; experimental validation of the evaporation model and studies of drop size distributions; assembly of a data base on jettisoning systems of pertinent Air Force aircraft; and training of Air Force personnel in the operation of the software.

CREARE, INC. Topic#: 92-007 ID#: 92-046
P.O. BOX 71 Office: PL1
HANOVER, NH 03755 Contract #: F29601-93-C-0204
Phone: (603) 643-3800 PI: Dr. Javier A. Valenzuela
Title: Advanced Capillary Evaporator for Thermal Management of High Power Density Electronic components
Abstract: We propose to demonstrate a capillary-pumped thermal management system based upon an innovative evaporator component that will: (1) enable direct cooling of electronics modules at higher power density (100 W/cm sq.), and (2) greatly extend the range of thermal load and heat transport distance for capillary pumped loops (CPLs) incorporating this evaporator. The novel Reentrant Capillary Structure (RCS) evaporator will have a maximum capillary pumping head two to five times larger than porous wick evaporators and accommodate a factor of ten larger power density at the same temperature difference between the electronics module and the radiator. Because of its large conductance and small temperature difference, the RCS will enable operation at high power densities without a large increase in radiator mass. It will enable large amounts of thermal energy to be collected over a small surface area and transported to a radiator over long distances if necessary. In Phase I we have demonstrated three microfabrication techniques for these RCS structures and analytically demonstrated the potential for high capillary head and heat flux. In Phase II we propose to demonstrate the RCS as a heat acquisition device for high power density electronic components and as the driver in an advanced CPL.

CREARE, INC. Topic#: 91-059 ID#: 91ARM481
POST OFFICE BOX 71 Office: AL
HANOVER, NH 03755 Contract #: F41624-93-C-6015
Phone: (603) 643-3800 PI: Walter Swift
Title: Closed Loop Bleed Air Driven Cycle for On-Board Oxygen Generating Systems
Abstract: This project involves the development of a unique gas bearing turbomachine for a closed loop refrigeration cycle to liquefy oxygen. The turbomachine is a turbo-compressor/expander, incorporating a power turbine, and expansion turbine and a compressor on a single shaft. Aircraft bleed air drives the power turbine which provides power to the compressor. The compressor and expansion turbine are coupled in a closed loop reverse Brayton cycle which liquefies oxygen produced in a molecular sieve. The cycle allows for on board production of liquid oxygen, reducing logistics support requirements associated with other oxygen systems. In Phase I the cycle was defined, performance was established and a preliminary design of the machine was performed. Phase II focuses on the design, fabrication and test of the turbocompressor/expander.

CREARE, INC. Topic#: 92-145 ID#: 92WL6-077
P.O. BOX 71, ETNA ROAD Office: WL6
HANOVER, NH 03755 Contract #: F33615-93-C-2351
Phone: (603) 643-3800 PI: Dr JAVIER A. VALENZUELA
Title: Auxiliary Bearings for Magnetically Supported Rotors
Abstract: Auxiliary bearings will be critical components of advanced gas turbine engines using magnetic bearings to support the

engine spools. Because of the high temperature in the bearing compartments conventional oil-lubricated bearings cannot be used either as the main or auxiliary bearings. Although solid-lubricated bearings under development are capable of supporting high loads at high temperatures, their short lifetime limits their use for man-rated aircraft engines. A novel auxiliary bearing design for magnetically supported rotors in high-temperature gas turbine engines has been developed. The design incorporates a pressurized gas bearing and solid lubricated touch sleeves to achieve a bearing system with extended life at high temperatures, no wear during normal operation, and significant over-capacity to handle aircraft maneuvers. The auxiliary bearing design integrates the pressurized gas bearing into the magnetic bearing state, resulting in a compact system with synergistic benefits to both the magnetic and gas subsystems. In Phase I the feasibility of the proposed bearing concept was assessed by developing a preliminary design of the hybrid magnetic/gas bearing and characterizing the auxiliary bearing performance. In Phase II, we propose to build and test a set of hybrid bearings. Creare will work with engine manufacturers in Phase III to incorporate the auxiliary bearings into advanced turbine engines.

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Topic#: 92-114 ID#: 92WL3-027
Office: WL3
Contract #: F33615-93-C-1294
PI: John W. Palmour

Title: A High Temperature Silicon Carbide Microwave Transistor

Abstract: There is an increasing need in many military systems to have solid state microwave devices with higher power capability, higher reliability, and higher operating temperatures. These devices would be important for airborne radar systems, electronic warfare and countermeasure systems, and airborne and space-based communication systems. While conventional semiconductor materials such as Si and GaAs are already being used near their limits of output power and operating temperature, the potential of SiC is just beginning to be demonstrated. High frequency 6H-SiC MESFETS with 12.5 db power gain at 1.0 GHz have been demonstrated. High temperature 6H-SiC MESFETs and JFETs have been demonstrated to 500 degrees C. There are some factors that could prevent a MESFET structure from meeting its potential for high frequency operation at high temperature. The amount of gate leakage known to exist for Schottky contact at 500-600 degrees C could degrade the RF performance of the devices. Therefore, it was proposed in Phase I that 6H-SiC JFET structures be investigated for high temperature, high frequency operation. The JFET will take advantage of the much lower leakage current inherent in SiC pn junctions at high temperature due to the wide bandgap. In Phase I, n-channels JFETs were both modeled and fabricated and the feasibility of producing SiC microwave JFETs was proven. The n-channel devices developed during Phase I showed very high field capability and values of ft as high as 2.1 GHz. The modeling showed that the JFETs power virtually identical to that modeled for 6H-SiC MESFETs. However, when the 6H-SiC devices were modeled for operation at 500 degrees C, they showed a maximum operating frequency of about 5 GHz due to the decreased electron mobility. Therefore, it is proposed that in Phase II these JFET devices also be developed in 4H-SiC because of its higher electron mobility. This effort will include physical modeling (RT and 500 degrees C), design, fabrication and high temperature testing of 6H- and 4H-SiC JFET structures.

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

Topic#: 92-130 ID#: 92WL5-222
Office: WL5
Contract #: F33615-93-C-5380
PI: G.M. Loiacono

Title: "Synthesis, Crystal Growth and Characterization of CsTiOAsO4 Crystals for OPO Applications to 5 Microns"

Abstract: There is a need for optical crystals, having large nonlinear coefficients for operation as optical parametric oscillators (OPO) in the mid IR region (1.5 to 5.0 microns). Single crystals of KTiOAs04 (KTA) have been shown to have superior transmission in this optical region, however, the presence of a domain structure complicates the utilization of this material. In addition, the nonlinear properties of KTA are reported to be considerably larger than KTP. In order to select the best material for this OPO application, the other members of the KTP family must be evaluated as single crystals. The synthesis, crystal growth and characterization of CsTiOAs04 CTA will be investigated in this program.

CRYSTALLUME
125 CONSTITUTION DRIVE
MENLO PARK, CA 94025

Topic#: 92-042 ID#: 92ES3-044
Office: ES3
Contract #: F19628-94-C-0013

Phone: (415) 324-9681 PI: Dr. Maurice I. Landstrass
Title: CVD Diamond Coatings for a Tailored Work Function Cold Cathode
Abstract: Because of their unique electronic properties, diamond thin films offer an opportunity to greatly improve the efficiency of power electron beam systems by using a high efficiency cold cathode employing diamond affinity coatings to achieve low work function and low emitter resistance. In addition, because of diamond's thermal shock resistance and resistance to radiation and chemical attack, diamond coated cathodes may also improve the life and reliability of the power tube systems. This proposal is intended to extend upon the Phase I work demonstrating low work function cold cathode devices and explore the feasibility of diamond-coated cathode displays and to determine the operational advantages of such systems in potential field applications. Patterned diamond thin films will be grown and characterized physically and electronically. Vacuum diodes will be fabricated and the current-voltage characteristics measured as a function field to determine work function and resistance, establishing the feasibility of this approach to improving cathodes. This project will focus on fabricating and characterizing diamond cathode components for use in existing operational systems.

CRYSTALLUME Topic#: 92-066 ID#: 92PL1-028
125 CONSTITUTION DRIVE Office: PL1
MENLO PARK, CA 94025 Contract #: F29601-93-C-0199
Phone: (415) 324-9681 PI: M. D. Drory
Title: Highly Optimized diamond Films for Wafer Scale Integrated Circuits
Abstract: Diamond films for electronic packaging will be developed for patterned overlay multichip module substrate technology. In particular, metal substrates will be diamond coated for use in high density interconnect (HDI) and other thermal management applications. The emphasis is on developing adherent diamond films with superior electrical and thermal properties for use in electronic packaging. Process scaling will be coupled with cost modeling in order to derive low cost methods for use in military and commercial applications. In addition, adhesion measurement techniques and analysis will be advanced in this program which has general applicability to thin film technology and reliability.

CRYSTALLUME Topic#: 92-138 ID#: 92WL6-156
125 CONSTITUTION DRIVE Office: WL6
MENLO PARK, CA 94025 Contract #: F33615-93-C-2357
Phone: (415) 324-9681 PI: Maurice Landstrass
Title: Diamond Power Capacitors
Abstract: Diamond film capacitors offer an opportunity to greatly improve the reliability and high temperature capability of power electronics. Diamond power capacitors offer temperature capability of greater than 700 degrees C, high power density of 7J/g, small size and weight, and high reliability/long life (HRLL) operation. Diamond coatings' high thermal conductivity and superior dielectric properties will increase the operating temperature and current handling of power capacitors. Diamond capacitors will improve the life and reliability of avionics power systems. This proposal is intended to extend on the success of the Phase I results of fabricating high Q, low ESR single layer diamond capacitors and will focus on fabricating and characterizing prototype diamond multilayer and wound capacitor components for use in existing operational systems. Prototype CVD diamond reactors will also be designed and built to automate the fabrication process for multilayer and wound capacitor structures. This program will demonstrate the feasibility of using diamond film in common capacitor configurations and develop processes and machines for their mass production. Phase III will focus on the manufacture of diamond multilayer and wound capacitors through use of the automated CVD diamond reactors to be designed in the Phase II effort.

CSA ENGINEERING, INC. Topic#: 92-071 ID#: 92PL3-015
2850 WEST BAYSHORE ROAD Office: PL1
PALO ALTO, CA 94303 Contract #: F29601-93-C-0180
Phone: (415) 494-7351 PI: David A. Kienholz, PHD
Title: Modular Piezoelectric Damping Element for Flexible Structures
Abstract: This Phase II proposal describes the development of a modular piezoelectric damping element for flexible structures. The device will be designed primarily for add-on application to existing structures. The effort will seek to develop an integrated combination of sensor, actuator, controller, and power amplifier. Such a device could bring the advantages of active damping

to structures not originally designed for it. Following the Phase I analytical study of system-level performance and electrical power requirements, the proposed effort will concentrate on the practical issues of component-level product planning, materials, fabrication, electronic components and packaging, assembly, and microcontroller hardware and software. The goals are a proven design ready for small-scale production and delivery to Phillips laboratory of samples suitable for a variety of patch demonstration hardware.

CSA ENGINEERING, INC.
2850 WEST BAYSHORE RD
PALO ALTO, CA 94303
Phone: (415) 494-7351
Topic#: 92-072 ID#: 92PL3-021
Office: PL1
Contract #: F29601-93-C-0203
PI: David A. Kienholz, PHD
Title: Airborne Suspension/Vibration Isolation System
Abstract: This Phase II proposal describes the design and development of an advanced Airborne Suspension/Vibration Isolation System (AS/VIS). Intended for risk reduction in the Airborne Laser (ABL) program, the project will develop the essential technology for suspending an optical bench payload of about 10,000 lb from an airframe in such a way as to isolate it from structure borne vibrations. The target passive isolation performance is well beyond that currently available even with laboratory isolators. In addition, the AS/VIS will allow moderate maneuvering loads to be accommodated without grounding the isolation system. It will also incorporate active elements (sensors and actuators) that may be used to actively counteract the effects of disturbances transmitted either through the isolation mounts or through flanking paths such as hoses, cables, or airborne accoustics. Phase II will culminate in the delivery to the Phillips Laboratory of a turnkey testbed system for technology demonstration and continuing in-house development toward a full, flightworthy system suitable for ABL.

CYBERNET SYSTEMS CORP.
1919 GREEN RD
ANN ARBOR, MI 48105
Phone: (313) 668-2567
Topic#: 91-051 ID#: 91CEL-007
Office: WL4A
Contract #:
PI: CHARLES J. JACOBUS, PH.D
Title: A High Accuracy Absolute Navigational System for Rapid Runway Repairers
Abstract: The effort proposes to demonstrate a multi-sensor-based navigational architecture for a rapid runway repair vehicle which augments dead reckoning, compass, inertial guidance, and GPS-type self-location with an RF-free optical landmark target recognizing system. In the Phase I effort we successfully built a database which demonstrated the accuracy of such a landmark-based approach (and performed some on-site demonstrations using mobile robot mounted CCD camera systems). In addition we have investigated using GPS and landmark tracking to construct topological maps which locate vehicle tracks and local features. In this effort we will (1) integrate a field hardened optical sensor for landmark image capture, (2) provide software for recognizing and sighting natural and artificial landmark targets, (3) implement software for automatic construction of site navigation maps (basically maps which locate navigational targets), and (4) integrate the navigational architecture (combining the optical landmark recognition and tracking method with GPS, inertial navigation, and magnetic compass self-location).

DAGONET SOFTWARE
2704 LA VETA DRIVE NE
ALBUQUERQUE, NM 87110
Phone: (505) 883-0381
Topic#: 92-060 ID#: 92PL2-046
Office: PL2
Contract #: F29601-93-C-0162
PI: Louis Baker
Title: Fragmentation Modeling
Abstract: Accurate simulation of the fragmentation behavior of warheads and impacted objects is important to a number of problems, such as weapon lethality, spacecraft survivability, and debris formation. There has been a lot of recent progress in the numerical simulation of such problems and in the theoretical understanding of fragmentation. This SBIR proposes to capitalize on these advances to develop a computer code capable of advancing the state-of-the-art in simulating fragmentation, enabling simulations of good fidelity and providing the ability to describe the fragment environment with reasonable accuracy. The approach will be to include appropriate fragmentation models within a smooth particle hydrodynamics (SPH) code. Phase I developed a fragmentation model based upon the physics of fractals. Phase II will incorporate this fragmentation model into an SPH code as a sub-grid fragmentation model, permitting physically consistent modeling of spallation and fragmentation in

hypervelocity impacts, increasing the fidelity of such simulations.

DATA FUSION CORP.
7017 S. RICHFIELD ST
AURORA, CO 80016
Phone: (303) 699-2421
Topic#: 92-101 ID#: 92WL2-020
Office: WL2
Contract #: F33615-93-C-1270
PI: Dr w. Kober
Title: An Analytic-based Sensor Management Software Package
Abstract: Data Fusion Corporation proposes the Phase II development of a software tool suitable for designing, modifying, simulating, and evaluating a Sensor Management System (SMS) for tactical aircraft. This tool will not be an actual Sensor Management System, but is intended to be a design tool supporting the exploration and evaluation of the sensor management functions. This tool will provide the following SMS functions: formulation of sensing requests, prioritization of contending alternatives, scheduling of requests. The tool will also provide medium-fidelity, Monte-Carlo dynamic-system simulation-testbed (DSST) capabilities to exercise these functions as well as analytic capabilities to evaluate the results of the simulations.

DEEGAN RESEARCH GROUP, INC.
39 PORTER LANE
PORTSMOUTH, RI 02871
Phone: (401) 683-1799
Topic#: 92-001 ID#: 92AED-006
Office: AEDC
Contract #:
PI: Thierry Deegan
Title: Soot Ion Quantification System
Abstract: Passive detection of cruise missiles, helicopters in defilade, and fixed-wing aircraft beyond the visual horizon is a capability of substantial tactical significance. The preliminary investigations of Phase I identified electromagnetic radiation from ions generated during combustion in engines as a potentially exploitable emission. Phase I identified these sources with relatively modest equipment which provided qualitative data. The work proposed for Phase II will confirm these sources with additional analysis and quantitative measurements. These lead to the design and assembly of a real-time processing suite that supports the collection of detailed source data. Additional analysis of this data is intended to determine the potential detectability of tactically significant sources. An option for developing the software for detection processing, classification analysis, and direction finding is also proposed. The team proposed has extensive experience in developing systems of the kind required.

DISPLAYTECH, INC.
2200 CENTRAL AVENUE
BOULDER, CO 80301
Phone: (303) 449-8933
Topic#: 92-037 ID#: 92ES3-004
Office: ES3
Contract #: F19628-93-C-0204
PI: Mark A. Handschy
Title: Adaptive FLC/VLSI Optical Focal Plane Processor
Abstract: The proposed work aims to add microlens arrays to FLC/VLSI (ferroelectric liquid crystal/very large scale integration) smart pixel spatial light modulators (SLMs). The result will be a class of hybrid optoelectronic image processing devices that integrate large arrays of pixels containing an FLC light modulator, single or multiple photodetectors, and multiple-transistor processing circuits. Integrating microlens arrays matched to the pixel array enables an adaptive device capable of accepting multiple optical input of data and control signals. The lenslet arrays also improve modulator and detector fill factor and modulator phase uniformity and throughput. During Phase II, we will analyze lenslet and SLM performance tradeoffs to determine the minimum feasible pixel pitch. We will then design and fabricate a full-scale SLM with a general-purpose adaptive thresholding pixel incorporating photodetectors and a modulator. The fabrication will rely on improved assembly techniques permitting precise lenslet-to-pixel registration with controlled window-to-chip attachment.

DYNA EAST CORP.
3201 ARCH STREET, 3RD FLOOR
PHILADELPHIA, PA 19104
Phone: (215) 386-4884
Topic#: 92-157 ID#: 92WL0-166
Office: AD
Contract #: F08630-93-C-0063
PI: Pei Chi Chou
Title: Effects of Solid-mechanic Properties of Energetic Materials on Munition Sensitivity
Abstract: The results of the Phase I research demonstrated that two mechanical properties of explosives are important in impact

initiation. These are the high strain-rate properties and the strength under hydrostatic pressure. Examples of the influence of these properties on the temperature in hot spots are given. Currently, very little data on these properties are available. Specific test methods are proposed to measure these properties. The methods include the Hopkinson bar and the Taylor impact tests for measuring the strain rate effect. A pressured bed apparatus and a combined compression-shear apparatus are proposed for the strength under hydrostatic pressure properties.

EIC LABORATORIES, INC.
111 DOWNEY ST
NORWOOD, MA 02062
Phone: (617) 769-9450
Topic#: 92-007
Office: AL1
Contract #:
PI: MICHAEL M. CARRABBA
ID#: 92CEL-024
Title: A Fiber Optic Aqueous Phase Trichloroethylene Sensing Instrument
Abstract: The purpose of this program is to develop a real-time chemical sensing instrument for detection and monitoring of chlorinated organic solvent contaminants, particularly trichloroethylene (TCE). The proposed work is based on the principle of combining spectroscopic, electrochemical, and fiber optic techniques. Spectroelectrochemical Fiber Optic Sensing (SEFOS) is, in principle, a generic technique which can be adapted to many different sensing applications. The incorporation of spectroscopic detection, such as fluorescence, should enable nonmolar detection limits (i.e., ppb levels or less), unlike electrochemical methods which are generally limited by background currents due to impurities and non-Faradaic processes. The technique has an advantage over current fiber optic chemical sensing methods in that the sensing only takes place when the electrode device is turned on. This enables long-term monitoring of a well/site to be accomplished with only one SEFOS probe. The goal of the Phase II program is to fabricate and field test at an Air Force specified facility a prototype SEFOS system for the detection of the chlorinated organic solvent, TCE, in the range of aqueous and headspace concentrations from 5 ppb to the solubility limit. Field testing will include the implementation of the SEFOS instrument with a Raman/Cone Penetrometer (CPT) site characterization system. The goal of the Phase III program is commercially available low-cost fiber optic based field portable instrument for field screening/in situ monitoring of TCE and other chlorinated organic solvent contaminants.

EIC LABORATORIES, INC.
111 DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450
Topic#: 92-078
Office: PL1
Contract #: F29601-93-C-0149
PI: K.M. abraham
ID#: 92PL3-057
Title: Optimization of Polymer Electrolyte Batteries
Abstract: A research and development program is proposed to identify and improve the parameters which affect the performance of polymer electrolyte-based solid-state batteries. The results obtained in Phase I have revealed that the cycle life of Li anode cells is limited by the low cycling efficiency of the Li electrode. The factors which affect the cycling efficiency of the Li electrode will be studied by in situ electrochemical techniques together with analysis of the products formed at the Li/polymer electrolyte interface by means of physio-chemical techniques. The role of the cathode/polymer electrolyte interface on the cycle life of polymer electrolyte batteries will be investigated in the same general manner as the anode/electrolyte interface. The cycle life of the solid-state batteries will be increased with the use of additives which scavenge Li dendrites, and with alternative anodes on which Li dendrites are not formed.

EIDETICS INTERNATIONAL, INC.
3415 LOMITA BLVD
TORRANCE, CA 90505
Phone: (310) 326-8228
Topic#: 91-079
Office: XRX
Contract #: F33657-93-C-2131
PI: Ken Shimabukuro
ID#: 91ASD-567
Title: T-38X: An Application of Technologies to Enhance the T-38 to meet BFTS Requirements
Abstract: The USAF Trainer Master Plan developed short and long-term strategies for meeting current and future Undergraduate Pilot Training (UPT) requirements. One element of the plan calls for the development of a Bomber-Fighter Training System (BFTS) aircraft to replace the T-38 in the 2005 time frame. Studies have been conducted to investigate aircraft alternatives which have ranged from new subsonic and new supersonic aircraft, to variations of existing fighters and trainers modified to meet BFTS requirements. This proposal suggests that a viable option has been overlooked as a BFTS candidate -- an enhanced and life extended T-38A, herein called the T-38X. This SBIR Phase II proposes to define the resulting cost effective T-38X

configuration that corrects the deficiencies identified in Phase I. Whereas Phase I deficiencies, Phase II will determine the T-38X configuration, performance, and cost that best meets the BFTS requirements.

EIDETICS INTERNATIONAL, INC.
3415 LOMITA BLVD
TORRANCE, CA 95050
Phone: (310) 326-8228
Topic#: 92-150 ID#: 92XPA-001
Office: XRX
Contract #: F33657-93-C-2439
PI: Steven M. Mosher
Title: ARENA Virtual Reality
Abstract: The principle objective of this contract will be to design, develop and deliver a state-of-the-art virtual reality based air combat simulation facility. The facility will allow the government to conduct air-to-air and air-to-ground missions, to evaluate new aircraft/weapon technologies and to evaluate new virtual reality technologies. The system will leverage the accomplishments of previous USAF SBIRs and will advance the development of key dual use technologies, aiding thereby, defense conversion efforts.

ELECTRONIC DECISIONS, INC.
1776 EAST WASHINGTON STREET
URBANA, IL 61801
Phone: (217) 367-2600
Topic#: 92-160 ID#: 92WL0-169
Office: AD
Contract #: F08630-93-C-0070
PI: Dr. Daniel A. Fleisch
Title: An ACT-based Range Extent Simulator
Abstract: An opportunity now exists to bring significant benefits to range-extent simulation systems by employing the emerging technology of acoustic charge transport (ACT). The results of a Phase I SBIR program have demonstrated that the capabilities of ACT selectable delay lines are well-matched to the requirements of both target and clutter range-extent simulation (RES) systems. The use of ACT microelectronic solid-state delay elements in place of thousands of feet of cable has the potential to both improve system performance and to greatly reduce the space occupied by RES systems. The objective of the proposed Phase II program is to develop an ACT-based RES system consisting of 2 target-simulation modules which provide delays from 7.5 to 480 nsec and 2 clutter-simulation modules which provide delays from 30 nsec to 15.36 microsec. The ACT devices, thick-film hybrids, and printed-circuit boards which make up the target and clutter RES modules will be designed, fabricated, tested, and delivered under the proposed Phase II program. An acceptance test plan, and operations/maintenance manual will be delivered with the system. Reports will include monthly status reports, a final test report, and a report on the commercialization of ACT technology.

ELECTROSYNTHESIS COMPANY (THE)
P.O. BOX 430
EAST AMHERST, NY 14051
Phone: (716) 684-0513
Topic#: 91-054 ID#: 91CEL-042
Office: AL1
Contract #: F08635-93-C-0144
PI: J. DAVID GENDERS
Title: Electrochemical Reduction, Electrodialysis and Precipitation for Iron Control in Air-stripping Groundwater
Abstract: An electrochemical process for removal of iron from groundwater, "electroprecipitation", was developed during Phase I. Iron and other metal ions such as calcium require removal to avoid plugging up the packing in VOC air-stripping towers by deposits of metal oxides. Electroprecipitation proved surprisingly effective in removing iron levels in the range of 5-80ppm with up to 99% efficiency. The Phase II effort will focus initially on optimization of the process parameters including cell design, electrode material, current density, flow rate and charge passed per unit volume. Some work will also be done on evaluating organics destruction in electrolyzed ground-waters. This will be followed by design and construction of a suitably sized electroprecipitation system for start-up and operation at an approved Air Force site. This system will treat about 35 gpm of contaminated groundwater and precipitate iron and calcium, as well as other potentially troublesome metal ions to sufficiently low levels such that the life and performance of VOC air-stripping towers is greatly extended.

ENERGY MATERIALS TESTING LABORATORY
5 MORIN STREET (A DIVISION OF FIBER MATERIALS)
BIDDEFORD, ME 04005
Topic#: 92-003 ID#: 92AED-025
Office: AEDC
Contract #:

107

Phone: (207) 282-5911 PI: Stephen A. Michaud
Title: 2400K Gas Sample Cell
Abstract: A Phase II program is proposed for the construction of a 2400 K Gas Sample Cell. The cell would be used by the US Air Force Arnold Engineering Development Center (AEDC) for the calibration and development of Raman spectroscopic instrumentation designed to monitor air, water vapor and NOx compounds present in the exhaust plume of hydrogen burning combustion RAM jet (SCRAMJET) engines. Results from a Phase I study have shown that the construction of an operational 2400 K Gas Sample Cell is entirely feasible using primarily temperature, pressure, gas flow and heating control subsystems that are available commercially. Some custom fabrication would be required, as with a pressure/vacuum chamber, but these are considered low risk efforts when ASME boiler design and construction guidelines are followed. Under this Phase II program, all subsystems would be procured or fabricated as necessary, and integrated into a working prototype 2400 K Gas Sample Cell. The operational cell would be tested for proof-of-design, and delivered to AEDC for a demonstration at AEDC.

EPI CHORUS CORP. Topic#: 92-112 ID#: 92WL3-036
261 EAST FIFTH ST Office: WL3
ST PAUL, MN 55101 Contract #: F33615-93-C-1296
Phone: (612) 224-1140 PI: Craig Bichrt
Title: Novel Monomeric Carbon Doping Sources for III-V MBE
Abstract: Minority carrier lifetimes in the base region of C-doped npn heterojunction bipolar transistors remains unacceptably low. Deep traps caused by the presence of polyatomic carbon complexes are currently believed to be limiting both material quality and device performance. In this proposed effort, two high purity doping effusion cells that produce monomeric carbon flux beams will be refined and made commercially viable. One of these cells will be provided to the Solid State Directorate of the Wright Laboratory for further testing.

ESSEX CORP. Topic#: 92-021 ID#: 92AL -104
1040 WOODCOCK ROAD, SUITE 227 Office: AL
ORLANDO, FL 32803 Contract #: F41624-93-C-3003
Phone: (407) 894-5090 PI: Robert S Kennedy, PhD
Title: Isoperformance: An Artificial Intelligence Model for Identifying Human System Integration Problems in Acquisition Programs
Abstract: Isoperformance methodology is a set of formal relations (trade-off functions) among the manpower, personnel, and training determinants of systems performance; it is derived by fixing a desired level of performance and then solving for combinations of the determinants sufficient to produce that level, and can be employed as a framework to guide the human systems integration process. Isoperformance curves are empirically accurate depictions of the form of trade-off relations among the factors that determine performance. In Phase I, we demonstrated the feasibility of the isoperformance model by creating a "script" to guide the user through the design process using a question-and-answer approach, with supplemental illustrative materials. In Phase II, this script will be further developed, refined, and recast as a specific interactive computer program designed to run on Air Force microcomputers to assist in providing mathematical functions for the Air Force Manpower, Personnel, and Training Decision Support System (MPTDSS).

FED MICROELECTRONICS CORP. Topic#: 92-024 ID#: 92AL -138
P.O. BOX 12802 Office: AL
RESEARCH TRIANGLE, NC 27709 Contract #: F41624-93-C-6019
Phone: (919) 990-9550 PI: Gary W. Jones
Title: Helmet-mounted Visual System Components and Assemblies - Miniature Cathode Ray Tubes (CRT's)
Abstract: This SBIR Phase II proposal addresses the development of a demonstration monochrome flat-panel display built using new self-aligned, gated field emitters with diamond-like coatings. This flat panel display will provide the highest resolution ever obtained from a field emitter display (-285 lines per inch) with the potential to achieve far higher resolution with high energy efficiency and brightness. Field emitter arrays for electron sources in CRTs have also been produced using a related version of this new technology. The goal of this Phase II proposal is to develop a demonstration 512X512 video display using this new field emitter technology and to produce 4 dozen emitter array sources for insertion into high performance mini-CRTs.

Assembly, connection, driver circuit development, and array fabrication are the primary tasks planned for this effort. This display represents what may eventually become the ultimate display technology for small and large area displays.

FIBER AND SENSOR TECHNOLOGIES
P O BOX 11704
BLACKSBURY, VA 24062
Phone: (970) 323-1424

Topic#: 92-120
Office: WL4
Contract #: F33615-93-C-3616
PI: Kent Murphy

ID#: 92WL4-053

Title: Survivability Enhancement of Optical Fiber Data Busses by Structural Integration

Abstract: Increasing development of avionics fly-by-light architecture has shown the need for more survivable optical fiber data busses. Optical fiber communication systems offer inherent electromagnetic interference (EMI) immunity, low radar cross-sections, and very light weight when compared to standard wire systems. The glass optical fibers are, however, not as strong as standard wires and therefore may present a liability because ballistic impacts, fires, or routine maintenance can damage them. Fiber & Sensor Technologies Inc., (F&S) and their research partners at the Fiber & Electro-Optics Research Center (FEORC) at Virginia Tech, during the Phase I portion of this research program, has demonstrated the feasibility of improving the reliability of the optical fibers through structural integration with the airframe. F&S proposes to continue this work during the Phase II portion of the project and develop both embedded and attached alternatives of a specially designed optical cable system. This cable system will greatly improve the survivability of the optical fiber thereby increasing the usefulness of optical fiber communication systems for aircraft.

FIBER AND SENSOR TECHNOLOGIES
P.O. BOX 11704
BLACKSBURG, VA 24062
Phone: (703) 382-7556

Topic#: 92-179
Office: WL9
Contract #: F33657-93-C-2300
PI: Tuan Tran

ID#: 92WL9-034

Title: High Temperature Measurement Using Sapphire Optical Fiber Sensors for NASP Material Tests

Abstract: The measurement of strain and crack opening displacement at high temperature on candidate NASP materials is required in order to monitor material response under simulated operational conditions and to design efficient hot aerospace structures. During the Phase I SBIR project, Fiber & Sensor Technologies, Inc (F&S) demonstrated the first sapphire sensor for strain measurement and high-cycle fatigue loading on a silicon carbide host at temperatures approaching 3000 degrees F. In the Phase II program, F&S proposes to develop a complete optical fiber sensing system for making absolute strain measurements at high temperature in real time, and a high-temperature extensometer for measuring crack open displacements. F&S has outlined technical objectives for continued research during a Phase II effort and also has discussed the commercialization prospects for optical fiber sensors which may, in the future, become fully integrated with control instrumentation for the structural control and health monitoring of large-scale military structures.

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

Topic#: 91-054
Office: AL1
Contract #: F08635-94-C-0002
PI: DR HARRIS GOLD

ID#: 91CEL-046

Title: Anoxic Air Stripping of Groundwater for Iron Control

Abstract: Air stripping followed by stripper off-gas purification is extensively used as a means of remediating contaminated groundwater. Ferrous iron, commonly found in groundwater, oxidizes in the stripper and fouls the packing, reducing air flow rates and treatment efficiency and causing extensive downtime and maintenance. The Phase I program conclusively demonstrated on a laboratory-scale that stripping with an anoxic gas that is rich in CO2 inhibits iron oxidation. The anoxic gas is produced as a result of improving the efficiency of stripper off-gas purification and is supplied at practically zero cost. The primary objective of the Phase II program is to confirm the feasibility of the process by a field demonstration on a pilot-scale system. Hanscom AFB (Bedford, MA) has been tentatively selected as the test site. Secondary objectives include additional laboratory testing to extend the limited data base obtained in Phase I to a wide range of freewater compositions and to determine if pH adjustment is required with alkaline waters. A comparison of the cost of anoxic stripping with conventional methods of iron control will also be carried out.

FOSTER-MILLER, INC.
350 SECOND AVE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 92-075 ID#: 92PL3-043
Office: PL3
Contract #: F04611-93-C-0175
PI: Marvin Guiles
Title: LCP Cryotank System Development and Testing
Abstract: Current manufacturing technology and state-of-the-art materials used in space-based cryogenic storage systems result in excessive loss and system weight. Replacing these current materials with high specific strength, low thermal conductivity and low permeability liquid crystal polymers will provide major thermal and weight saving benefits to future cryogenic systems. Design analysis from our successful Phase I program demonstrated that an LCP cryotank system will provide at least a 70% reduction in heat loss and a 60% reduction in dry system weight when compared to a conventional system. Also demonstrated in the Phase I program is a key enabling manufacturing technology for forming seamless LCP liners in an innovative blow molding process. Foster-Miller has assembled a strong team to move the technology demonstrated in the Phase I program into a prototype cryogenic system to verify the impressive thermal performance gains and weight reduction predicted in the Phase I design analysis. The team includes Arde, Inc., a recognized leader in design and fabrication of state-of-the-art cryogenic systems and McDonnell Douglas Space Systems Company, a leading integrator of these subsystems into advanced space systems. Both of these organizations will assist Foster-Miller in the design, fabrication, and testing of this system. This industry involvement during Phase II will provide the cornerstone for Phase III commercialization.

FOSTER-MILLER, INC.
350 SECOND AVE
WALTHAM, MA 02154
Phone: (617) 890-3200
Topic#: 92-077 ID#: 92PL3-054
Office: PL3
Contract #: F04611-93-C-0160
PI: JOHN J. GLASSNER, Sc.D.
Title: Innovative Resin Transfer Molding Techniques
Abstract: This proposal addresses development of a revolutionary new approach for producing continuous fiber reinforced composites using advanced thermoplastic matrix resins such as liquid crystalline polymers (LCPs). It builds upon the results of a Phase I SBIR effort in which the feasibility of an innovative processing technology for impregnating braided graphite preforms was demonstrated. This method is one of the few truly novel methods for processing continuous fiber-reinforced composites to be developed in years. The proposed process eliminates problems associated with high viscosity flow and movement of fibers within the preform which are normally associated with processing of thermoplastic polymers, and has the potential to simplify the process of preform infiltration and improve composite uniformity for a wide range of component geometries. It allows the use of net shape preforms, thereby reducing the number of subsequent processing operations which must be performed. Simultaneously, it expands the range of matrix resins which can be employed to those having high strength combined with high thermal and chemical stability. As an added bonus, the approach employed is sufficiently general to allow its use with a variety of continuously-reinforced Air Force components and geometries including bodies of revolution and thin plates as well as nonsymmetric design configurations.

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Topic#: 92-098 ID#: 92PL6-034
Office: PL6
Contract #: F29601-94-C-0008
PI: David H. Walker
Title: The Use of Alternative Refrigerants for Missile Guidance Cooling Systems
Abstract: In response to the concern over the depletion of the stratospheric ozone, the U.S. Air Force has begun a phase out of halogenated hydrocarbons. Of particular importance are the refrigerants now used for cooling in strategic systems, such as the guidance systems of intercontinental ballistic missiles. The replacement of the refrigerant in the application is more difficult because both ground and in-flight components are affected. The purpose of the Phase I of this project was to examine drop-in and near-drop-in refrigerants and determine the necessary changes and modifications that must be made to the present guidance cooling systems for their implementation. Cooling tests showed that the HFC-134a produced a higher transient cooling rate than the CFC-12, indicating that adequate cooling could be produced if guidance systems were converted for its use. A difference in pressure-temperature characteristics were noted between the two refrigerants. To compensate for this, a small amount of a second HFC refrigerant was added to the HFC-134a to produce a refrigerant blend. Several compositions were examined and an exact match with CFC-12 was found. This refrigerant blend could conceivably be used as a "drop-in" replacement for

CFC-12. Further investigation of the HFC refrigerant blend in Phase II is warranted, since the use of this refrigerant could minimize the amount of hardware change required for a refrigerant conversion. Considerable concern has also been expressed about the new synthetic polyester (POE) oils used with the HFC refrigerants. Questions have been raised about the compatibility of these oils with existing guidance system components. The approach suggested here is an extended life test of the compressor and major components such as system hoses, valves, orifices, etc., which will investigate a number of candidate oils with HFC-134a and the HFC refrigerant blend.

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Topic#: 91-133 ID#: 91WL6-070
Office: WL6
Contract #: F33615-93-C-2370
PI: GLENN FREITAS

Title: Automated Formation of Net-shape Multidirectional Fiber Preforms for Advanced Turbine Engine Applications

Abstract: In the Phase I program, Foster-Miller demonstrated a hybrid braiding process to produce 3-D, net-shape, integrally bladed fiber preforms for high temperature composite turbine components. Compared to current state-of-the-art preform processes, this new approach offers numerous performance and cost advantages. From a performance standpoint, the Foster-Miller design includes continuous +0./-0./0. fibers in blades that are integrally woven into an individually tailorable hub fiber architecture. These features allow the engine designer to employ more aerodynamically efficient rotor designs than are achievable with current composite materials. Regarding cost, the Foster-Miller preform process can be highly automated, with the attendant reduction in labor hours, by integrating standard textile machinery on a common synchronized bed. Furthermore, because the preforms are near net-shape, further cost savings may be realized through a reduction in secondary machining operations. The Phase II program seeks to develop semi-automated textile machinery to produce turbine rotor preforms. To ensure that the program is relevant to Air Force requirements, the development effort will be focused on a specific component, i.e., a WR24-7 C/SiC rotor. We will validate our process using the ultimate proof-of-concept, a live engine test in a WR24-7 test engine. Foster-Miller has assembled a strong program team. Our textile/composite expertise will be supported by the engine and testing experience of Williams International, and the preform densification know-how of Ceramic Composites, Inc. We have received written support from Pratt & Whitney and Textile Products, Inc., ensuring that commercialization and potential "dual-use" applications of the textile technology are addressed.

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Topic#: 92-032 ID#: 92ES2-072
Office: ES2
Contract #: F19628-93-C-0179
PI: Edward P. Jordan

Title: CTAPS Imbedded Rraining (ESD)

Abstract: USAF is introducing the Contingency Tactical Air Control System Automated Planning System (CTAPS), a hardware/software environment to modernize command and control. Designed as an operational system, CTAPS currently does not have training programs built in. For exercising the system and training personnel in its effective employment, wargame-style simulations are needed to prompt CTAPS. Such training is now supported primarily by Blue Flag, at the rate of one exercise per year, per Air Operations Center (AOC), using the AWSIMS air-war simulation model, linked to the TEXIS ground-war model and other models. The AOCs need an autonomous capability for more frequent training to supplement Blue Flag, which itself needs automation in employing CTAPS/AWSIMS for more efficient, less manpower-intensive operations. This Phase II effort will provide prototypes of two CTAPS software modules for Blue Flag: 1) an interface to translate between the CTAPS data bases and the AWSIMS/TEXIS files; and, 2) an exercise controller to initialize the exercise scenario in CTAPS and AWSIMS, to make "Red" and "White" team inputs during the exercise, and to generate graphs, etc., for debriefings. A CTAPS Training Development Roadmap for planning and programming Phase III and related work will also be prepared in Phase II. Phase III will include validation, certification of the Phase II prototype product for incorporation in the operational CTAPS environment, then expansion to other TACS elements and evolution through incorporation of "semiautomated forces" controls and advanced wargame simulations.

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Topic#: 92-125 ID#: 92WL5-003
Office: WL5
Contract #: F33615-93-C-5374
PI: Paul Juneau
Title: Advanced Heat Shield Materials
Abstract: This proposal describes the efforts required to study the effects of various materials on the reduction of electronic interface in the plasma of a re-entry vehicle heat shield. A fundamental understanding of the mechanism by means of which these materials achieve a reduction in electronic interference is the goal of the proposed investigations, in which the GSI Flame Test Apparatus is used to determine initial characteristics, followed by an elucidation of mechanisms of material behavior at elevated temperatures.

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Topic#: 92-029 ID#: 92AL -091
Office: AL
Contract #: F41624-93-C-5015
PI: Dr Thomas T Chen
Title: Re-usable Instructional Strategy Templates for Highly-effici nt Computer Based Training Development and Delivery
Abstract: Global proposes to create an authoring system that will significantly reduce courseware development time and increase the potential for more effective training. The system will include instructional strategy templates that will be reusable by subject matter experts who are not instructional designers and instructional designers who are not programmers. During Phase I of this investigation, Global determined the feasibility of selecting, validating and implementing instructional strategy templates within a full-featured, programmerless authoring environment. Based on a study of existing courseware, Global identified lesson segments that are instructionally sound, labor intensive to code, and useful across many domains. A test case determined that a strategy that currently takes an experienced author 25 hours to code could be authored in only 15 minutes. During Phase II, Global will determine groups of the most useful strategies to design and implement based on analyses of instructional objectives, existing courseware from various domains, and upcoming military development requirements. The strategies will be implemented, tested, and optimized. A common strategy authoring approach will be analyzed and a prototype will be developed. A prototype method for strategy selection will be designed and implemented. Product documentation will be created, and the entire system will under go controlled testing.

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Topic#: 92-079 ID#: 92PL3-064
Office: PL3
Contract #: F04611-93-C-0161
PI: Dr. Alan S. Hersh
Title: Development of Flightweight, Compact, High Intensity Sound Source
Abstract: A research program is proposed to design and construct a high intensity, rugged, flightweight, compact sound source capable of generating broadband sound at ambient pressures as high as 2,000 psi which when coupled with a nonlinear control system offers the potential to 1) improve liquid rocket engine stability via appropriate phase and amplitude coupling with combustion generated noise and 2) significantly improve combustion efficiency. An acoustically driven high pressure spray combustion chamber will be designed and constructed. The facility will be used to provide fundamental information concerning the effect of intense sound upon the following important spray properties: size distribution, spread angles, mass flux distributions and spatial drop size distributions. Flow field characterization experiments will be conducted to map the acoustic particle velocity field within the spray combustion chamber as a function of resonant excited mode. The flow visualization survey will provide critically important information about the interaction of droplet sprays with the steady state streaming flow generated from the intense, nonlinear sound fields.

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Topic#: 92-044 ID#: 92ES3-059
Office: ES3
Contract #:
PI: William R. Caid
Title: ICARS: Image Content Addressable Retrieval System

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Abstract: During Phase I of the Automated Librarian System SBIR, HNC developed and demonstrated a technique for automated indexing and retrieval of free text. This technique, also chosen by DARPA as part of the TIPSTER text detection program, is based on the concept of "context vectors" which encode a partial representation of the associated text. This proposal describes the extension of this context vector approach to images. Unlike text, no automated cataloging and retrieval system exists for image databases. The context vector algorithms demonstrated as part of Phase I of the Automated Librarian System will be extended to process unlabeled imagery. HNC proposes to use affine "wavelet" transformations to define a set of image primitives. Wavelets provide a robust set of features that characterize local spatial frequency content and orientation. These primitives, when processed, will comprise a "vocabulary" of image features (atoms). This atomic vocabulary will be used to represent images within ICARS and has a direct analogy to text-based systems. As such, most of the existing algorithms can be utilized as the basis for extensions. This context vector approach is independent of the specific image features used and can be up-graded if different features are desired or developed. When complete, ICARS will be able to: 1) Provide content addressability of images based on similarity of content. 2) Retrieve images using text, partial or full images as queries without the requirement to perform object recognition. 3) Highlight portions of retrieved images that most closely correspond to user queries. 4) Assign index terms to unlabeled images based upon similarity of content to a training set of images and associated index terms.

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Topic#: 92-152
Office: XRX
Contract #: F33657-94-C
PI: Robert Hecht-Nielsen

ID#: 92XRX-071

Title: Multifusion: A New Approach to Mobile Target Identification

Abstract: In an age of proliferating ATR system elements (sensors, target detectors, target classifiers, target identifiers, etc.), a tool set for constructing universal, easily reconfigurable, target identification back ends that can combine the information produced by other ATR elements for final output to the platform mission management system is needed. This project is developing such a multisubsystem fusion tool set. The elements developed in Phase I include a new algorithm for fusing multisensor images, a method of identifying redundant and wasted features in a feature set used for target classification, and a new computationally efficient reasoning network. In Phase II of the project these will be extended to a multisensor image registration module, a special feature extractor (for mid-level features such as wheel-like objects and gun barrel-like objects), and a reasoning network with increased classifier output likelihood information handling. An optional demonstration system will, if built, bring all of these tools together in an integrated multisensor ATR system.

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Topic#: 92-010
Office: WL4A
Contract #:
PI: Eugene L. Anderson

ID#: 92CEL-094

Title: Masking Hardened Aircraft Shelter Door Radar and Infrared Signatures

Abstract: Horizons Technology, Inc. proposes to build upon the research accomplished in Phase I which demonstrated the feasibility of reducing the Radar Cross Section (RCS) and Infrared (IR) Signatures of the steel framework supporting 3rd Generation Aircraft Shelter Doors. This reduction is accomplished by wrapping the steel in a Radar Absorber Material (RAM) modified to provide IR signature reduction through insulation and isolation of the members. In Phase II, an extensive testing program in both radar and IR spectrums will serve to verify the concept. Test results will also be used to validate the software models used in Phase I in place of full-scale testing. Testing will be conducted on components, assemblies, and using scalar modeling test facilities. Phase II will review classified background data, test system concepts and, with data analysis, recommend a system design and a Phase III Test Plan. Phase III will provide full field fabrication, real time testing using fixed and mobile sensors and validate the design for production.

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Topic#: 92-048
Office: ES3
Contract #: F19629-94-C-0014
PI: Dr Elie Track

ID#: 92ES3-102

Title: Integrated High Performance Superconducting RSFQ A/D Converters for Digital Beam Forming Applications
Abstract: HYPRES is pleased to propose in this phase II the implementation of a complete integrated high resolution ADC. Phase I has successfully attained its goal of demonstrating the key components of a new class of high performance superconducting A/D converters (ADCs). A multibit front end has been demonstrated operating at internal clock frequencies as high as 10 GHz. All the required elements for digital signal processing have been designed and successfully simulated, including full adders, full accumulators, a clock controller cell, and an output buffer cell with fast high-output voltage drivers. This superconducting ADC will achieve 17.1 effective bits at 100 MS/s and has virtually infinite static accuracy since it is based on flux quantization. By maintaining a unique bandwidth-to-accuracy trade-off ratio of 1.5 effective bits per octave, the same ADC will be capable of producing 12.2 effective bits at 1 GS/s. This approach is superior to the sigma-delta method and produces a performance not achievable with any other technology. This performance is obtained with the use of an ultrafast decimation filter based on recently developed RSFQ logic elements. All the signal processing will be implemented monolithically with the ADC front end, offering the user a single IC chip ADC that will perform all the required digitization functions as a "black box". The ADC will have both small area (10 mm2/ADC) and ultra-low power dissipation (less than 3 mW/ADC), allowing the implementation of a large number of channels on a single chip. HYPRES has already produced a prototype of a fast flashtype ADC, based on a different approach involving R-2R ladders and superconducting comparators, which is capable of 4.4 effective bits of resolution at 4 GHz input bandwidth. This prototype is currently being demonstrated to potential radar systems customers, including Loral and E-Systems. This proposed program will lead to a similar prototype of a high resolution ADC.

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Topic#: 91-034 ID#: 91ROM-028
Office: ES3
Contract #: F30602-93-C-0174
PI: Kurt Matis
Title: Efficient Network Models
Abstract: In the Phase I effort of "Efficient Network Models", we have developed a detailed design for a new class of network simulation tool that provides comprehensive capabilities and is portable across many machines, including PC's. In the phase II effort, we propose to implement this design. Our proposed design employs the most recently developed DOS extender and windows-oriented graphical user-interface technology to provide a full-featured simulator on a low-cost IBM-PC workstation for the first time. The new technical features of our proposed design provide the network designer with additional flexibility, ease-of-use and run-time efficiency over competing approaches. A novel feature of our proposed design is the ability to model communication networks at a variable level of detail, even within the same simulation. The proposed tool employs an object-oriented design methodology to model layered network architectures in an integral fashion with their protocols. The simulator is designed to support the OSI layered architecture and general layered network architectures. The specific application target of our proposed design is the class of networks operating in stressed environments, subject to jamming of links, failures of nodes, etc. The simulator is expected to find wide application to military and commercial network problems.

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Topic#: 92-012 ID#: 92CEL-127
Office: WL4A
Contract #:
PI: LEONARD S. HAYNES
Title: Vehicle Navigation Using 3D Camera
Abstract: An autonomous Airfield Repair Vehicle (ARV) will need to be able to navigate through an area to perform repair operations on runways and taxiways. In order to simplify use, it is imperative that only the onboard sensors and memory resident topographical map be used for this navigation. Intelligent Automation, Incorporated has developed the concept for a three dimensional camera which will give a full-range map of the scene as seen by the camera at a rate of 60 frames per second. Our initial experiments show that we will be able to obtain an accuracy of less than 1 inch over a range of 100 feet from the camera, which is far better than the 1/2 foot requirement of the ARV. The full, accurate range image produced at 60 frames per second make the problem of navigating based on a topographical map a straightforward application of image matching algorithms. Under Phase I SBIR funding, we demonstrated analytically and experimentally that the Fast 3D Imaging Camera can be fabricated, that it could function to ranges well beyond what is required for the Airfield Repair Vehicle, and that it could operate under any normal outdoor ambient light conditions.

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Topic#: 92-090 ID#: 92PL6-084
Office: PL6
Contract #: F29601-94-C-0011
PI: Dr. Fariborz Maseeh
Title: Innovative Guidance & Navigation Sensors and Processing
Abstract: A self-contained navigation instrument, such as an inertial navigation system, is the most reliable positioning system available for air and ground vehicles today. Future vehicle designs are demanding high-accuracy positioning instrumentation which are smaller and less expensive. The objective of this multi-phase program is to develop and commercialize a miniature, light-weight, inexpensive multi-sensor based navigation system. In Phase I, a feasibility study was performed which demonstrated the viability of developing a miniature navigation system using the micromachining technology today. In Phase II, this system will be developed and tested and in Phase III it will be commercially manufactured by establishing strategic alliances with other companies. The resulting micromachined navigation system will be several times lighter, less expensive, and smaller than any existing navigation system with similar performance characteristics. When commercialized, a low-cost, self-contained navigation and positioning system--made possible with microsensors--will find applications both to replace current technology and to make possible new applications where current technology is prohibitively expensive. This is the case for many military (navigation of air vehicles), avionics (navigation and aircraft stabilization), biomedical (pacemakers) and commercial (robotics, automotive, consumer) applications.

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Topic#: 92-069 ID#: 92PL1-073
Office: PL1
Contract #: F29601-93-C-0206
PI: Michael S. Walker
Title: Shielded High Temperature Superconductor Interconnect Technology for Packaging High Speed Cryoelectronic Systems
Abstract: The development of HTS-based MCM interconnects for semiconductor chip packaging has been hindered by the lack of a low dielectric constant material which is appropriate for the growth of epitaxial HTS multilayers. In Phase I we solved this key problem by (a) devising a novel interconnect package architecture composed of multilayered HTS and compatible insulators providing required performance without necessitating major breakthroughs in existing HTS materials technology and (b) confirming material and process compatibility using MOCVD, the industrial technique of choice. Our Phase II objectives are to exploit our design to construct a 9 chip HTS MCM interconnect package to demonstrate 400 MHz operation at 77K, and operate as a 400 MHz cryogenic digital signal processor by employing two CMOS gate array chips cooled by forced-flow liquid nitrogen through microgroove channels. IGC will design and construct this MCM with The Center for Integrated Electronics at RPI and the State of NY Center for Advanced Technology in Thin Films and Coatings at Albany, which have worked jointly to develop new interconnect technologies through the Sematech's NY Center of Excellence in Multilevel Metallization. IGC's APD Cryogenics subsidiary with U. of Pa. will use experience in microgroove cooling to build and test the refrigeration package for 450 Watts heat removal. All manufacturing techniques, associated tools, and package characteristics will fit within the guidelines of the Semiconductor Industry Association and Sematech Packaging Metrology.

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Topic#: 89-090 ID#: 32841
Office: WL2
Contract #: F33615-93-C-1335
PI: DAVID E LUDWIG
Title: Multimode Optical Search and Track (MOST)
Abstract: In the Phase I SBIR program, Irvine Sensors Corporation (ISC) addressed the goal of protecting an aircraft from missile threats and unfriendly aircraft by warning crews early enough to counter the threat. ISC postulated a system which merged the real time programmability of the Z-technology focal plane with the clutter rejection capability of continuous spatial and temporal filtering known as Dynamic Stare. In the planned Phase II program ISC will study and develop two important aspects of the continuous dual mode (threat warning and IRST) system. ISC will develop the on focal plane electronics which will validate the hyperpixel concept, i.e. electronically combining pixel information on the focal plane to provide high frame rate coarse resolution and low frame rate fine resolution information from the same sensor. ISC will also refine the performance prediction of the Dynamic Stare by performing a high spatial and temporal resolution simulation of such a sensor operating in a flight environment. These tasks will lead to a detailed specification for a hardware flight sensor.

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Topic#: 91-247 ID#: 91SDC-202
Office: PL1
Contract #: F29601-93-C-0157
PI: Raphael Some
Title: Multi-mode N-Modular Redundant (Fault Tolerant) Computer
Abstract: The proposed innovation is a technique for 3D stacking of heterogeneous sets of ICs such as would be required to implement a complete system or complex subsystem in a cube. With this technology, systems such as missile seekers or signal/data processors including microprocessors, memory, "glue logic," custom SICSs and hybrid/analog ICs can be combined into a single integrated quasi-monolithic structure of approximately 8 cubic centimeters. In addition to the volumetric efficiency gain, this approach also results in weight, power, reliability and cost improvements of up to one to two orders of magnitude over conventional packaging approaches and is extremely rugged and environmentally robust. Significant performance en ments deriving from the close spacing of the ICs and the resultant lowering of line capacitances are a prime benefit of this ogy. Beyond the basic Quasi-Monolithic Stack (QMS), a unique and innovative multi-QMS structure providing i arity, repairability, and next level mechanical, thermal, and electrical interface is defined. The modular approach allows the design of common electronic modules which can then be "plugged together," by the system designer, to configure extremely dense high throughput systems for space, military, or commercial systems where power, weight and volume are at a premium.

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Topic#: 92-149 ID#: 92WL7-013
Office: WL4
Contract #: F33615-93-C-3804
PI: Larry Lafferty
Title: Development of Descriptive Methods for Verification and Validation Testing of Associate Systems
Abstract: As software has increased in complexity, and particularly with the introduction of manned systems with behavior as complex as that of associate systems, the conventional approaches to testing have been unable to meet the needs of either the design community or the operational community. Not only are test costs staggering, but test reliability is low, leaving higher costs in the form of degraded operations, training, and maintenance once complex systems are in the field. This proposal describes a powerful alternative to statistical testing that is only now practical because of steady progress in machine intelligence and low cost computing power. This approach, Descriptive Testing, has the potential to shorten test time and increase test reliability for complex, manned systems. During the Phase I portion of this effort, the theoretical framework for descriptive testing was developed and the methodology was demonstrated using a set of test log data from the Pilot's Associate program. The proposed effort involves development and field testing of a Descriptive Test Tool that puts the principle of this innovative testing approach into practice. The Phase II tasks will serve as a foundation for integration of the test tool with off-the-shelf CASE tools and product development during a Phase III program.

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Topic#: 91-243 ID#: 91SDC-176
Office: WL3
Contract #: F33615-93-C-1297
PI: Blaine Johs
Title: Electron Cyclotron Resonance (ECR) Semiconductor Etching Process Control by Ellipsometry
Abstract: The need for smaller semiconductor device structures for use in very high speed microelectronics requires a new generation of plasma etching technology. ECR promises to provide features as small as 0.2 microns in size, as well as a high degree of etching anisotropy, selectivity, etch rates, and low damage. For manufacturing process control involving ECR etching in production of electronics and opto-electronics on silicon and compound semiconductors, a considerable amount of further research and development is needed. Spectroscopic ellipsometry uses polarized light reflectance, and has sensitivity to surface and interface effects a fraction of an atomic monolayer thick. Thus surface damage, surface roughness, and surface compound/alloy stoichiometry can be determined. We recently developed the ability to convert ellipsometric psi and delta data in real time into desired materials properties such as thickness, alloy ratio, surface temperature during semiconductor crystal growth. The purpose of the proposed Phase II research is to implement control of ECR etching processing using spectroscopic ellipsometry. Control of ECR etching of Si, GaAs, InP, InGaAs, and HgCdTe semiconductor materials, as well as aluminum and its oxide, will be implemented. One final aspect of this contract is the follow-on Phase III commercialization. To better understand the real industrial environment and needs, we will carry out demonstration-type experiments at Texas Instruments

Inc.'s facilities in Dallas towards the end of the Phase II work.

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Topic#: 91-220 ID#: 91WL7-001
Office: WL7
Contract #: F33615-94-C-4405
PI:

Title: Substitution of Liquid CO2 Aerosols for CFC-113 in Cleaning of Precision Surfaces and Microelectronics

Abstract: A 24 month, Phase II Small Business Innovative Research (SBIR) program is proposed to conduct developmental work on a novel, patented process which substitutes high velocity sprays of liquid carbon dioxide for conventional chlorofluorocarbon (CFC) solvents. Under a completed Phase I project, the basic principles have been demonstrated as effective, using high purity liquid carbon dioxide sprays accelerated by high pressure, dry, filtered air. Test coupons of polished silicon wafers were used, with particulate contamination and finger prints as materials to be removed. In additional to proof-of-principle accomplishments, Emadel Enterprises, Inc. has acquired exclusive, worldwide rights to the patented core technology covered in U.S. Patents 4,832,753 and 4,936,922, and has also acquired a $100,000 cleaning system based on the core technology, but using CFC solvent. The latter acquisition is part of a partnership with Siltec Silicon, which will supply technical cooperation in Phase II and business assistance in Phase III. In Phase II, the proved liquid carbon dioxide spray technology will be combined with the existing, commercial quality Class I glovebox system as a test bed to screen commercial applications of the new technology as a CFC replacement, beginning with electronic applications of importance to the U.S. Department of Defense.

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Topic#: 92-128 ID#: 92WL5-228
Office: WL5
Contract #: F33615-93-C-5386
PI: Ray J. King

Title: Nondestructive Evaluation of Moisture in Composites Using Microwaves

Abstract: The broad objective of this exploratory research is to demonstrate the feasibility of using innovative microwave sensors to nondestructively evaluate and monitor moisture which has diffused into nonconducting fiber reinforced cured composite structures and matrix prepregs. In cured composites, moisture causes the matrix to swell and soften with a subsequent loss of stiffness and strength. It induces residual swelling strains and microcracking, and irreversibly degrades the fiber/matrix interface. In repair, moisture diffuses into the repair adhesive to cause deterioration and blistering. In uncured prepregs, moisture slows the formation of the polymer network and increases the viscosity and void content. Preliminary microwave tests have shown that diffused moisture has a pronounced effect on the macroscopic dielectric properties of composites. Using an innovative sensor design, the bulk effects of both the real dielectric constant and the loss factor have been shown to provide two independent effects of diffused moisture. From such independent measurements, it appears possible to quantify the cumulative moisture and to even make some assessment of the moisture in the boundary layer which often occurs following transient exposure and drying cycles. Specific tasks focus on sensor design, their optimization and use, monitoring moisture diffusion into cured composites and prepregs, and modeling of the diffusion process for correlation of moisture profiles with the microwave measurements.

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Topic#: 92-101 ID#: 92WL2-025
Office: WL2
Contract #: F33615-93-C-1322
PI: Dr. Robert Fung

Title: Decision-Theoretic Approaches to Sensor Management

Abstract: Sensor management is a key problem for the Department of Defense. New sensors, harder-to-detect platforms, and threats are increasing the need to effectively and rapidly collect and exploit sensor data so that the best actions can be taken. However, the complexity of streams of real-world sensor data and scenarios has challenged efforts to automate the control of sensors. The project will employ decision-theoretic principles to design and implement an architecture for sensor management. We call this framework Decision-Theoretic Sensor Management (DTSM). The architecture is: mathematically sound, comprehensive, and computationally tractable. Our primary objectives in the project are to: perform a detailed design of the DTSM framework, apply the framework to a particular mission (e.g., offensive counter air), and evaluate the resulting sensor

manager with respect to clear measures of performance through simulation.

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Topic#: 92-129 ID#: 92WL5-136
Office: WL5
Contract #: F33615-93-C-5382
PI: Dr. M.B. Spitzer
Title: Feasibility of GaInP/GaAs Quantum Well IR Detectors
Abstract: This proposal addresses the Nation's need for improved infra-red detectors and detector arrays. In Phase I, we proposed to investigate the feasibility of improving multi-quantum well AlGaAs/GaAs superlattice detectors, by replacing the AlGaAs by GaInP. The greater band gap discontinuities in the GaInP/GaAs system, as well as the absence of Al, may yield enhanced performance. Phase I work was limited to establishing the basic feasibility of the approach. In Phase II of this work, superlattice detectors will be formed and evaluated. Phase III comprises commercialization of the technology.

KTAADN, INC.
1340 CENTRE STREET, SUITE 202
NEWTON, MA 02159
Phone: (617) 527-0054
Topic#: 89-031 ID#: 93ES3-231
Office: ES3
Contract #: F30602-94-C-0010
PI: Ilya Schiller
Title: RL Aircraft Radar Evaluator (RARE)
Abstract: Rome Lab Aircraft Radar Evaluator (RARE) is a long-range noncooperative target identification (NCTI) method using a conventional narrow-band, track-while-scan radar operating in S-band frequency that can be adapted to the multi-frequency and multi-target environment. RARE has the potential to be a long-range NCTI technique which requires no modification to current narrow-band surveillance radars. The radar returns are converted to RCS vs. the target's aspect angle. The observed fragmented target's RCS is matched with the RCS data library best representative to estimate the target's identification and uncertainty. The identification is performed with a neural net classifier or linear estimator. A neural network approach may produce faster results. The linear discriminant method will be used for benchmarking and comparison with neural net method. The tasks addressed in this Phase: (1) theoretical work to provide neural net and linear discriminant target identification, (2) the near real-time real-target identification at Rome Laboratory radar, (3) development of extensive data library for RARE classification, (4) system architecture study to provide solid engineering basis for building fieldable RARE brassboard prototype for development and installation with TPS-75 or other surveillance radars in Phase III.

LASER POWER CORP.
12777 HIGH BLUFF DR.
SAN DIEGO, CA 92130
Phone: (619) 755-0700
Topic#: 90-003 ID#: 90PL1-555
Office: PL1
Contract #: F29601-93-C-0116
PI: GRAHAM W. FLINT
Title: Classification of Non-Resolved Orbital Debris (CONROD)
Abstract: Despite the aberration-free nature of space, conventional imaging of small objects at extreme ranges requires large telescope apertures. However, a recent in-house study has led to a non-conventional imaging concept whereby the geometric properties of isolated, but non-resolved, objects can be determined via telescopes of substantially lesser size. We refer to this concept as Classification of Non-Resolved Orbital Debris (CONROD). Our research shows that object shape and orientation can be established for objects which encompass angles substantially less than D, where D is the telescope diameter. In the context of 1-meter telescopes, we find it possible to characterize objects having overall dimensions of 25-30cm at standoff ranges in excess of 1,00 km. Conventional techniques would require telescope apertures greater than 20 meters for such characterization. Within the scope of our proposed Phase II program, we intend to refine the theory of sub/D imaging and using existing in-house image profiling instruments, to perform experiments which will validate all key aspects of the concept and will demonstrate sub/D imaging in near real-time.

LIGHTWAVE ELECTRONICS CORP.
1161 SAN ANTONIO ROAD
MOUNTAIN VIEW, CA 94043
Topic#: 92-103 ID#: 92WL2-038
Office: WL2
Contract #: F33615-93-C-1302

(118)

Phone: (415) 962-0755 PI: Dr. D.C. Gerstenberger
Title: High Power Single-frequency Pump Source for 1.5um to 5um Optical Parametric Oscillators
Abstract: This program will develop a high power single-frequency 1064nm laser source suitable for pumping optical parametric oscillators (OPOs) in the 1.5 to 5um spectral range. The diode-pumped source will be used to test OPOs using potassium titanyl phosphate (KTP) and other nonlinear crystals. The laser system will consist of single-frequency 1064nm Nd:YAG master oscillator, a high-power diode-laser pump module and an Nd:YAG multipass amplifier. The single-frequency output from the amplifier can be easily tailored from 4 watts cw to 500 watt peak 1 usec long pulses.

LIGHTWAVE ELECTRONICS CORP. Topic#: 91-118 ID#: 9120204
1161 SAN ANTONIO ROAD Office: WL3
MOUNTAIN VIEW, CA 94043 Contract #: F33615-93-C-1303
Phone: (415) 962-0755 PI: Dr. D.C. Gerstenberger
Title: Research and Development of Periodically-poled Lithium Niobate as a Mid-infrared Optical Parametric Oscillator Driven by a 2um Laser
Abstract: This research project will investigate compact and efficient tunable solid-state laser sources in the 3-5 um spectral region based on optical parametric oscillators (OPOs) pumped by diode-laser-pumped single-frequency 2 um lasers. The use of diode laser pump sources for coherent sources in this spectral range provides for highly efficient, compact and long-lived devices. The two-part Phase II program will continue research and development of periodically-poled lithium niobate (PPLN) as the nonlinear material, build and test OPOs using PPLN and develop an OPO system using a diode-pumped 15 Watt Tm:YAG laser to pump the OPO.

LOGOS, INC. Topic#: 91-025 ID#: 91ES2-001
8 MACKINTOSH LN Office: ES2
LINCOLN, MA 01773 Contract #: F19628-93-C-0140
Phone: (617) 259-8266 PI: D. Johnson/J. Brodman
Title: Metric and Document Generation Model
Abstract: Phase I of this contract investigated the application of the Software Engineering Institute's (SEI) Capability Maturity Model (CMM) for software key practices of metric collection and document generation to small business. The Phase I research not only confirmed that the activities associated with these practices are problem areas for small business, as suspected, but also highlighted several other areas within the CMM which create implementation problems in a small business. Small businesses are frustrated in their attempts to implement process improvement programs because they do not have the resources that are required by the CMM to implement many of the process improvement practices as stated. Phase II efforts, therefore, will concentrate on tailoring the current CMM, or, if necessary, generating a new maturity model for small businesses. The effort will be expanded to include small organizations as well as small businesses. Small organizations tend to be separate cost centers and have small projects and, thus, were found in Phase I to face many of the same problems as small businesses in the implementation of their software improvement programs. Since the SEI products of Software Process Assessment training, Software Capability Evaluation training, and the Software Process Maturity Questionnaire are all based upon the CMM, the tailoring of these products to meet small business needs will be part of the Phase II effort. The results of the Phase II effort will provide small organizations with the tools necessary to build a successful software improvement program.

M-DOT, INC. Topic#: 92-141 ID#: 92WL6-030
3416 SOUTH 48TH STREET, SUITE 2 Office: WL6
PHOENIX, AZ 85040 Contract #: F33615-93-C-2349
Phone: (602) 921-4128 PI: John E. Harper
Title: Fabrication and testing of a Smart Actuator for Aircraft Turbine Engines
Abstract: M-DOT proposes to design, fabricate and test a high-temperature, "smart" guide-vane actuator suitable as a drop in replacement for the existing actuator on the GE/Allied Signal Joint Technology Advanced Gas Generator (JTAGG) Engine. This actuator will contain high-temperature electronics for sensing, motor drive and control loop closure. Assisting M-DOT in this program as consultants will be Allied Signal Aerospace Propulsion Engines, GE Aircraft Engines Division and the GE Corporate Research and Development Center. The actuator system will consist of speed sensor, position sensor, engine inlet temperature

sensor, electronics module, switched reluctance motor, gearbox with lead screw and electrical harness. During Phase II, JTAGG requirements will be examined and the actuator system will be designed, fabricated and bench tested. The final product would be available for testing on the JTAGG engine during CY 1995.

M.L. ENERGIA, INC.
P.O. BOX 1468
PRINCETON, NJ 08542
Phone: (609) 799-7970
Topic#: 92-005
Office: AEDC
Contract #:
PI: Dr. Moshe Lavid
ID#: 92AED-036

Title: Real-time Subsonic Flow Vector Measurement

Abstract: This is a Phase II proposal to further develop the RELIEF flow tagging optical diagnostic technique. The primary goal is to construct instrumentation specifically designed for the Arnold Engineering Development Center's 16T Transonic Wind Tunnel, and to demonstrate its performance. The RELIEF technique uses stimulated Raman scattering to vibrationally excite ordinary oxygen molecules within an air flow. The process effectively "tags" the flow with a pattern determined by the illumination optics. After a suitable time delay, during which time the tagged molecules convect downstream with the flow, their new position is "interrogated" via laser-induced fluorescence imaging. The measured displacement within the elapsed time interval represents a measure of the velocity. Phase I proof-of-concept experimental measurements, coupled with the results of modeling calculations, demonstrated the scalability of the technique to full size facilities over a wide range of Mach numbers and flow static conditions. The Phase II work will consist of assembling a complete, stand-alone measurement system, including required image acquisition and analysis, integration to the 16T Wind Tunnel, demonstration of capabilities, and on-site training of AEDC personnel.

MAINSTREAM ENGINEERING CORP.
200 YELLOW PLACE
ROCKLEDGE, FL 32955
Phone: (407) 631-3550
Topic#: 89-9-7
Office: WL6
Contract #: F33615-93-C-2358
PI: Robert P. Scaringe
ID#: 89WL6-013

Title: A Phase II Demonstration of an Innovative, Lightweight, Magnetic-bearing Centrifugal Compressor

Abstract: The intent of this Phase II effort is to demonstrate the benefits of an innovative, lightweight, lubrication-free compressor as part of the More-Electric-Aircraft Power System. The use of the jet engine as a source of bleed-air is becoming an increasing problem. Excessive bleed air lines on the engine significantly increases the difficulty of engine maintenance and repair, and the Air Force as well as commercial aircraft manufactures are seeking an alternative source for this compressed air. This Phase II effort will result in the design and demonstration of a non-contact, lightweight, magnetic-bearing centrifugal compressor as a replacement for engine-bleed air. The previous SDIO/SBIR Phase I effort and other related Mainstream/SatCon programs have resulted in the preliminary design of a long-life, high-reliability, high-performance, lightweight, magnetic-bearing centrifugal compressor. These previous efforts have included the testing and development of innovative compressor impellers and diffusers; and the design and demonstration of magnetic bearings and control electronics specifically designed for this compressor. This Phase II effort will result in the extensive ground testing of an innovative compressor for use in the All-Electric-Aircraft. This Phase II effort will result in the development of hardware that could be flight tested under a follow-on Air Force or commercial aircraft flight demonstration effort. Both commercial aircraft manufacturers and the U.S. Air Force have expressed interest in this project. In addition, Mainstream plans to pursue development of the compressor to satisfy numerous commercial applications and has already secured substantial follow-on commitments.

MARCHEM
P.O. BOX 6914
HOUSTON, TX 77265
Phone: (713) 523-8236
Topic#: 92-124
Office: WL5
Contract #: F33615-93-C-5383
PI: Alan Wesley Moorehead
ID#: 92WL5-148

Title: Direct Fluorination Technology: The Synthesis of Prefluoropolyalkylether Fluids Using Liquid Phase Direct Fluorination

Abstract: This proposal outlines research into the feasibility of the production of prefluoropolyalkylether fluids, with a variety of molecular structures, using the technique of dynamic flow direct fluorination in the liquid phase. This would involve the surface fluorination of rapid stirred (ca. 3500 r.p.m.), neat ether, and polyether liquids over a range of temperatures (-78 to 100 C). This represents a significant departure from the existing direct fluorination methods of prefluoropolyalkylether production

in that the starting material is not a solid, but a liquid. To accomplish this, a liquid phase reactor which will enable the rapid, even dispersal of elemental fluorine into the reaction mixture must be constructed. The products obtained in the subsequent experiments will be analyzed using spectroscopic methods and elemental analysis.

MATERIALS SCIENCES CORP.
500 OFFICE CENTER DRIVE, SUITE 250
FORT WASHINGTON, PA 19034
Phone: (215) 542-8400
Topic#: 91-164 ID#: 91MTL-027
Office: WL5
Contract #:
PI: Crystal H. Newton, PHD
Title: Metaknowledge for Polymer Matrix Composite Materials
Abstract: Composite material property data are often not available for all the properties needed for preliminary design, as an example. This "sparseness" of data can be alleviated by using models of material behavior to gain as much insight as possible from existing data. The inclusion of these predictive models in Metaknowledgebase capable of accessing external databases provides a tool for the composite material designer that eliminates searching for data through a variety of source materials and predicting missing properties with various models and software. The Metaknowledgebase will include an expert system, an object-oriented internal database, and tools for accessing external databases. Data validation will be incorporated into the knowledge management system rules. Data validation will be incorporated into the knowledge management system rules. Data quality and accuracy indicators will be used to predict quality and accuracy along with property values for the missing information. Other considerations for the Metaknowledgebase include the user interface and data transfer to and from other databases. User input will be obtained in designing the prototype full-scale system. The Metaknowledgebase system will be used to poll external databases for data for design and fabrication, apply rules to determine the best data set, and function as a consultive expert system. The proposed program will produce a full-scale metaknowledgebase that meets these requirements.

MDA ENGINEERING, INC.
500 E. BORDER STREET, SUITE 401
ARLINGTON, TX 76010
Phone: (981) 786-0666
Topic#: 92-157 ID#: 92WL0-027
Office: AD
Contract #: F08630-93-C-0074
PI: Ralph Noack
Title: An Efficient Hybrid Grid Scheme for Calculation of Viscous Flows
Abstract: An efficient hybrid grid scheme for use in obtaining viscous CFD solutions that utilizes structured meshes glued together by unstructured meshes is proposed for development. The hybrid method promises to combine the ease and low man-hour requirement for the generation of unstructured meshes with the efficiency of the viscous flow solver on structured meshes. Thus, the hybrid scheme will combine the advantages of the two meshes with minimal degradation in performance. The goal is to develop a balanced set of grid generation and flow solver codes which will reduce the person-hours required to generate the grid with only a modest increase in computer execution time for the flow solver. The proposed approach is to generate structured grids near the surface of the geometry and use unstructured grids to glue these structured grids together. Structured grids that overlap are automatically detected and trimmed to be non-overlapping. This approach will allow the flow solver to execute at optimal efficiency on the structured portion of the grid. The hybrid grid can be generated in a semi-automated fashion without requiring significant user expertise or time. This will allow the CFD analysis capability to be placed in the hands of engineers without requiring them to be CFD experts.

MEMRY TECHNOLOGIES, INC.
57 COMMERCE DRIVE
BROOKFIELD, CT 06804
Phone: (203) 740-7311
Topic#: 92-156 ID#: 92XRX-042
Office: XRX
Contract #: F33657-94-C-2105
PI: L. MacDonald Schetky
Title: Reusable Locknuts Using Shape Memory Alloy Inserts for Providing the Prevailing Torque
Abstract: Fastener improvement was identified in the Air Force Advisory Board's study of subsystem and component reliability needs, FACTS. Nylon insert locknuts cannot be reused with confidence and alternative insert materials are required. Phase I studies of polymeric and metallic insert materials demonstrated that shape memory alloys will provide the necessary prevailing and breakaway torque specified in MIL-N-25027-Amendment for 250 degrees F improved locknut, and prior Memry Technologies research provides data which clearly identified the Copper-Aluminum-Nickel system as the best insert candidate. The design of a shape memory alloy insert locknut system requires extremely careful measurement and control of thread

(121)

dimensions in order to assure that it meets performance goals over the entire range of ANSI thread tolerance. After choosing with ALC personnel a series of locknut sizes best suited to AF field trials and demonstrations, the design and testing of prototype locknuts will be carried out. This will include shape memory alloy optimization and the establishment of dimensional tolerance levels. Industrial applications will be identified for the Air Force locknut design or for a modified design for commercial demonstration.

METSAT, INC.
515 S. HOWES ST.
FORT COLLINS, CO 80521
Phone: (303) 221-5420

Topic#: 92-088 ID#: 93PL1-015
Office: PL4
Contract #: F19628-93-C-0197
PI: DONALD L. REINKE

Title: Production of a 1-Year, Hourly, 5 km, Global, Satellite-derived Cloud Climatology

Abstract: Clouds have been identified as one of the most significant deterrents to mission success for a wide range of Air Force systems and missions. In the Joint Chiefs of Staff report MJCS 154-86, clouds were identified as the highest priority atmospheric science research element. Additionally, the USAF/XOW No. 2 Geophysical Requirement is "improved cloud data handling and analysis". This Phase II proposal addresses both of these requirements. Past research by METSAT, Inc. has identified High-Resolution Satellite Cloud Climatologies (HRSCCs) as the optimum cloud cover product available today for meeting these requirements. Our Phase I work has supported these findings, and identified a technique for producing this unique and innovative product. In Phase II we will build a prototype global, hourly, 5 km HRSCC that will require special processing of over 300 gigabytes of digital imagery (over 70,000 satellite images). It will be produced at a higher spatial and temporal resolution than the current DoD cloud product, the USAF Real-Time NEPHanalysis (RTNEPH), using almost 2 orders of magnitude more data. More importantly, we will provide the DOD with a global cloud climatology that is more accurate and more reliable than previous global nephanalysis products from any other source.

MISSION RESEARCH CORP.
735 STATE STREET, P.O. DRAWER 719
SANTA BARBARA, CA 93102
Phone: (703) 339-6500

Topic#: 92-064 ID#: 92PL2-084
Office: PL2
Contract #: F29601-93-C-0182
PI: Dr. Richard Smith

Title: Diagnostic Tools for Characterizing EM Impulse Fields

Abstract: We propose to develop, demonstrate and deliver to Phillips Laboratory an electro-optic, ultra-wideband (UWB), radiated-field measurement system with measurement bandwidths to 20 GHz, sensitivity to radiated electric fields from ~1 V/m to >100 kV/m, and the ability to measure and acquire individual radiated-field waveforms either on a single shot basis or, in burst mode, at repetition rates >100 kHz. The system to be developed consists of minimally perturbing, small, mostly-dielectric, electro-optic field sensors, using a single fiber-optic signal cable, together with an all new, electro-optic acquisition and recording system which performs the function of a 20 GHz, single-shot and repetition rate oscilloscope. Secondary objectives include (1) delivery of a limited field-measurement capability early in the contract, (2) limitation of the size of the sensors to millimeter dimensions, and (3) delivery of a capability to measure fields inside UWB transmitters. In this proposal, we thoroughly discuss our approach and our Phase II work plan, give the reasons why our likelihood of success is very high, and discuss the considerable commercial potential of the new technology together with our strategy for commercializing this technology in Phase III.

MRJ, INC.
10455 WHITE GRANITE DRIVE
OAKTON, VA 22124
Phone: (703) 385-0740

Topic#: 92-044 ID#: 92ES3-075
Office: ES3
Contract #: F30602-94-C-0074
PI: Dr. George V. Wilson

Title: The Application of Concept Space to the Automated Librarian

Abstract: Concept-based search of full text databases was shown to be valuable by our Phase I study. Improved relevance ranking of documents can be achieved with only minimal user interaction. This proposal presents enhancements to the Phase I software that will be required for development of a commercial product. These changes will provide greater functionality to the user, better performance in both speed and relevance ranking and also allow packaging of the software in several different ways to increase the potential market for the code.

MSNW, INC.
P. O. BOX 865
SAN MARCOS, CA 92079
Phone: (619) 489-9471
Topic#: 92-045 ID#: 92ES3-081
Office: ES3
Contract #: F19628-93-C-0190
PI: Dr. John R. Norman
Title: Phosphorus Purification
Abstract: The proposed Phase II research will produce 99.99999% PH3 by low temperature fractional distillation techniques. Information about the viability of this process was developed during Phase I of this program. In Phase I the main emphasis was on the purification of PH3 through conversion to PH4I, distillation of PH4I, and reconversion to PH3. While this process was functional, it was expensive, corrosive, and potentially contaminating. A second part of the Phase I effort involved the measurement of vapor pressures in the PH3-SIH4-H2S system. The results of this study indicated probable success for attempts to purify PH3 by low temperature fractional distillation using a packed column. The proposed Phase II effort includes demonstration and operation of a low temperature column wherein a 99.9995% PH3 can be distilled to reduce the SiH4 and H2S contents by a factor of 50. Other contaminants not having the same vapor pressure as PH3 will also be reduced to a lesser or greater degree. In order to maintain the quality of the phosphorus source, it is also proposed to study the direct manufacture of the desired InP from purified PH3 and In rather than the conversion of pH3 to P(red) before reacting with In. Thermodynamic considerations indicate the viability of such a process.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45432
Phone: (513) 426-3111
Topic#: 92-110 ID#: 92WL3-039
Office: WL3
Contract #: F33615-93-C-1301
PI: Praveen Chawla
Title: VHDL Behavioral Simulation Acceleration Engine
Abstract: The objective of the Phase II program is to produce a design specification for the Accelerator for VHDL Simulation (AVS), and to qualify the design through performance modeling and prototype testing. The preliminary design and initial performance models from the Phase I work will form the basis of this design effort. Tasks in the Phase II effort include Design Completion, Performance Modeling, Prototype Development and Testing, and Design Specification Production. The design, which was pre-qualified through Phase I performance modeling, is based upon an innovative, 5-processor accelerator node architecture, with a 2-dimensional-mesh node interconnection structure. It also employs virtual time and innovative memory management methods. It was shown, through the Phase I performance modeling, to be capable of significant acceleration, in a user-transparent paradigm. In addition to the qualified design specification, the prototypes will be delivered, to provide a laboratory-grade accelerator for immediate application or continuing research.

MTL SYSTEMS, INC.
3481 DAYTON-XENIA ROAD
DAYTON, OH 45431
Phone: (513) 426-3111
Topic#: 92-148 ID#: 92WL4-090
Office: WL4
Contract #: F33615-93-C-3803
PI: John H. Harshbarger
Title: Automatic Brightness Control for Cockpit Electronic Display Instruments
Abstract: The Phase I effort resulted in definition of a system for control of cockpit electronic instrument brightness. Relevant human factor considerations were developed and the concept was validated by laboratory experimentation. An experimental cockpit environment was created for assessment of control effectiveness. The Phase II effort proposed herein is a direct continuation of that work. It will result in a system design for Automatic Brightness Control of electronic cockpit instruments of various formats and types. The design will be structured for retrofit of an ABC system into existing aircraft. Phase II work includes construction of an ABC system which can be used for further development of control algorithms appropriate for military aircraft, algorithm development and refinement, and finally construction of a number of deliverable prototype systems for Air Force evaluation.

NEOMECS, INC.
4832 PARK GLEN ROAD
ST LOUIS PARK, MN 55416
Phone: (612) 927-7223
Topic#: 92-027 ID#: 92AL -158
Office: AL
Contract #: F41624-93-C-9014
PI: Hiroshi Nomura, PhD

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Title: Membrane Sampling System to Concentrate Toxic Environmental Compounds for Raman Spectroscopy Analysis
Abstract: Phase I proved the proposed membrane system to concentrate three pesticides (2,4-D, Endrin, and Chlorpyrifos) and to detect and measure them using Raman spectroscopy. The Phase II will build on these results and develop a prototype system which integrates membrane concentrator and Raman spectroscope into field-deployable equipment for monitoring many contaminants in groundwater. Specific objectives: (1) Prepare hollow fiber membranes by surface modification. (2) Assemble membrane modules and characterize surface chemistry. (3) Test modules for concentration of additional pesticides (including DDT Isomers, Diazinon, Paraquat, PCB's and DBCP). (4) Perfect the Raman spectroscope and solvent flow cell for the detection of a wide range of pesticides. (5) Verify results by gas chromatography (GC) detection of pesticides by EPA methods. (6) Assemble a composite system and confirm its performance with field tests to detect typical contaminants. (7) Demonstrate batch sampling for GC analysis by selection and test of suitable solvents. (8) Prepare recommendations to appropriate federal agencies to approve the methodology and equipment developed in this research.

NIELSON ENGINEERING & RESEARCH, INC.
510 CLYDE AVENUE
MOUNTAIN VIEW, CA 20332
Phone: (415) 968-9457
Topic#: 91-189 ID#: 91OSR-313
Office: AFOSR
Contract #: FQ8671-93-01446
PI: Robert E. Childs
Title: A Study of Compressible Turbulence
Abstract: Increased knowledge of turbulence at supersonic and hypersonic speeds is needed for the design of future Air Force flight vehicles. The proposed study will identify the physical processes specifically associated with high Mach numbers which govern turbulence in free shear layers, will investigate wall-bounded flows, and will address the effects of shock/turbulence interactions. The work will employ large eddy simulations, theoretical analyses, and conceptual structure models. Some of the goals of the work are to identify the underlying causes of the structural changes in turbulence which occur with increasing convective Mach numbers; to identify possible hypersonic, as opposed to supersonic, effects on turbulence; to understand compressibility effects in wall-bounded flows and their relation to those in free shear flows; and to interpret this knowledge of physics in a manner that will guide turbulence modeling efforts.

NONVOLATILE ELECTRONICS, INC.
12800 INDUSTRIAL PARK BLVD.
PLYMOUTH, MN 55441
Phone: (612) 550-0913
Topic#: 91-102 ID#: 91WL4-070
Office: WL4
Contract #: F33615-93-C-3412
PI: George F. Denehy Jr.
Title: In-place Data Recorder for Aircraft Transparency Systems
Abstract: An embedded real time data recording system is needed that can be used with today's aircraft to resolve the current problem of obtaining realistic, actual and complete data on the fabrication history and operational experience of existing transparency systems for use in failure analysis, reliability predictions and durability specifications. NVE has been utilizing special "Smart Sensors," an MRAM nonvolatile memory, a unique busing system, micro-miniature system modules, special power systems, and unique software and hardware to acquire "impact events" while in flight. The objective of the Phase II program is to develop the unique components needed to make the data acquisition system feasible: MRAM data storage modules, the "smart sensors" needed to measure 1) strain, 2) pressure, 3) temperature, 4) humidity, 5) acceleration, and 6) ultraviolet radiation, a 2 wire modular bus, a control computer, and a power conversion system. These components will then be used to construct a prototype data acquisition system to be embedded and tested in an F16 canopy. Transfer of parameters, software and data will be demonstrated under different powerless conditions.

NORTHEAST PHOTOSCIENCES
18 FLAGG ROAD
HOLLIS, NH 03049
Phone: (603) 465-3361
Topic#: 91-025 ID#: 91ROM-123
Office: ES3
Contract #: F19628-93-C-0080
PI: Jacques E Ludman
Title: Index Interferometer
Abstract: The refractive index of scientific materials is often a very important parameter. Many classical or conventional techniques for measuring index of materials require complicated apparatus and often require special sample preparation, such as fabricating prisms of the material. This may render the material unsuitable for use, as in the case where it must be in slices

to be useful. This new technique permits the determination of the index of any slice of material, without any special surface preparation other than simple polishing. The technique is accurate to five significant figures and provides the index at any desired wavelength, as well as a profile of the index of the entire sample. The technique compares the fringe pattern from the top surface with that from a reference mirror to determine the thickness. Then, with the aid of a white light source, the interference pattern from the back surface is compared with that from the front to yield the optical thickness of the sample. The combination of the two measurements gives the index. The back surface fringe pattern itself gives the index profile.

OMNIVIEW, INC.
402 PENN CENTER WEST IV
PITTSBURGH, PA 15276
Phone: (412) 788-9492

Topic#: 91-095 ID#: 91WL3-020
Office: WL3
Contract #: F33615-93-C-1321
PI: Charles W Buenzli Jr

Title: Computer-aided Design and Synthesis System for Electronic System Design

Abstract: The front end of the design process for electronic system-level hardware determines nearly 70% of the life-cycle cost. Available CAE/CAD tools only automate the back end of the design process which determines 10% to 20% of the cost. The complexity of the front-end design process has been increasing explosively due to: the rapid proliferation of high-density packaging, the large number of components, increasing system complexity and speed, and emphasis on life-cycle cost and abilities. The designer's lack of time and experience to deal with these factors results in suboptimal design, component selection and packaging, and multiple design iterations. Longer time-to-market, higher product life-cycle and development costs are the end result. In Phase I, Omniview developed a detailed functional specification and demonstrated feasibility of a Design and Synthesis System (DSS) and a family of Design Advisors to automate the front-end, electronic, system-level hardware design process. Phase II proposes to implement a working prototype of DSS, an initial family of Design Advisors, and a Design Knowledge Repository including sufficient part and template models to allow evaluation of DSS on actual design problems. A solid foundation for a commercial product for Omniview will result.

OPHIR CORP.
10184 WEST BELLEVIEW AVE, SUITE 200
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Phone: (303) 933-2200

Topic#: 92-118 ID#: 92WL4-027
Office: WL4
Contract #: F33615-93-C-3613
PI: Dr David C MacPherson

Title: A True Airspeed Indicator Based on Doppler Shifted Incoherent Molecular Backscatter

Abstract: In this Phase II effort, we propose to design, construct and flight-test an Optical Air Data System (OADS) that will measure aircraft airspeeds with a resolution of better than 1 m/s at any angle of attack. This system utilizes incoherent Doppler shifted molecular backscatter which, at our design wavelength, yields 1,000X more signal than aerosol backscatter lidars and, unlike aerosol backscatter, is reliable at all altitudes and air quality conditions. Our velocity measurement technology makes use of an etalon edge filter and a short-pulse, high-fluency laser while eliminating the need for ultra-high speed electronics and wavelength-slaved reference lasers. Resolving a small shift in the relatively broad backscatter signal caused by molecular Brownian motion is accomplished by averaging the signal from 150,000 temporal-spatial modes for each laser pulse. This new OADS technology promises to give reliable data under all atmospheric and flight conditions. We will demonstrate this instrument's performance in Phase II by constructing a prototype, and then conducting extensive laboratory and flight tests.

OPTICOMP CORP.
P.O. BOX 10779
ZEPHYR COVE, NV 89448
Phone: (702) 588-4176

Topic#: 92-052 ID#: 92ES3-161
Office: ES3
Contract #: F30602-93-C-0216
PI: Peter S. Guilfoyle

Title: "Supercomputer Data/Knowledge Bases"

Abstract: The primary objective of the Phase II effort will be to implement selected data/knowledge base algorithms on a second generation digital optical computer (DOC II). This machine has been designed and fabricated under Rome Laboratory/ONR contract N00017-89-C-0266. DOC II is the first fully programmable, optoelectronic, 32 bit machine designed to operate from within a UNIX environment running a RISC instruction set. By exploiting the physical principals inherent to optics (speed and low power consumption), an architectural balance of optical interconnects and software efficiency can be attained by maximizing the high Fan-In and Fan-Out of optical interconnects. Initially, raw text primitives will be implemented on DOC II. These

algorithms will serve as the building blocks for relational database primitives which will be implemented and evaluated. It is anticipated that a relational database management system will then be developed using algebra operators. Selected multimedia database primitives will also be implemented and evaluated for text, image, voice and video applications. It is anticipated that these algorithms will have direct applicability in solving common multimedia information problems. In order to measure the efficiency of DOC II, a comparative performance analysis between DOC II and other electronic database processors will be established for relational and multimedia databases.

OPTRA, INC.
66 CHERRY HILL DRIVE
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Phone: (508) 887-6600
Topic#: 92-022
Office: AL
Contract #: F41624-93-C-6021
PI: Andrew Lintz
ID#: 92AL -133
Title: Magneto-optic Gravity Induced Loss of Consciousness
Abstract: The proposed program will continue the development of a new magneto-encephalograph (MEG) sensor applicable to the detection of gravity induced loss of consciousness (G-LOC) in fighter pilots. OPTRA will combine several recently developed technologies to produce a laboratory prototype of an instrument capable of measuring the small fluctuating magnetic fields produced by normal and unconscious brain activity. The new magnetometer uses the field strength dependent Faraday rotation of an optical beam as a transducer, and single mode fiber optic interconnections to produce a compact, all dielectric sensor head that could be easily incorporated into a pilot's helmet. By combining advanced engineered materials with high Verdet coefficient, high power laser diode sources and OPTRA's high resolution phase measurement techniques, a sensor system with 10-14T resolution is expected. The measurement would be linear over 140 dB so changes in background magnetic fields would not affect the sensitivity. The sensor could be configured in first or second order gradient configurations. The sensor operates at room temperature and requires no cryogens as does the alternative magnetic sensing technology (SQUID).

OR CONCEPTS APPLIED
12408 FLORAL DRIVE
WHITTIER, CA 90601
Phone: (310) 695-3108
Topic#: 91-082
Office: XRX
Contract #: F33657-93-C-2052
PI: DR. RUBIN JOHNSON
ID#: 91ASD-745
Title: Future System Concepts and Related, Innovative, Analysis Tools: A Desktop Route Planning Tool
Abstract: OR Concepts Applied has demonstrated the feasibility of automated route planning algorithms fast enough and small enough for desktop analysis tools. We have developed innovative concepts in route planning that make it possible to avoid threats and terrain, perform masking analysis, and schedule sensors without time-consuming ray tracing algorithms. For the Phase II effort, we propose to expand the single sortie route planner with improvements to the graphical interface, algorithmic implementation, and the batch mode processing. We will implement designs for a simulation mode that includes inflight replanning and an automated target tie up module. We propose to rehost the system to a Unix work-station as well as pen-based portable computer.

ORBITAL TECHNOLOGIES CORP.-ORBITEC
402 GAMMON PLACE, SUITE 10
MADISON, WI 53719
Phone: (608) 833-1992
Topic#: 92-074
Office: PL3
Contract #: FO4611-93-C-0149
PI: Dr. Eric Rice
ID#: 92PL3-074
Title: Storage and Delivery Device for Cryogenic Solid Oxygen Propellants
Abstract: In this Phase II effort, ORBITEC proposes to demonstrate and deliver an innovative small test-bed rocket engine to produce and utilize high-energy-density solid oxidizers with gaseous or liquid fuels. Feasibility for this approach was proven in the Phase I effort - oxygen was solidified into a high-density formation directly from the gas state by processing under the triple point condition. For introducing high-energy additives to oxygen, this approach appears to be best. To simplify delivery of oxygen to the combustion chamber in a test-bed engine, the combustion chamber will be used for freezing and storage, as the oxidizer solidification process is mostly controlled by a liquid helium-chilled freezer and oxygen gas pressure. The Phase II project has been divided into three major technical task areas: 1) additional characterization of solid oxygen formations in the context of the cryogenic solid rocket engine application; 2) improved design specification for an oxygen solidification apparatus that was built in the Phase I effort; and 3) a small test bed rocket engine that would be designed, developed, tested,

126

and integrated into a test cell at a USAF facility, then used by the USAF to measure the effectiveness of different high-energy-density oxidizer mixtures.

ORINCON CORP.
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SAN DIEGO, CA 92121
Phone: (619) 455-5530
Topic#: 92-031 ID#: 92ES2-023
Office: ES2
Contract #: F19628-94-C-0026
PI: Dr. Robert N. Lobbia
Title: Command, Control and Communications Systems/Subsystems
Abstract: Noncooperative target sensor registration (NCTSR) is an approach that can significantly enhance data fusion performance when operating on data from offboard sources. In a recently completed Phase I SBIR contract funded by ESC, Orincon demonstrated performance gains associated with the use of this algorithm in a set of simulated test scenarios. These scenarios depicted track-level fusion onboard an AWACS platform, with offboard track scenes containing unknown biases. The test results have been encouraging enough to warrant the use of this NCTSR approach in a more realistic data fusion environment. This Phase II proposal is thus oriented toward a more practical implementation of NCTSR as a front-end to Orincon's multiple hypothesis tracker (MHT). To accomplish the integration of the two, the MHT will be modified to incorporate NCTSR for each hypothesis carried in the MHT and to perform a combined geometric/attribute scoring function when generating new hypotheses. The latter feature will provide a descriptive target classification for each track in the database via a Bayesian taxonomic hierarchy. The completed NCTSR-MHT software package will then be integrated into ESC's Fusion Evaluation Testbed (FET). A series of comprehensive test scenarios, representative of AWACS types of missions, will be implemented to assess the performance of this track fusion design. Comparisons with other tracker/correlator designs and the baseline AWACS tracker will also be conducted. The software will be developed to provide a seamless transition into airborne testing applications for potential Phase III follow-on work.

PAI RESEARCH LTD.
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Phone: (410) 455-6310
Topic#: 92-166 ID#: 92WL0-048
Office: AD
Contract #: F08630-93-C-0060
PI: Dr. Vencatesh R. Pai Vern
Title: Laser Diode Initiation of Primary Explosives
Abstract: In Phase I PAI Research Ltd. (PRL) has drastically reduced the laser energy required to initiate lead azide by employing doping techniques. Thus, the cw IR power requirement has been brought down from 200 mw to 30 mw and the pulse energy from 2.5 mj to 0.21 mj for dopant concentration as little as 0.2 wt%. We have also successfully initiated our doped lead azide samples simply by focusing the sun's radiations. If the threshold initiation power requirement is further brought down from 30 mw to 10 mw, the cost goes down from $300 to $30. (Costwise, our present Phase I efforts have already brought the cost from $1200 to $300-$150). In Phase II, PRL is proposing improvements in doping techniques which will enable the doped lead azide to be initiated by 10 mw laser diode. We will also carry out experiments to understand our Phase I observation that green light is ten times more efficient than IR in initiating lead azide and further extend the concept to blue light initiation.

PAQ COMMUNICATIONS
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Phone: (408) 946-3305
Topic#: 92-031 ID#: 92ES2-002
Office: ES2
Contract #: F19628-93-C-0065
PI: Quyen D. Hua
Title: Ionospheric Scintillation Monitoring for C3I
Abstract: Various DoD C3I communications and radar systems can be seriously affected by the disturbances of the earth's ionosphere, especially for those located at near-equatorial regions such as Kwajalein, Diego Garcia, Ascension Island and the Gulf region. One way to alleviate this problem is to use alternate C3I assets during times of predicted signal outages due to ionospheric scintillation fading. However, current prediction techniques based on monthly climatology of ionospheric fading does not provide real-time solutions. The proposed Ionospheric Scintillation Monitor (ISM), based on state-of-the-art commercial high-performance C/A-code GPS receiver technology, is so inexpensive that it may be deployed in large numbers in a theatre battlefield environment. The Phase I effort has successfully produced a prototype ISM capable of providing the basic real-time measurements for estimating the amplitude scintillation index and the equivalent phase scintillation index. Off-line detrending

algorithms to remove the effects of oscillator phase noise and selective availability have been successfully developed and tested. The Phase II effort will produce the complete ISM in which the detrending algorithms will be done in real-time so that parameters of the ionospheric scintillation environment will be derived in real-time. This ISM will also produce real-time measurements of satellite code/carrier divergence. The Phase II ISM will be capable of parallel tracking of all GPS satellites in view, thus providing simultaneous measurement of the scintillation parameters in many directions.

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Topic#: 92-161
Office: AD
Contract #: F08630-93-C-0065
PI: Jeffrey S.N. Paine

ID#: 92WL0-148

Title: Adaptive Composite Hydraulic Cylinders with Embedded Shape Memory Alloy Fibers

Abstract: Hydraulic componentry for aircraft bomb rack and missile launcher systems requiring very high hydraulic pressures are being developed, however, typically the component weight is high and there is a strong desire to investigate methods to reduce the total weight. Components made of composites and hybrids are desirable options in order to reduce weight and therefore maximize aircraft fuel efficiency and speed. The proposed effort utilizes a new and innovative approach to lightweight pressure devices, based on shape memory alloy hybrid composites. The research during the Phase I program has demonstrated the feasibility of adaptive SMA high-pressure vessels for increased reliability (higher strength and lower thickness) and dimensional stability, and significant reduction in weight. The previous research has also proven the concept of structural intelligence for safety, which could have a significant impact on the development of ultra-light-weight load carrying aircraft structures. Based on the success and achievement of the Phase I research, the Phase II research and development program will conduct an advanced design and optimization of the adaptive SMA high-pressure vessel, fabricate working laboratory models, conduct proof-pressure test, and develop commercial applications.

PARKE MATHEMATICAL LABORATORIES
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Topic#: 92-045
Office: ES3
Contract #: F19629-94-C-0010
PI: Dr. Alton F. Armington

ID#: 92ES3-077

Title: Phosphorus Purification for High Speed InP Circuit Technology

Abstract: The use of Phosphorus for the growth of III-V and other electro-optic materials requires a higher purity than presently available commercially. Parke Mathematical Laboratories, Inc. proposes to develop the ultra-purification of red phosphorus and commercialize the purified phosphorus at a very low cost. This proposal outlines the sublimation technique used in the Phase I part of this SBIR contract to improve the purity of red phosphorus as an element. The purity was improved by several orders of magnitude. The cost of material produced by this process is probably about a quarter of the cost of the electronic grade material. An additional factor is that while this material would be produced in the U.S.A., there is presently no supplier of high grade phosphorus in this country. In Phase III we propose to team up with a chemical manufacturer based U.S.A. and produce electronic grade red phosphorus.

PHYSICAL OPTICS CORP.
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Topic#: 90-026
Office: ES3
Contract #: F30602-93-C-0131
PI: Dr Freddie (Shing-Hong) L

ID#: 39720

Title: Parallel Processing Based on Wavelength/Angularly Multiplexed Holography

Abstract: Volume holograms demonstrate both wavelength and angular selectivities. By changing either illumination wavelength or reading beam direction, interconnect network can be reconfigured in real time. Additionally, volume holograms are characterized by low insertion loss (<1 dB) and low crosstalk (<-20 dB) for a single connection. Furthermore, free-space holography allows a large number of interconnections (high fan-out) in a manner that does no rely on a material path. For flexible reconfiguration of interconnection networks, volume holograms and optical fibers are used. The optical fibers are used to carry signals from electronic systems to hologram array (interconnect matrix). As a part of Phase II project we propose the development of low exploratory development models (EDM). A high speed (HS) prototype will provide data transmission of up to 200 Mb/s per node for a small number of nodes, -8. A large scale (LS) prototype will include -64 nodes with data

transmission rate of 10 Mb/s per node.

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Topic#: 92-170
Office: AD
Contract #: F08630-93-C-0071
PI: DR. FREDDIE LIN

ID#: 92WL0-124

Title: A Laser Doppler Velocimeter with Range and Directional Grating Capabilities

Abstract: Physical Optics Corporation (POC) proposes a novel Laser Doppler Velocimeter (LDV) system to measure 3-D wind velocities, and thus to predict the effects of wind on the trajectories of projectiles. The major challenge is that the actual wind patterns are inhomogeneous in both direction and range. The proposed LDV system will utilize four major technologies: (1) confocal optics and laser coherence technology to provide range gating, (2) multiplexed holographic optical element (HOE) technology to provide directional gating, (3) multiple-aperture optics technology to measure 3-D wind velocity components, (4) fiber optic transmission line technology to produce a flexible, compact, modularized system. The combination of these four technologies will not only solve the inhomogeneous 3-D wind velocity measurement problem, but will also provide flexible, compact, modularized LDV system packaging. The goal of the Phase II program is to establish the engineering basis of the above four technologies and to demonstrate a compact and rugged LDV system to measure 3-D wind velocities with various ranges and directions. In addition, the commercialization of the developed LDV-related technologies will also be strongly pursued.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CENTER
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Topic#: 92-019
Office: AFOSR
Contract #: FQ8671-93-01447
PI: Dr David Opie

ID#: 92AFO-007

Title: Compact Active Hydrogen Maser

Abstract: We propose to demonstrate the operation of an active compact hydrogen maser. We have resolved the issues that needed to be addressed before proceeding with development of compact active masers. These issues dealt with the mechanical stability of the superconducting cavity, the temperature coefficient of the resonator, required temperature control of the teflon containment surfaces (and therefore, temperature control of the whole cavity), and several other topics. With these issues resolved, we propose to fabricate and test a CRYSTAT and superconducting resonator that can replace the microwave cavity of an existing maser. Using this economical approach, we intend to demonstrate that the based compact can preform at least as well as a conventional maser. Combining the superconducting resonator and compact cryo-cooler technologies, a compact maser physics package could be realized that is not significantly larger than a typical cesium standard physics package. This would make a hydrogen maser very appealing for a wide range of applications. This demonstration will lead smoothly to a Phase III program where a complete compact active maser package can be developed in a configuration relevant to space applications.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CTR
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Topic#: 92-062
Office: PL2
Contract #: F29601-93-C-0161
PI: Peter E. Nebolsine

ID#: 92PL2-064

Title: Instrumentation for Hypervelocity Particle Impacts

Abstract: The proposed Phase II program will: a) develop a shadowgraphic holography system based on the Phase I design; and b) measure the location, cross-sections and the velocities of debris particles generated during hypervelocity impact events. This holographic technique has already been demonstrated in the ordnance velocity regime and is ready for application to orbital debris experiments. The elements of the proposed program include the optical, electrical, and mechanical design of the system, continued optical analysis to determine the optimal laser pulse parameters for holographic capture of debris-particle images, fabrication and laboratory testing of a pulsed shadowgraphic hologram system, installation and checkout of the system at the UAH Aerophysics Research Center ballistic range, generation of holograms of debris producing events such as particle impacts on plate using one of the UAH two stage light gas guns, analysis of the holograms to determine particle size, location and velocity. This program will provide government personnel the opportunity to become familiar with, and be trained on the

equipment. The delivery of a shadowgraphic holography system at the end of the Phase II Program is an option.

PHYSICAL SCIENCES, INC.
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Phone: (508) 689-0003
Topic#: 92-091
Office: PL6
Contract #: F29601-94-C-0010
PI: Michael L. Finson
ID#: 92PL6-059
Title: Reentry Turbulent Plasma Modulation Model
Abstract: In this program PSI will develop the technology to predict and analyze plasma modulation effects on RV antenna performance for advanced guidance and navigation concepts. A laboratory arc experiment simulating EM propagation through representative turbulent flows will be implemented to provide a database on plasma modulation. A model will be developed to predict line of sight electromagnetic wave propagation through over dense turbulent boundary layers. The validated model will be incorporated into a computer code that interfaces with existing flow field codes for advanced RV configurations. The code will be utilized to predict plasma modulation effects for relevant scenarios and documented and delivered to BMO/BMT.

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Phone: (508) 689-0003
Topic#: 89-148
Office: WL6
Contract #: F33615-93-C-2353
PI: Mark G. Allen
ID#: 89WL6-125
Title: PLIF Imaging Instrument for High-pressure Spray Combustion
Abstract: A Phase II program is proposed which builds on the successful Phase I feasibility demonstrations of Planar Laser-Induced Fluorescence (PLIF) imaging in spray flames. As a step in commercialization of this technology for the aerospace propulsion industry, a PLIF instrument will be designed, assembled, and tested for application to high pressure spray combustion environments. Strategies for quantitative imaging measurements for OH and NO will be developed and demonstrated in a high pressure spray burner at PSI. The fuel vapor technique demonstrated in Phase I will be quantified and applied at high pressure. In addition, a novel combination of fuel vapor and O2 fluorescence detection will be developed which will permit, for the first time, direct measurements of fuel/air equivalence ratio and temperature at single points in the flow. Finally, the prototype instrument developed during the program will be delivered to the Wright Laboratory and tested in a single dome spray combustor facility. This prototype development program will provide a key bridge in the transition of advanced diagnostic instrumentation from the laboratory to the commercial aerospace industry by proving its applicability at conditions of practical combustor test facilities.

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Phone: (508) 689-0003
Topic#: 91-181
Office: WL6
Contract #: F33615-93-C-5375
PI: Victor DiCristina
ID#: 91BMO-990
Title: Advance RV Integrated Heatshield Structures
Abstract: Three viable heatshield concepts identified during the Phase I effort will be evaluated as material candidates for MaRV applications. Two of the concepts are integrated two-layer materials with a moderate density abator and a low density insulating layer. The third concept is a single-layer carbonized wool felt impregnated with resin. The material response of selected concepts will be tested in a simulated MaRV thermal environment. The high heating rates of initial reentry and trajectory-modification maneuvers will be simulated utilizing the 10 MW Arc facility at Textron Defense Systems with the long glide maneuver low heating rate simulated by a quartz radiant heat lamp. Test data will be analyzed using the thermal analysis code that was certified against measured thermocouple data on a low-density heatshield in the Phase I study. It is anticipated that a primary new candidate heatshield for MaRV applications will be selected from an assessment of the test results.

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Phone: (415) 641-9044
Topic#: 92-006
Office: AL1
Contract #:
PI: Lloyd D. Stewart, PhD, PE
ID#: 92CEL-016

Title: In Situ Aquifer Restoration From Dense Solvent Contamination by Steam Injection
Abstract: The implementation of multiple technologies is necessary to achieve successful in situ restoration of soil and groundwater contaminated by dense chlorinated organics. Steam injection is proposed as a technology which can enhance the application of pump-and-treat, soil venting, and bioremediation technologies in the cleanup of aquifers contaminated by dense solvents. The activities necessary to accomplish the demonstration of steam injection will follow steps leading to and including a field demonstration of the steam technology to remediate DNAPL contamination in aquifers. Developing the ability to extrapolate laboratory and field results will be emphasized in all facets of the work. Conditions are different at every DNAPL site and numerous applications of the technology in the field are required to establish the process on a commercial scale. Phase II will include the fabrication of a mobile extraction system. This equipment will be suitable for future demonstrations of the steam technology as well as other in situ processes. Different operating strategies will be evaluated during the project with the goal of minimizing the water introduced into the soil while maximizing the utility of the energy injected.

PRECISION COMBUSTION, INC.
25 SCIENCE PARK
NEW HAVEN, CT 06511
Phone: (203) 786-5215
Topic#: 92-140 ID#: 92WL6-094
Office: WL6
Contract #: F33615-93-C-2355
PI: Dr William C. Pfefferle
Title: Catalytic Integral Ignitor/Injector for Aircraft Gas Turbine Engines
Abstract: Integrating a catalytic ignitor into a fuel injector offers an opportunity to significantly improve flame stability and altitude relight, among other advantages. Previous work by Precision Combustion developing a catalytic glow plug has shown that a catalytic ignitor offers substantially improved ignition over conventional (non-catalytic) surface ignition devices. In this project we propose to use this improved ignition capability to achieve an effective integral ignitor/injector suitable for improving aircraft gas turbine ignition and blowout limits. In Phase I, a modified design of an airblast injector fitted with a catalytic ignitor was made and bench tested. Testing in a laboratory, an annular segment combustor demonstrated ignition and blowout performance. A study of total system requirements and an optimized design concept will be conducted. These results will be used to optimize the catalytic ignitor/injector integration scheme for engine testing. These proof-of-concept results indicate the potential for improvement based on this technology. Phase II will build on Phase I results to develop and test the technology for a gas turbine engine currently used or planned for use by the Air Force.

PRO-TECH
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Phone: (510) 284-9690
Topic#: 92-061 ID#: 92PL2-051
Office: PL2
Contract #: F29601-93-C-0185
PI: David V. Giri, Ph.D.
Title: Radiating System for Impulse-like Waveforms
Abstract: Under Phase I of this program, we studied certain aspects of an impulse radiating antenna, such as the low frequency performance and aperture blockage issues. The antenna consists of a parabolic reflector fed by a pair of TEM horns. Based on the results of Phase I efforts coupled with the past analysis and available experimental data, we are proposing to build a parabolic reflector antenna system, fed by a pair of TEM horns that are driven by a fast pulse generator (100kV, differential output, with a 10-90% rise of 100ps, e-fold decay of 15ns and a prf of 100Hz). The terminating impedance of the feed horns will be optimized from a low frequency performance consideration. The switch at the apex of the feed horns and a suitably designed lens ensure a fast, spherically expanding wave propagating in air along the feed horns that illuminate the reflector antenna.

PROMETHEUS, INC.
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Phone: (401) 849-5389
Topic#: 92-035 ID#: 92ES3-252
Office: ES3
Contract #: F30602-94-C-0038
PI: James S. Byrnes
Title: Automated Decision Aids for Tactical Air Warfare
Abstract: The potential value of automated decision aids to modern warfare in general, and to Tactical Air Warfare in particular, has been recognized for many years. The need to compare, for each particular strategy, relative benefits with costs such as weapons expenditures, personnel casualties, and damage to friendly C3 capabilities makes the tasks of choosing a correct C3CM

strategy, and convincing the operational commander to employ it, exceedingly difficult. Thus, there is a need for a credible concept on how to measure the warfighting benefits of a comprehensive C3CM strategy, to effectively employ operations security, deception (exploitation), jamming, and destructive means against an adversary. In Phase I we showed how our Dependency Model (DM) can be expanded to enable the quantitative comparison of all levels of possible tactical and strategic decisions. We will complete this expansion in Phase II, fully develop a user interface, code this Extended Dependency Model (EDM) on an appropriate computer platform, and apply EDM to enhance a selected mapping/targeting aid and to several other C3CM problems of current concern to the Air Force. Our final product will be an extremely useful and powerful model, which we will demonstrate as the required integrated C3CM measure of effectiveness (MOE) tool.

Q-DOT, INC.
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Phone: (719) 590-1112
Topic#: 92-048 ID#: 92ES3-099
Office: ES3
Contract #: F19628-93-C-0164
PI: Donald L. Herman, Jr.
Title: HBT Delta-Sigma Analog-to-Digital Converter

Abstract: Q-DOT proposes an extensible 100 Ms/s, 16- to 18-bit delta-sigma a/d prototype with tremendous commercial and government (dual-use) potential. Speed and resolution are programmable by altering the digital filter following the delta-sigma modulator. Thus, the prototype Phase II modulator can produce a broad a/d family (e.g., 12 bits at 400 Ms/s through 22 bits at 25 Ms/s). Q-DOT has contingent follow-on funding commitments from multiple commercial partners. The baseline architecture and several innovative circuits were developed during Phase I. The modulator and initial filter use an advanced heterojunction bipolar transistor (HBT) pilot line. The modulator was modeled mathematically then simulated using Spice models provided by the foundry. A representative digital circuit's operation was also verified. The results established the proposed a/d's feasibility. During Phase II, a custom front-end IC will be fabricated and the second filter implemented by a buffer memory and PC interface. This provides flexibility to test alternative filters and assess speed versus resolution trades. It also provides a powerful development system for follow-on customers. The filter will ultimately be implemented in a conventional gate array. Phase II is the first stage of an effort culminating in a two-chip a/d with performance 100 times better than current state-of-the-art.

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Phone: (719) 590-1112
Topic#: 92-059 ID#: 92PL2-036
Office: PL2
Contract #: F29601-93-C-0141
PI: Thomas E. Linnenbrink
Title: A Low-cost, High-Speed, Multiple-channel Transient Recorder

Abstract: Q-Dot proposes to develop a low-cost, high-performance transient recorder for use in high-energy physics experiments. Heretofore, the recording of complete, amplitude vs. time histories from detectors has been desirable but prohibitively expensive and limited in versatility. Q-Dot's single-channel per chip, 1 Gs/s transient recorders using charge-coupled devices (CCDs) have demonstrated the capability of recording 1 GHz bandwidth data at higher rates. Since the cost of single-channel recorders is dominated by control and support circuitry, one cost-saving strategy is to build multiple recording channels with common control and support functions. The proposed A19 Data Recorder, resulting from the Phase I effort, comprised four (4) complete recording channels housed in a standard C-size VXI module with common control (i.e., time base, trigger, FIDU, etc.). Eleven (11) A19s are housed in a standard VXI chassis with a standard, (i.e., 386-based), VXI controller to form an S3 Data Acquisition System. Every one of the S3s and channels is capable of acquiring 40K samples (i.e., 40,960 samples) of data with 1 GHz bandwidth at 5 Gs/s to at least 10-bit resolution (using a 12-bit a/d). The common time-base within an A190 permits groups of channels to be time-tied to operate at higher sampling rates with longer memory (e.g., 80K samples at 10Gs/s, 160K samples to 20 Gs/s) while maintaining 1 GHz bandwidth and 8 us record length. Integrating sampling and data storage for each channel on a single unique CCD chip (the SPS Array) results in high performance at low cost. The four-channel A19 is estimated to sell for $12,000 ($3,000/channel) in production, one-tenth the cost of currently available equipment. The complete S3 development is structured as three overlapping elements: Phase II -- Develop Critical Elements: Option A -- Develop SPS Array and Support Circuitry; and Option B -- Develop System. All high-risk circuitry will be demonstrated during the 13-month Phase II. The entire program (spanning 21 months) will result in a preproduction S3 system complete with documentation.

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Phone: (413) 549-0568
Topic#: 92-082 ID#: 92PL4-031
Office: PL4
Contract #: F19628-93-C-0139
PI: Mark Goodberlet
Title: Passive Microwave Imaging Through Smoke and Obscurants
Abstract: Quadrant Engineering, Inc. designed a millimeter wave imaging system during Phase I of the SBIR project that is capable of collecting high resolution images of the earth when obscured by clouds and other observants. Here, we propose to fabricate and test a synthetic aperture system during Phase II. The completed system will use thinned array, fan beam antennas to generate a push broom image as the aircraft platform moves forward. It will generate an image by correlating all possible pairs of a 16-element waveguide array antenna. The image will consist of approximately 90 pixels over a swath that can extend from horizon to horizon. The system will have both operation and research applications resulting from the choice of frequency and high resolution mapping capability. In this proposal, we describe the radar design and our plans to develop and flight test a prototype.

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Phone: (415) 637-3036
Topic#: 92-171 ID#: 92WL0-020
Office: AD
Contract #: F08630-93-C-0083
PI: Robert R. Durrell
Title: Advanced Missile Safe and Arm (S&A) Concepts
Abstract: The Phase I final report documents are a trade study of four advanced missile hybrid safe and arm (S&A) concepts. Each hybrid concept utilized an all electronic logic front end to make the if-to-arm and when-to-arm decision, and; a mechanical out-of-line back end or explosive train. The objective of the trade study was to select the best hybrid configuration for fabrication and testing during Phase II. Since the trade study showed that two candidates were virtually equal, both will be fabricated and subjected to limited environmental testing including a critical arm during high g's test. This testing will validate one or both candidate designs for transition to engineering/manufacturing development (EMD) during a planned Phase III effort.

QUANTUM EPITAXIAL DESIGNS, INC.
115 RESEARCH DRIVE
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Phone: (215) 861-6930
Topic#: 92-038 ID#: 92ES3-012
Office: ES3
Contract #: F30602-94-C-0011
PI: Larry W. Kapitan
Title: Development of Characterization Methods and Molecular Beam Epitaxial Growth Technologies for OEIC Materials
Abstract: Fiber optic systems require high performance photoreceiver integrated circuits. One successful approach combines a Metal-Semi-Conductor-Metal (MSM) photodetector with an amplifier circuit based on either a standard Metal-Semiconductor Field Effect Transistor (MESFET) or a high electron Mobility Transistor (HEMT). This approach may be implemented using a stacked epitaxial growth where both the MSM photodetector and MESFET/HEMT are grown sequentially during one Molecular Beam Epitaxial growth run. Future optical communication systems are being designed at longer wavelengths to take advantage of the lower attenuation and dispersion associated with the optical fiber. Wavelengths of 1.3 and 1.55 micron will require photodetectors based on alternative material Systems. One possible alternative employs InGaAs/InAlAs lattice matched to InP which is used as the substrate. This material system is currently in its infancy in production readiness when compared to the more widely used GaAs technology. It is the intention of this proposal to address the basic material problems relating to the cost effective production of Opto-Electronic Integrated Circuits (OEIC) wafers using the InGaAs/InAlAs/InP based material system. This proposal will concentrate solely on the optimization of 76 mm, InGaAs/InAlAs/InP OEIC structures grown by solid source Molecular Beam Epitaxy (MBE).

QUEST INTEGRATED, INC.
21414 65TH AVENUE SOUTH
KENT, WA 98032
Phone: (206) 872-9500
Topic#: 91-079 ID#: 91ASD-696
Office: XRX
Contract #: F33657-94-C-2147
PI: DR. PETER LIU
Title: Portable Wind Shear Detection and Warning System for Aeronautical Missions
Abstract: Phase I demonstrated the feasibility of developing a portable Surface Windshear Alert System (SURFWAS) to improve

the safety of aeronautical missions. A prototype SURFWAS will be developed in Phase II to improve the safety of aeronautical missions. A prototype SURFWAS will be developed in Phase II for near-ground measurements, where ground clutter severely interferes with radar sensors. The prototype will be an upgrade of a patented system that incorporates the important Phase I findings and recommendations from WPAFB. Emphasis will be made on timeliness and cost-effectiveness in issuing warnings directly to pilots so that they may avoid hazardous windshear conditions during landings and take-offs and, for military missions, on portability/mobility for rapid deployment. The SURFWAS will include ten or more low-profile anemometer stations installed with variable spacing alongside the runway, each equipped with cup/vane or propeller/vane anemometers. A PC-based data acquisition and control system, together with a robust software package, will control the operation of the SURFWAS. The wind pattern along the runway will be displayed on a Wind Information Display Terminal (WIDT) at the air traffic control tower and a Windshear Alert Indicator (WAI) in the cockpits via radio telemetry. The prototype will be designed, fabricated, and field-tested at a selected site where strong windshear often occurs, with active participation and input by experienced air traffic controllers and pilots.

QUEST INTEGRATED, INC.
21414-68TH AVE SOUTH
KENT, WA 98032
Phone: (206) 872-9600

Topic#: 92-116 ID#: 92WL4-051
Office: WL4
Contract #: F33615-93-C-3208
PI: Gary B. White

Title: A Damage-assessment and Temperature-measurement System Suitable for Thermo-structural Testing of Composite Materials

Abstract: Advanced aerospace programs require materials that maintain strength and dimensional stability over a range of dynamic thermal and mechanical loads. These programs have spurred the development of new high-temperature materials including intermetallics, continuous fiber-reinforced ceramics, and metal matrix composites. Typically, these materials must undergo thermal and/or mechanical fatigue testing to establish lifetime estimates. Traditional test-monitoring techniques are labor intensive and fail to capture localized strain or temperature gradients that drive the fatigue failure process. During Phase I, we demonstrated an infrared imaging technique to measure crack growth, temperature, and strain for materials undergoing thermo-structural testing. Based on these results, we propose to develop a high-resolution infrared imaging system that would automatically capture time sequence of images during thermo-structural testing. These images would be processed in real time to extract crack length and surface maps of the temperature and strain distribution. Information from this system would be transmitted to a laboratory host computer for assimilation with other test data. Measurement rates approaching the mechanical fatigue frequency are possible.

RADEX, INC.
3 PRESTON CT.
BEDFORD, MA 01730
Phone: (617) 275-6767

Topic#: 92-089 ID#: 92PL5-004
Office: PL4
Contract #: F19628-94-C-0017
PI: Dr. James N. Bass

Title: Computer-efficient Models of Thermospheric Density and Composition

Abstract: Various empirical and theoretical atmospheric density models have been developed for application to satellite tracking data to make orbital predictions. Over the years, researchers have incorporated more observations into empirical models and added sophistication to theoretical models. However, none of these models has decreased the one-sigma standard error for density to less than 15%. In fact, NORAD prefers the 1970 version of the Jacchia density model for its best orbital predictions. One barrier to improving density models is the lack of sufficient information about geophysical parameters which influence temporal variations of the atmosphere. Currently, most density models use the 10.7cm solar flux and a geomagnetic index as indicators of the relevant geophysical parameters. SPACECOM has conducted a limited study which seems to indicate that their satellite tracking data, given sufficient observations and careful processing, yields high resolution density information. In fact, RADEX proposes using this density information as a near-real-time input to a density model to correct for temporal atmospheric variations beyond the resolution of present corrections. The density model will be updated continuously with recent density values to provide an improved basis for orbital predictions.

RADIATION MONITORING DEVICES, INC.
44 HUNT STREET
WATERTOWN, MA 02172
Phone: (617) 926-1167

Topic#: 91-042
Office: ES3
Contract #: F19628-93-C-0089
PI: Pierre de Rochmont, M. En

ID#: 91ROM-069

Title: Bragg Filters Using High Scattering Efficiency Volume Holographic Glasses

Abstract: It has recently been shown that amorphous solids can be utilized as volume holographic recording media using sufficiently intense write beams at appropriate wavelength(s). In Phase I it was demonstrated that the ability to record optically nonlinear gratings in glass was related to the vibronic structure of the network, and that optical activity of these gratings can be enhanced using the optically active dopants proposed in the Phase I effort. These results are entirely consistent with the theoretical model initially proposed. The Phase II effort proposes to continue this research by developing glass compositions which enhance these effects and evaluating theoretical models which are consistent with these empirical results. The Phase II effort will also examine the commercial utility of these materials by evaluating inexpensive laser diodes packaged with optical fiber drawn from glass compositions exhibiting optimal scattering efficiencies in which permanent distributed feedback optical induced gratings have been recorded. The commercial potential for passive micro-optical components manufactured from the glassy state is significant. Glass can be easily shaped, worked, readily drawn into fiber and other optical waveguide structures and volume manufactured at low cost. Permanent holographic gratings induced in glass can be optically or thermally erased without damaging the material, suggesting a potential application in all-optical read/write/erase three-dimensional memory architectures.

REMTECH, INC.
3304 WESTMILL DRIVE
HUNTSVILLE, AL 35805
Phone: (205) 536-8581

Topic#: 91-049
Office: ES3
Contract #: F30602-93-C-0128
PI: Ronald P. Schmitz

ID#: 91ROM-116

Title: Automated Vibration and Thermal Analysis of Electronic Devices

Abstract: The objective of this project is to develop an interactive modeling and analysis environment for PWB reliability assessment, that is not based on a finite element approach. The modeling environment of "selection" rather than "construction" will remove the curtain of analytical intimidation that confronts users, especially designers and reliable engineers attempting to use finite element packages. The use of a menu/event-driven interactive software package and the speed of closed form solutions will make interactive parametric studies inviting. The PWB Reliability Assessment Code (PRAC) will be implemented using five different software modules. These modules, will be tied together by an event-driven control algorithm that will enable the user to easily access any of the three modules that perform analytical operations (Model Construction, Response and Life Estimates, and Parametrics). Likewise, once inside any of the analytical modules, the user will have easy access to the data storage and control modules.

ROCHESTER PHOTONICS CORP.
330 CLAY ROAD
ROCHESTER, NY 14623
Phone: (716) 377-7990

Topic#: 90-061
Office: AL
Contract #: F41624-93-C-6003
PI: FAKLIS, DEAN

ID#: 90ARM-006

Title: Application of Surface-relief Diffractive Optics to Helmet Mounted Displays

Abstract: During the SBIR Phase I research and development effort, several helmet mounted display systems were investigated with special emphasis given to the correction of chromatic aberration. It was found that through the use of surface-relief diffractive optics technology, lightweight, color corrected HMD systems that operate over wide fields of view are feasible and can be implemented with current fabrication technologies. The hybrid refractive/diffractive HMD system capability utilizes a unique technology. Our primary goal in Phase II is to generate a prototype of an off-axis, color-corrected HMD system using combinations of conventional refractive and diffractive optical elements. Emphasis is placed on increasing light throughput and reducing overall weight. Assuming that the proposed SBIR Phase II program is successful, it is anticipated that functional HMD instrumentation will have been designed, developed, demonstrated and delivered to the U.S. Air Force. The hardware will represent a specialized HMD capability based on microstructured diffractive optics. We intend to pursue aggressively diffractive HMD development through Phase III where flyable hardware will be produced.

135

SARCOS RESEARCH CORP.
261 EAST 300 SOUTH, SUITE 150
SALT LAKE CITY, UT 84111
Phone: (801) 581-1012
Topic#: 91-005 ID#: 9110501
Office: WL5
Contract #: F33615-93-C-5364
PI: Glenn Colvin
Title: Active Fibers for Development of Adaptive Structures
Abstract: This proposal is concerned with the development of active fibers as the fundamental sensing and actuating subcomponents in adaptive structures. In contrast to past efforts, which were aimed at the development of adaptive structures, active fibers offer solutions to major challenges related to the development of these structures for practical use. These challenges include the development of scalable structures, distributed placement of sensors and actuators, development of communication and control schemes, and integrated fabrication techniques. Research by SRC during Phase I has identified the need for practical fabrication techniques and the development of structures capable of undergoing large deformations (strains of up to 20%) for applications requiring shape control of structures. Phase I proposed the concept of linear micro-stepping devices as an actuation mechanism for large deformation of structures and Non-Planar Lithography (NPL) as a fabrication technique for adaptive structures. In this proposal, SRC outlines a two-year program for the fabrication and demonstration of adaptive structures based on the Phase I research. Phase II will include the development of a single active fiber, possible collimation and per cluster grouping of fibers, macro-level multidegree of freedom actuation capabilities and a demonstration of active fiber technology in a compliant flow control structure.

SCIENTIFIC & ENGINEERING SOFTWARE
4301 WESTBANK DRIVE, BLDG. A
AUSTIN, TX 78746
Phone: (512) 329-9758
Topic#: 92-050 ID#: 92ES3-135
Office: ES3
Contract #: F30602-94-C-0017
PI: Ken Zink
Title: Construction of an Object-oriented Graphical Development Environment for Parallel Systems
Abstract: This project will implement an experimentally usable graphical/visual development environment for parallel structured and object-oriented software systems and will experimentally validate the effectiveness of this development paradigm. This development environment is based upon well-validated concepts: graphical/visual abstract specification of parallel structuring from the CODE 2.0 research project at the University of Texas at Austin, graphical/visual specification of object models in the SES/object-bench product of SES, and integration of these concepts by SES in the just completed Phase I SBIR project, "Design Approach for High Performance Computing." Object-orientation will be integrated with parallel structuring at all levels of development from analysis through implementation. Specification of both parallel structuring and the system object model will be abstractly defined for analysis and design phases of development in a unified interface via graphical and textual specifications. Implementation will be supported by interfaces to one or more object-oriented language development environments. Component reuse and application domain specialization will be supported by interface to class library browsers. Experimental evaluation will be accomplished with the collaboration of the University of Texas at Austin in laboratories associated with classes on parallel programming and by government, industrial and commercial software developers.

SCIENTIFIC STUDIES CORP.
2250 QUAIL RIDGE
PALM BEACH GARDEN, FL 33418
Phone: (407) 694-0999
Topic#: 92-031 ID#: 92ES3-193
Office: ES3
Contract #: F30602-93-C-0193
PI: Jaime R. Roman, Ph.D.
Title: Multichannel System Identification and Detection Using Output Data Techniques
Abstract: Multichannel processing techniques offer enhanced signal detection performance over less optimal, single-channel methods. In this program, multichannel identification and detection is pursued in the context of surveillance radar array systems via a model-based approach. An algorithm was developed in Phase I which operates on the channel output data directly to generate an innovations sequence, without the need to estimate the output correlation matrix sequence. This approach eliminates the computational load associated with the calculation of the correlation matrix sequence, and reduces the dynamic range of the calculations. Feasibility of the proposed detection methodology was demonstrated in Phase I. In Phase II, an optimized architecture to implement the algorithm will be defined, and candidate implementations will be identified (VLSI, etc.). Also in Phase II, a processor development system will be configured to use as a testbed and design tool for model-based detection methodology and algorithms in a laboratory environment. The system will be capable of processing simulated as well as real data.

SCIENTIFIC SYSTEMS CO, INC.
500 W. CUMMINGS PARK, SUITE 3950
WOBURN, MA 01801
Phone: (617) 933-5355
Topic#: 91-195 ID#: 91OSR-262
Office: AFOSR
Contract #:
PI: Dr Raman K. Mehra
Title: Clutter Rejection Signal Processing
Abstract: The problem of detecting and tracking targets with small radar cross-sections in the presence of high amounts of noise and clutter is a highly challenging technical problem. The overall goal of Phase II is to achieve significant success in solving this problem, thereby enhancing the capability of modern radar systems for accurate detection, tracking and classification. The feasibility of achieving the above goal was demonstrated during I on Relocation Over-the-Horizon (ROTHR) data. The specific technical objectives of Phase II effort are: (1) Advance the state-of-the-art in multidimensional signal processing by further developing theory and applications of: (a) Stochastic Realization Algorithms (SRA) (b) Flexible Template Matching (c) Markov Random Fields (2) Advance state-of-the-art in Radar Signal Processing by (a) developing methods for clutter filtering using spectral decomposition and spatial features that discriminate clutter from targets. (b) reducing the number of false alarms, and (c) improving resolution in doppler, range and azimuth by using extensions of SRA (3) Improve ROTHR detection capability for slow moving ships, small boats and low radar cross-section targets. Raytheon Company's Equipment Division will support Phase II R&D.

SCIENTIFIC SYSTEMS CO., INC.
500 W. CUMMINGS PARK
WOBURN, MA 01801
Phone: (617) 933-5355
Topic#: 91-003 ID#: 91-EW-303
Office: ES2
Contract #: F19628-94-C-0005
PI: Dr. Raman K. Mehra
Title: System Identification Based Target Classification in High Clutter Environment
Abstract: The benefits of using System Identification and Stochastic Realization Algorithm (SRA) were demonstrated during Phase I using off-line analysis of simulated and real data. A major goal of the Phase II effort is on-line demonstration of SRA benefits. This requires that SRA be implemented on a suitable signal processing platform and tested in parallel with current signal processing algorithms. Based on this goal, the technical objectives of the Phase II effort are: (i) On-line implementation of SRA and target classification algorithms, (ii) Quantification of SRA benefits for the Joint STARS and/or AWACS radar systems, (iii) Extension of SRA to nonstationary signals and two-dimensional random fields, (iv) Prototype software system delivery and technology transfer to AF JSTARS and AWACS program offices, and (v) Phase III commercialization. It is proposed to use a high speed RISC workstation and attached processors as necessary based on the Intel i860 chip as a platform for SRA implementation with overall sustained output of 100 MFLOPS. Applications of SRA will be considered for improvements of resolution in range, Doppler and angular dimensions for MTI and SAR modes. In addition, the potential of SRA for the reduction of false alarms and gain in dbs will be investigated. Norden Systems, a designer and manufacturer of the JSTARS radar system, will provide consulting support and participate in Phase III commercialization.

SECURE COMPUTING CORP.
1210 WEST COUNTY ROAD E., SUITE 100
ARDEN HILLS, MN 55112
Phone: (612) 482-7441
Topic#: 92-031 ID#: 92ES3-192
Office: ES3
Contract #: F30602-93-C-0219
PI: Barry Miracle
Title: A Semi-automated Downgrader for MLS Network Guards
Abstract: In the past C31 systems have been implemented either as a single, system high operating environment or as multiple, separate system high operating environments. The transfer of information between separate systems is generally restricted to transfer of data by hard-copy, or, more commonly, by removable media such as tapes or floppy disks. Because manual transfer procedures are time consuming and expensive, information cannot move quickly and efficiently enough to meet today's mission needs. To solve this problem, specialized computer systems called, Network Guards, are connected with the separate computer systems and provide high speed, secure transfer of information among the systems. The proposed Phase II effort will demonstrate the integration of new and existing technology. The Semi-automated Downgrader provides a highly assured process for releasing information from system high computers to system low computers.

SEMTAS CORP.
7217 MASONVILLE DRIVE
ANNANDALE, VA 22003
Phone: (703) 573-8454
Topic#: 90-034 ID#: 39708
Office: ES3
Contract #: F30602-93-C-0129
PI: William G. Duff
Title: Detecting Degraded or Soon-to-fail Cables and Connectors
Abstract: The Phase I effort resulted in two breakthroughs that show promise for detecting corroded connectors and degraded cables. Both breakthroughs apply the use of proven electromagnetic interference and compatibility (EMI/EMC) investigative techniques. The techniques involve the detection of nonlinear electromagnetic/radio frequency (EM/RF) effects present in corroded connectors and the detection of EM/RF energy transients generated when cables are flexed or moved that cause a "make-break" condition on the internal conductors of the cable. This Phase II proposal completes the research and application of EMI/EMC techniques to the measurement of nonlinearities and transients. Methodologies and test instrumentation will be developed. The test instrumentation will be designed with the specific characteristics and features for the detection of corroded connectors and degraded cables without disturbing the installation. One of the goals of Phase II is to provide developmental test instrumentation that will consist of commercially available off-the-shelf components and equipments with characteristics that can be production engineered for manufacture during a Phase III effort. A field demonstration will be performed on a "real world" operational system. A description of the methodology, instrumentation O&M procedures, final report and the hardware developed during the effort will be delivered.

SENSORS UNLIMITED, INC.
3490 U.S.ROUTE 1, BLDG 8
PRINCETON, NJ 08540
Phone: (609) 520-0610
Topic#: 92-056 ID#: 92PL2-015
Office: PL7
Contract #: F29601-93-C-0117
PI: Dr Gregory H. Olsen
Title: Advanced Diode Laser Structures for 2-5 um
Abstract: We propose to develop and deliver 3.3 um DFB lasers which operate at or near room temperature. These devices will have high-power (>10mw), single-mode, narrow line-width (<0.01nm) and be useful applications such as sensing methane (CH4) gas in parts-per-billion quantities. Our Phase I program demonstrated the fabrication of diffraction gratings near 3.7 um in GaSb with efficiencies of 31%. Our Phase II program will initially demonstrate the growth of n-type AlGaAsSb for 3.3 um using an innovative stibine (SbH3) generator and modified Al- and Ga-bearing alkyls to reduce carbon incorporation which turns the material p-type using MOCVD growth. This technique has the potential for high-volume production as envisioned for our Phase III program (commitment enclosed). We will then develop, characterize and demonstrate the 3.3 um lasers, including a demonstration of methane detection at parts-per-billion levels. We will also pursue development of 2.9 um DFB lasers, useful for water vapor detection. Dr R.U. Martinelli and the SRI David Sarnoff Research Lab will subcontract part of this work.

SIMPSON WEATHER ASSOC., INC.
809 E. JEFFERSON STREET
CHARLOTTESVILLE, VA 22902
Phone: (804) 979-3571
Topic#: 91-158 ID#: 91PAA-805
Office: PL4
Contract #: F19628-93-C-0196
PI: George D. Emmitt
Title: Lidar Mapping of Cloud Tops and Cloud Top Winds
Abstract: It is feasible for a space-based Doppler lidar (2 micron) of modes energy (< 1j) to detect winds near clouds and other high backscatter regions of the atmosphere. The probability of clouds being in the field of view is on the order of 70-80% based upon the most current analysis of satellite observations. While there are hardware issues unresolved regarding 2 micron technology, there are also pending questions related to the processing of Doppler returns from/near clouds and the algorithms needed to produce usable estimates of the horizontal wind components. We propose in this Phase II effort to: (1) develop a computer simulation model for a pulsed Doppler lidar designed to sample in the vicinity of clouds; (2) develop advanced algorithms for estimating winds using Doppler returns from clouds or other high backscattering media; and (3) use the simulation model to conduct lidar system trade studies leading to the specification of an optimal design concept.

SOFTWARE & ENGINEERING ASSOC, INC.
1000 E. WILLIAMS ST., STE 200
CARSON CITY, NV 89701
Topic#: 90-148 ID#: 93PL3-006
Office: PL3
Contract #: FO4611-93-C-0158

Phone: (702) 882-1966 PI: Curtis W. Johnson
Title: Combustion Processes in Space Storable Liquid Rocket Engines
Abstract: Computer software is to be developed that will provide a capability for studying the over-all performance of liquid fueled rocket engines. A generalized method will be used so that all engine cycles or current and projected usage can be evaluated, and compared on a consistent basis. The emphasis is to be placed on cryogenic propellants; specifically LOX/LH2. Other propellant combinations to be included are NTO/MMH, NTO/A5O, and LOX/RP-1. Engine components to be modelled include tanks, lines, valves, turbines, pumps heat exchangers, combustion chambers, etc. The effects of heat transfer on the performance of these devices are to be calculated. Pump fed engines are of particular interest. Steady state engine performance is to be derived after first calculating transient performance. The code is to be validated using transient data from existing engines, such as the RL-10. Extensive documentation will be provided so that the users can understand the basis for the analysis. An innovative feature of the project is the application of a "Fourth Generation" language to construct a Graphics User Interface (GUI). The GUI is to be designed so that the user is effectively guided in setting up the engines that are to be analyzed.

SOHAR, INC. Topic#: 92-051 ID#: 92ES3-151
8421 WILSHIRE BLVD., SUITE 201 Office: ES3
BEVERLY HILLS, CA 90211 Contract #: F30602-94-C-0013
Phone: (213) 653-4717 PI: Kam Sing Tso, PhD
Title: Reusable Ada Software Fault Tolerant Components
Abstract: The proposed research is a continuation and expansion of our successful Phase I effort which demonstrated the feasibility of (1) using an object-oriented approach to develop a set of reusable Ada software fault tolerant (SWFT) components, (2) developing a domain-specific repository management system using the Reliability Library Framework (RLF) developed under the STARS program, and (3) incorporating provisions for fault injection testing into the components to allow for reliability assessment on the unit, subsystem, and system levels. In the Phase II research, we will fully develop the reusable SWFT components encompassing recovery block (RB), N-version programming (NVP), and other fault tolerant techniques that do not require complete logical redundancy, exemplified by the primary/backup (PB) approach. Additionally, three SWFT Systems, (RB, NVP, and PB) together with a realistic mission critical application will be implemented to demonstrate the developed technology. A testbed consisting of three workstations, dual redundant network, and a graphical user interface will be developed for the creation, execution, and analysis of the resulting SWFT systems.

SPACE COMPUTER CORP. Topic#: 92-067 ID#: 92PL1-058
2800 OLYMPIC BLVD, SUITE 104 Office: PL1
SANTA MONICA, CA 90404 Contract #: F29601-93-C-0156
Phone: (310) 829-7733 PI: Nicholas J. Teneketges
Title: Application of Multi-chip Module Technology to Analog Electronics
Abstract: We propose to demonstrate an innovative new form of multi-chip module (MCM) technology to reduce the size, weight and noise levels in high-performance analog systems such as space-born infrared sensor preprocessors. In particular, we will employ special MCM interconnect structures to shield sensitive analog signal paths and to isolate circuits from noise sources. Based on the interconnect structures developed and evaluated in Phase I, we will design and fabricate a miniaturized, low-power analog MCM. This module will be designed as part of an analog preprocessor for an infrared focal-plane array, and will also be useable in a number of other analog applications requiring miniaturization and reduced weight such as millimeter-wave environmental sensors. The substrate hardware to be fabricated will be evaluated with respect to performance predicted in Phase I and demonstrated as part of an infrared sensor system. The proposed MCM technology provides an order of magnitude reduction in the size and weight of analog preprocessor systems over more conventional technologies. We will be assisted on a subcontract basis for Phase II by Aerojet's Electronic Systems Division. This firm is a leader in the development, manufacture, and operation of space-borne infrared sensor systems, including high-performance analog preprocessors.

SPAUCHUS ASSOC., INC. Topic#: 92-098 ID#: 92PL6-007
300 CORPORATE CENTER COURT EAGLE'S LANDING Office: PL6
STOCKBRIDGE, GA 30281 Contract #: F29601-94-C-0013

Phone: (404) 507-8849 PI: David R. Henderson
Title: Replacement of Refrigerant R12/R-22 Based Cooling Systems for Missile Guidance Systems
Abstract: Phase I of this SBIR contract investigated the feasibility of replacing the chlorofluorocarbon (CFC) refrigerant in the Peacekeeper GCCU/MECA/IMU with an atmospherically benign substance, HFC-134a. Polyolester lubricants were screened for suitability, and laboratory tests were applied to determine the most desirable from among four candidates. Identification of a preferred oil was accomplished. Since that time, it has become evident that formulation of the preferred lubricant has been improved by the manufacturer, and that other polyolester lubricants suitable for this application are available. This phase II proposal represents a logical continuation and broadening of compatibility studies necessary for successful retrofit of the system with HFC-134a and synthetic lubricants. The information to be generated is of value, both to the Government and to Spauschus Associates, Inc., due to high current interest among Government agencies as well as the private sector in replacing CFC-12 with a non-chlorine containing refrigerant. This proposal further describes development of a refrigerant system monitor and purge device which provides monitoring and early warning capability, not only that a given system has incipient problems, but also diagnosis as to what specific malfunctions are occurring. The concept has been developed and patents issued; the work to be accomplished here will reduce the invention to practice.

SPIRE CORP. Topic#: 91-014 ID#: 91MNP-157
PATRIOTS PARK Office: WL0
BEDFORD, MA 01730 Contract #: F08630-93-C-0080
Phone: (617) 275 3000 PI: Ms Patricia Sekula-Moise
Title: InP-Based HBTs for Extremely High Frequency Transmission
Abstract: Development of InP-based heterojunction bipolar transistors (HBTs) will make possible devices operating at hundreds of gigahertz. To produce these devices reliably and at minimum cost, new metalorganic chemical vapor deposition (MOCVD) processes specifically tailored for InP HBT structures must be devised. This proposal presents a comprehensive plan for optimization of both InP MOCVD processes and the accompanying HBT fabrication technologies; it is targeted at devices which will operate at frequencies up to 140 GHz. Phase I explored alternatives to IMPATT diodes; the InP-based HBTs grown achieved record performance. Phase II will build on this accomplishment, seeking to replace wave-guide implementation with a monolithic technology applicable to a wide variety of voice and data communication tasks.

SRS TECHNOLOGIES Topic#: 92-080 ID#: 92PL3-069
990 EXPLORER BLVD. Office: PL3
HUNTSVILLE, AL 35806 Contract #: FO4611-93-C-0173
Phone: (205) 971-7026 PI: Paul Armin Gierow
Title: Non-imaging Secondary Concentrator
Abstract: The solar thermal rocket requires the use of highly concentrated solar energy to heat and expand hydrogen gas. The hardware components needed to provide concentrated energy to an absorber consist of a concentrator system, pointing and control system, and support structure system. These components must be properly designed individually and matched as a system to provide the required flux at the absorber of a solar propulsion system. The requirements of the concentrator system include projecting a large flux of collected solar energy to a focal region located in an absorber of view angle matched to the concentrator. The Phase I results of this program demonstrated the feasibility of a focus extending secondary. The feasibility was demonstrated by analytical ray trace methods as well as laboratory experimentation. The use of a secondary optic is necessary for the single chamber concentrator. Phase II objectives are to refine and complete these activities through design, fabrication, and integration of a secondary optic and support structure into a large single chamber concentrator. Optical and thermal "on-sun" testing of the concentrator system will be done following the integration.

STR CORP. Topic#: 92-153 ID#: 92XRX-079
10700 PARKRIDGE DRIVE, SUITE 200 Office: XRX
RESTON, VA 22091 Contract #: F33657-93-C-2434
Phone: (703) 758-1100 PI: Wilfred Leon Goodson
Title: Deployment of Critical Analysis Tools for AF Planning (IOC in ASC/XR CWAC)
Abstract: This project deals with a "Conventional Warfare Analysis Center" (CWAC) whose purpose is to help improve

developmental planning. The project's technical objectives recognize that developmental planning cannot take place in a vacuum, but rather must work within the context of how the Air Force does its overall acquisition analysis and force planning. That context was established in Phase I which identified two critical analysis capabilities that must be present in CWAC (and a number of other places in the Air Force) in order for the "Strategy to Task" analysis framework to be implemented. This Phase II effort will put these two critical analysis capabilities in place in ASC/XR by providing two essential analysis tools: OME-IV--a campaign model that will be fast running, yet provide the capability of using both opposing air forces to best effect as stated by DoDI 5000.2 and the "Strategy to Task" framework. Interfaces will be provided which permit OME-IV and TAC-Thunder to be used together. (These are included in the core task, a Combat Effectiveness Estimating System (CEES).) The proposed optional tasks expand the scope of the current Fighter and Munition Planning System" to create a "CEES - Version 1.0."

SUNPOWER, INC.
6 BYARD STREET
ATHENS, OH 45701
Phone: (614) 594-2221
Topic#: 92-066 ID#: 92PL1-043
Office: PL1
Contract #: F29601-93-C-0207
PI: Lyn Bowman
Title: Microstructures for Heat Transfer in Stirling Micro-refrigerators
Abstract: Sunpower proposes to develop microstructures for heat transfer in novel Stirling microrefrigerators inside multi-chip module packages for removing heat at low temperatures from wafer scale integrated circuits in space systems. The microrefrigerator exploits the material properties, mechanical designs, tiny dimensions, and batch fabrication processes of silicon micromachining. If feasible, the microrefrigerator will enable electronic devices bonded directly to the silicon cold plate, or fabricated within it, to be operated at temperatures from 250K down to 60K or less, depending upon the application-specific design. During Phase I microscale heat exchangers and silicon micromachining processes for fabricating them were designed and numerous microrefrigerators incorporating these heat exchangers were simulated under Air Force electronics operating conditions. In Phase II these heat exchangers will be fabricated, tested to validate the theory used in their design, and mechanically integrated with circuit substrates and piston diaphragms as cold and warm plates for microrefrigerators that will be assembled under separate funding.

SUPERCONDUCTIVITY, INC.
2114 EAGLE DRIVE
MIDDLETON, WI 53562
Phone: (608) 831-5773
Topic#: 92-013 ID#: 92CEL-130
Office: WL4A
Contract #: F08635-93-C-0155
PI: DR MARK DAUGHERTY
Title: Use of Superconducting Magnetic Energy Storage (SMES) to Improve Power Quality for Critical Air Force Applications
Abstract: Superconducting Magnetic Energy Storage (SMES) can help meet Air Force requirements for stored electrical energy in a very efficient and reliable manner. One application of SMES is to provide stored energy to ride through short-term voltage disturbances. Poor electric power quality is costing large U.S. electrical power consumers billions of dollars a year in downtime, product loss, and equipment damage. We are proposing to demonstrate SMES technology for electrical energy storage as a method to improve electrical power quality for critical Air Force operations. SI will install and operate a superconducting magnetic energy storage system, called the SSD, for a period of one year. This 750kVA system has been designed and built to carry large critical loads through short duration electrical power sags and outages. During the operational period SI will continuously monitor the performance of all systems on the SSD. Power consumption, efficiency, and response to changing environmental conditions will all be recorded. In addition to the continuous monitoring of the system high speed data will be collected during disturbances on the electrical grid to verify system operation and protection of the load. These high speed files will also be analyzed to gain additional insight into the dynamic between the grid and the SSD.

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Phone: (805) 683-7646
Topic#: 92-106 ID#: 92WL2-073
Office: WL2
Contract #: F33615-93-C-1233
PI: Roger J. Forse
Title: High Temperature Superconducting (HTS) Switch
Abstract: STI has demonstrated the feasibility of HTSC phase shifters under contract F33615-91-C-1772. Results showed the capability of realizing HTSC circuits with RF operating powers up to 20W in the 6 GHz range without failure. This proposal

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contains a number of planned developments aimed at bringing the advantage of HTSC networks to a system ready reality compatible with existing phased array control requirements. Optimal low loss HTSC topologies are proposed to realize the best overall performances of minimum loss, lowest VSWR and phase accuracy for a broad band multi BIT phase shifter. In addition, switch topologies are incorporated, offering minimum losses with combined improvements due to cooling, and are based both on conventional and newer types of optical/HTSC switch developments. These advances are as a result of computer model developments and the necessary cooling techniques based on liquid nitrogen or closed cycle coolers. This proposal sets out to demonstrate small size high performance multi-BIT phase shifter assemblies having low distortion with high operating power levels of 10-20W, the goal being to develop the capability of realizing beam forming networks suitable for standard system control.

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Topic#: 92-112
Office: WL3
Contract #: F33615-93-C-1295
PI: Dr Peter P. Chow

ID#: 92WL3-025

Title: Carbon and Tellurium Doping Sources for Molecular Beam Epitaxy (MBE) of III-V Compounds

Abstract: For high temperature III-V compounds electronics good p- and n-type dopants are needed. Carbon and tellurium are considered promising candidates. We propose to investigate in detail MBE dopant sources for the two species. The program will be based on our Phase I effort which demonstrated that controllable carbon and tellurium fluxes can be accomplished. Good carbon-doping results have also been obtained. We plan to refine the techniques by optimizing the prototype designs and perform material and device structure evaluation. We expect to produce practical dopant sources for MBE applications.

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Topic#: 92-012
Office: PL1
Contract #: F29601-93-C-0205
PI: Sherman M. Seltzer, Ph.D.

ID#: 92-267

Title: Low Cost Space Structure (LCSS) Pointing Experiment

Abstract: The primary objective of the Low Cost Space Structure (LCSS) Pointing Experiment is two-fold. First: to provide a preliminary design of a packaged self-contained optical payload system. The payload package and extendable booms consist of spatially correct sparse optical elements. The payload package must be sufficiently versatile so that it can be used to perform a variety of military and commercial missions. Second: to demonstrate that the necessary precision pointing and control performance for a dynamically emulated large scale optical system can be achieved with a low-cost, lightweight space experiment. Preliminary design of a candidate carrier of this system, a lightweight low-cost satellite, is near completion. The satellite will be dynamically representative of a large space-borne optics system (such as a surveillance system, a communications system, or a Directed Energy System). Previous approaches for assessing this performance have been expensive, inaccurate, or both. The satellite will be comprised of a sparse representative optical payload carried onboard a low-cost lightweight spacecraft. Use of sparse elements minimizes cost, weight, and size of the experiment. A critical feature is the reliance on standard commercial parts, both hardware and software. The technical feasibility of this concept has been shown in Phase I.

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Topic#: 92-031
Office: ES2
Contract #:
PI: Bradley A. Rogers

ID#: 92ES2-028

Title: Integration of ADRI in JSIPS

Abstract: Phase I of this effort demonstrated to the Air Force the benefits of using ARC Digital Raster Imagery (ADRI) installed on a Joint Service Imagery Processing System (JSIPS) Softcopy Exploitation System in performing geopositioning on an uncontrolled reconnaissance image. This effort will address three major areas for improved methods of exploiting reconnaissance imagery using ADRI and ARC Digital Raster Graphic (ADRG) that were identified as a result of the demonstration: (1) The development of an imagery and metric support data format so that JSIPS can input both an ADRI and ADRG and use it directly with Eagle Vision or other sources to perform geopositioning and other functions. (2) Investigate the best approach for performing the image correlation function that is required for transforming points from ADRI into a reconnaissance image to

allow geoposition in the reconnaissance image, and for transforming a reconnaissance image into an ADRI format for mission planning and other uses. (3) This effort will provide the Air Force with a capability to use ADRI, A P3I plan for incorporating ADRI and ADRG into JSIPS supported by cost, schedule, risk assessment, new exploitation procedures and new products that can be achieved with this capability.

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Topic#: 92-100 ID#: 92WL2-011
Office: WL2
Contract #: F33615-93-C-1352
PI: Barry Griffiths

Title: Performance Enhanced Navigation Using Neural Network Technology (PENANT)

Abstract: Soft failures in aircraft navigation instruments have adverse consequences for mission effectiveness, crew workload, and maintenance costs. Significant improvements in the reliability of each navigation instrument have had only limited impact on the system availability problem, since the highly-integrated design of current aircraft navigation systems allows one failed instrument to contaminate the others. Previous techniques for controlling the effects of soft failures have had only limited effectiveness, due to the time-varying, unstable, random nature of navigation instrument errors. SYNETICS proposed solution is PENANT, which incorporates both model-based statistical methods (modified Kalman filters) and neural networks. The Kalman filters are used to perform dynamic normalization on the instrument data, providing composite measurements with time-invariant statistics to the neural net. The neural network is used to identify failure sources by detecting characteristic patterns in the composite measurement data. Reconfiguration is accomplished automatically, by optimally combining composite data from only those instruments diagnosed as healthy. SYNETICS proposes to deliver a detailed PENANT design and performance projections for a current-generation aircraft, such as an F-15. We will also deliver the PENANT Design Workstation and associated software. With our subcontractor, McDonnell Douglas Corporation, we will port this design to flight-qualified hardware and test it in a hardware-in-the-loop laboratory testbed.

SYSTEMS & PROCESSES ENGINEERING CORP.
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Phone: (512) 385-0082

Topic#: 91-083 ID#: 93WL2-120
Office: WL2
Contract #: F33615-C-93-1290
PI: Gary McMillian, Ph.D.

Title: Digital RF Memory Modulator

Abstract: Systems & Processes Engineering Corporation (SPEC) has developed an advanced GaAs Digital RF Memory Modulator design providing programmable time delay, Doppler frequency shifting, amplitude scaling, and phase shifting for IF signals. The modulator accepts 12-bit digital representations of the In-Phase and Quadrature components of the IF signal at 500 MHz and provides two independent 12-bit vertical and horizontal polarization outputs. Multiple outputs can be summed together to form a complete target and clutter signal environment for simulation of electronic countermeasures. An advanced design for a pipelined multiplier has been developed for use in a Numerically Controlled Oscillator (NCO), Doppler shift modulator, and phase/amplitude modulator. The unmodulated latency is 4 nsec, with each enabled modulator adding 20 nsec of delay. A synchronization signal is output when the initial time delay has expired and valid data is available. A synchronization input to the NCO permits Doppler phase coherency to be maintained across multiple channels. Simulations with 12-bits of precision throughout show a spectral purity better than 66 dB. Increasing the resolution of the modulation inputs and internal computations to 14-bits yields outputs compatible with TriQuint's 14-bit DAC and a spectral purity better than 70 dB.

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Topic#: 93-016 ID#: 93AFO-005
Office: AFOSR
Contract #: FQ8671-93-01678
PI: James H. Bechtel

Title: Multifunctional Polymers

Abstract: The objective of this work is to use new device architectures and techniques to develop nonlinear optical polymeric electro-optic modulators and switches with 1) large effective electro-optic coefficients, 2) simple and low cost fiber pigtails, and 3) lower insertion loss for high-speed communications applications. Based on our Phase I investigation of the device architecture and polymeric electro-optic material, we will focus on the device fabrication and optimization during Phase II. We will fabricate

polymeric E-O modulators using a new device architecture: the nonlinear optical polymers with different indices will be used in both waveguiding layer and cladding layer. Our theoretical calculations indicate that this arrangement can increase the effective electro-optic coefficient approximately 30%, and thus reduce the half-wave voltage (V) by 30%. The required modulation power will decrease by approximately 50%, and therefore, the modulator will be more efficient than the device of the same E-O polymer with only one NLO guiding layer. By incorporating a push-pull electrode structure, a factor of four increase of the modulation efficiency can be achieved. To lower the insertion loss, we will use an elliptical core fiber to match the mode pattern in the modulator for loss reduction and use an etched wafer with v-grooves to aid the fiber alignment and connection.

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Topic#: 92-031
Office: ES3
Contract #: F19628-93-C-0238
PI: James H. Bechtel

ID#: 92ES3-191

Title: Large Dynamic Range, Linear Response Laser

Abstract: A large dynamic range, fiber-optic analog data link is proposed for wideband communications. The link will be designed to minimize phase and temporal changes of the input RF/microwave signal as it is transmitted by the fiber-optic data link and provide 0 dB gain. The proposed data link will have a target frequency response from 5 MHz to 18 GHz. The link will use a low-noise laser and external modulator with a TACAN-invented distortion correction scheme. This distortion correction approach will include our novel optically-sensed, computer-controlled, universal feedback method for minimizing the nonlinearities of the link. The link will be designed to operate over a wide temperature range with switchable AC input voltage options or with 28 VDC input voltage. The success of our Phase I feasibility experiments bode well for the success of the Phase II program and the commercialization of this program in Phase III.

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Topic#: 92-066
Office: PL1
Contract #: F29601-93-C-0197
PI: Stephen R. Schaefer

ID#: 92PL1-024

Title: Thermal Management for High-Density Electronics Using Epitaxial Liftoff Technology

Abstract: We propose to combine the technologies of epitaxial liftoff and patterned overlay to form a powerful new approach to advanced electronics packaging. Single crystal semiconductor films which are about one micrometer thick can be produced using epitaxial liftoff technology. These thin films can be used to improve various aspects of electronics packaging. Some potential advantages are improved thermal management, higher density three-dimensional packaging, and flexible or nonplanar packages. Patterned overlays can be used with epitaxial films to provide mechanical support and electrical interconnection. In this program, we will combine these two technologies to develop a process which maintains the advantages of each separate technology. We will fabricate circuits to measure the thermal performance of epitaxial films of GaAs which have been transferred to other substrates. The results of our development will be used to demonstrate two novel packaging approaches, selected during the contract. The options which are presented for this development are: a passively cooled package, a forced-liquid cooled circuit, flexible packaging, cylindrical packaging, and three-dimensional packaging.

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Topic#: 92-142
Office: WL6
Contract #: F33615-93-C-2377
PI: Ron Grayson

ID#: 92WL6-039

Title: Unique Optical High Temperature Sensors for Turbine Engines

Abstract: Rapid, accurate, and minimally perturbing temperature measurements of turbine engine gases and components are important in the design and monitoring of advanced engines. Conventional temperature sensing technologies are inadequate for providing useful data in the harsh engine environment. We propose to develop a prototype fiber optic thermometer which uses thermographic phosphor emission spectral shifts or intensity changes to infer temperature. The phosphors will be located at the distal end of refractory lightguides. Use of a micro-optic module will greatly reduce sensor size and weight while increasing its vibration resistance. The excitation light source and its associated optics can be eliminated through use of a fluorescence

pump located in the probe tip. This also enables use of a greater variety of lightguiding materials for the probe. The developed sensor is expected to measure temperatures ranging from room temperature to approximately 1950 degrees C, with a minimum resolution of 20 degrees C, response time of less than one second, and about +1% full scale accuracy. This work will complement three other fiber optic thermometers we have successfully developed through SBIR Phase II and Phase III efforts. This prototype will satisfy a need for small, fast response, environmentally inert, and rugged sensors for extremely harsh environments.

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Phone: (303) 940-2301
Topic#: 92-147
Office: WL6
Contract #: F33615-93-C-2352
PI: Michael E. Karpuk
ID#: 92WL6-096
Title: Supercritical Heat Exchangers for Hypersonic Aircraft
Abstract: The heat loads on board military aircraft have increased with higher speeds and greater use of heat generating electronics. The heat load is dissipated by heating the fuel prior to its combustion. Today's aviation fuels, such as JP8, can be heated to 325 degrees F (163 degrees C) without significant degradation. This maximum temperature is constraining the design of future aircraft and their weapon systems. Advances in fuel chemistry may allow operation temperatures up to 900 degrees F (483 degrees C) which is above the critical point of most hydrocarbon fuels. Several problems must be overcome in the design of supercritical heat exchangers for high speed aircraft. First, there is a lack of data on heat transfer to supercritical hydrocarbons which makes accurate prediction of the heat transfer difficult. In addition, high frequency pressure oscillations have been observed at high heat fluxes. These oscillations can rupture stainless steel tubes in a few minutes. TDA Research proposes a systematic experimental investigation of supercritical heat exchangers suitable for high speed aircraft.

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Topic#: 91-018
Office: WL6
Contract #: F33615-93-C-2354
PI: Harold Howe
ID#: 91AVS-349
Title: Ceramic Brush Seals
Abstract: The purpose of this proposal is to develop ceramic brush shaft seals for gas turbine engines. Phase I demonstrated that ceramic brush seals can be manufactured and identified with the appropriate materials. The technical objectives of this proposal are to: (1) Perfect the manufacture of an all-ceramic brush seal; (2) Test appropriate aspects of the seal; (3) Demonstrate the seal's worthiness in an engine test rig; and (4) Provide sufficient test data to fully describe the all-ceramic brush seal. Testing of the ceramic brush seals will include leakage, pressure drop, bristle wear and rotor wear for selected coatings. Bristle tufts will be used to determine wear rate, bristle load and bristle drag. These tests will be carried out over a temperature range of 80 degrees F to 1550 degrees F. Attempts will be made to determine the rotors temperature rise due to bristle rubbing. All testing will be carried out on existing rigs. A gas turbine manufacturer will be involved in all phases of the work and will test the capabilities of a ceramic brush seal in an engine rig test. It is expected that ceramic brush seals will prove to be superior to their metallic counterparts in both wear and temperature capabilities. These superior attributes of ceramic brush seals can greatly enhance the industry acknowledged performance and efficiency of brush seals.

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Topic#: 92-023
Office: AL
Contract #: F41624-93-C-6016
PI: Owen D Brimhall
ID#: 92AL-114
Title: Advanced Development of New Actuators for Human Sensory Feedback
Abstract: The development of actuators with enhanced capabilities is critical to the achievement of sensory feedback systems for intuitive, real-time human operations of telerobotic systems. The objective of this research project is to continue development of new actuators using active materials which will enhance the capabilities of dexterous, exoskeletal feedback systems for telerobotic applications. In Phase I, feasibility of novel Terfenol-D driven actuators was demonstrated. The new actuators are efficient, responsive, small and exert relatively high forces. The actuators provide proportional forces and are easily interfaced with digital electronics because of low voltage requirements. Phase II will pursue advanced development of proportional force

resistive brake actuators and active linear actuators. The actuator designs will be optimized, fabricated and integrated into a digitally controllable exoskeleton demonstration test bed.

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Topic#: 92-132
Office: WL5
Contract #: F33615-93-C-5388
PI: Gail Bowers-Irons
ID#: 92WL5-195

Title: The Biodegradation of Spent Pre-preg Materials

Abstract: Thermoset resin impregnated yarns, fabrics and tapes (prepregs) comprise a significant fraction of the materials used in the fabrication of current and developing Air Force aircraft systems. Two problems exist, however, with the pre-preg materials. These materials have only a six-month shelf life and there can be residual or non-spec waste materials generated. The spent pre-preg wastes, now reported to be environmentally unsafe, may include uncured resin and rejects at all steps of the fabrication process. Current disposal methods such as incineration, autoclaving or landfilling will soon lack EPA acceptance due to the production of poisonous decomposition products. In response to this toxic waste problem, Technical Research Associates (TRA) proposes to develop a regulated and contained biodegradation process which would eliminate the reported environmental and health hazards caused by present disposal systems. Preliminary work has shown that TRA's biodegrading bacteria and/or fungi have the potential to degrade the spent pre-preg thermoset resins. This would allow the separated fibers to be recycled or safely landfilled.

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Phone: (301) 261-8373
Topic#: 92-135
Office: WL5
Contract #: F33615-93-C-5329
PI: Dr. Yue Cong
ID#: 92WL5-241

Title: Real-time, Self-directed MBE Flux Control Incorporating In Situ Ellipsometry

Abstract: The objective of the proposed program is to achieve fully automated control over electronic, electro-optic and microwave thin film devices grown by molecular beam epitaxy (MBE). The MBE control system will comprise two feedback loops: a process control loop incorporating auto-leaning capabilities and compensation for shutter opening transients; a materials properties control loop comprising a spectroscopic ellipsometer as the sensor. Both loops will cooperate through computer controlled growth supervision to produce repeatable films in accordance with a recipe film sequence established by the user. The devices used to demonstrate this MBE control system will be based on films of AlxGa1-xAs on InP, and other growth processes, such as MOCVD. Recipes for specific devices already have been supplied by a national laboratory. They will fabricate devices from these films and will evaluate their performance. During Phase III, the control technology will be made available to chip fabricators and epi-toll houses. To expedite this transfer, TA&T will form a wholly owned subsidiary that will provide control software, set up new MBE/ellipsometry control systems, retrofit existing systems, and advise during acquisition of accessory equipment and subsystems.

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Topic#: 92-020
Office: AL
Contract #: F41624-93-C-5017
PI: Charles J Benton
ID#: 92AL -148

Title: Implementation of the Semi-automated Flight Evaluation System (SAFES)

Abstract: Implementation of the Semi-Automated Flight Evaluation System (SAFES) is proposed. SAFES will improve flight training programs by providing specific, objective records of pilot flight data acquired in the performance of specific maneuvers. The system's conceptual approach is based upon extension of the performance recording and evaluation features of the Basic Flight Instruction Tutoring System (BFITS) to an aircraft based microcomputerized instrumentation package. Phase I has encompassed the preliminary design stage, component specification, feasibility analyses, and completion of a detailed design specification. Through testing of critical sensor technologies in an actual aircraft, development of SAFES has been proven feasible. This Phase 2 proposal addresses integration of a SAFES unit which will exploit recent developments in performance measurement (BFITS flight criteria methodology) and new hardware capabilities (low cost high performance microcomputers and flight instrumentation systems). Discussion of SAFES and BFITS integration is addressed including modification of the

BFITS flight model and enhancement of existing performance evaluation capabilities.

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Topic#: 92-119 ID#: 92WL4-070
Office: WL4
Contract #: F33615-93-C-3614
PI: Dr Richard J. Brown

Title: Common Input/Output (I/O) Interfaces for Vehicle Management Systems

Abstract: The principal technical objective of this SBIR Phase I study was to examine interface requirements of sensors and actuators associated with aircraft flight control and vehicle management system and determine applicability of DSP technologies towards creating common I/O modules to replace the various interfaces. A small, light weight, high capability adaptable Common Input/Output Interface (CIOI) was conceptually designed, its feasibility established and its implementation planned. By appropriate programming this CIOI is to replace the above mentioned interfaces. The principle CIOI module is an intelligent measurement and control device which achieves adaptability to various interface requirements by use of programmable analog/digital interface circuits, programmable digital arrays and a programmable Digital Signal Processor (DSP). The expected size of the compact CIOI module is only 3.125" x .875", including power supplies. All objectives were achieved.

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Topic#: 88-073 ID#: 88AL-019
Office: AL
Contract #: F41624-93-C-6018
PI: Dr. A. David Johnson

Title: Shape-memory Alloy Tactile Feedback Actuator

Abstract: In Phase I, feasibility of programmable arrays of tactile stimulators was demonstrated using nickel-titanium shape-memory alloy wires. These programmable tactile array are compact, light in weight, and deliver a tactile stimulation suitable for tactile feedback. In Phase II, we propose to utilize this technology to instrument gloves for tactile feedback. To fill a need for improved knowledge of the fundamental capabilities of touch sense as it applies to tactile feedback, we will collaborate with scientists at the University of California at Berkeley in psycho-physical tactile research. Existing engineering knowledge will be incorporated in a small number of programmable tactile arrays which will be constructed. These systems will be used as tools for tactile research aimed at virtual reality applications. A second generation of programmable tactile arrays will be designed, constructed and tested for use in virtual cockpit and teleoperator studies.

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Topic#: 91-082 ID#: 91ASD-825
Office: XRX
Contract #: F33657-93-C-2057
PI: Dr A. Vince Mrstik

Title: Advanced ECM/ECCM Modeling

Abstract: Recognizing the importance and critical need for fast executing radar ECM/ECCM simulations, Toyon Research Corporation identified an innovative approach for developing simulations which are very fast running, yet model all principal factors, including those which are computationally demanding. The feasibility of this new approach was impressively demonstrated during the Phase I effort in which it was applied to a simulation of semi-actively guided missiles against terrain bounce and towed decoy countermeasures. (A computer disk containing a demonstration version and ten example ECM/ECCM scenarios is included with this proposal.) When compared with conventional approaches, the new approach demonstrated an order of magnitude reduction in running time. This Phase II proposal is directed at using the new approach to develop a high quality simulation of the endgame interaction of a missile and its target in a complex environment including clutter, multipath, and ECM/ECCM. The simulation will provide ASD with an efficient means of exploring a wide spectrum of ECM/ECCM techniques over an extensive range of system and environment parameters. The proposed simulation is designed to use the graphical capabilities of readily available personal computers. Users may interactively work with the system to develop, refine, and/or analyze alternative ECM/ECCM designs. In addition the endgame simulation is formulated to provide a convenient interface with ASD's Surface-to-Air Missile Simulation (SASIM) which has served as a major simulation tool at ASD for nearly ten years. The interface will enable SASIM to include important endgame effects.

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Phone: (505) 345-5668
Topic#: 92-012 ID#: 92PL2-090
Office: PL1
Contract #: F29601-93-C-0145
PI: Timothy C. Tiernan
Title: Miniature, Ultrasensitive, Solid State Sensor for Atomic Oxygen
Abstract: A sensor system capable of monitoring the effects of atomic oxygen on a wide range of materials in the laboratory or in space is proposed. This research would lead to improved vehicle health, reduced mass and size from over designed components, and longer life for important structural components, yielding a positive impact on programs in hypersonic flight, the space station, government and commercial satellites, and other LEO missions. A collaboration with the Los Alamos National Laboratory (LANL) High Velocity Atom Beam Facility provided TPL access to a calibrated atomic oxygen beam. Prototype sensors were shown to have excellent sensitivity to atomic oxygen. Performance analysis indicated that sensors able to measure 8.8×10^{11}g, could monitor erosion rates over the course of one to five years. A flight ready panel, compatible with the standard satellite systems and containing an array of 10 sensors, each 1cm^2 by 0.1 mm thick and weighing only 0.02 g, along with support electronics, would occupy 100 cm3, weigh 150 g, and have average system power consumption of 1 to 2 mW. Benefits from the research include real time atomic oxygen monitoring capability for critical spacecraft materials, important data concerning atomic oxygen effects on a wide range of materials, and a new sensor technology with broad application in the areas of mass sensing, chemical sensing, and determination of thin film properties.

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Phone: (505) 344-6744
Topic#: 91-136 ID#: 91ETD-028
Office: WL0
Contract #: F08630-93-C-0078
PI: Richard W. Brotzman, Jr.
Title: A Nonlinear, High Energy Density Dielectric Material System for Discharge Capacitors
Abstract: Current Capacitor systems are materials limited. Current materials have low dielectric energy storage densities and are generally large, heavy, and difficult to maintain. The Phase I program demonstrated the feasibility of an organic/inorganic graft copolymer as a dielectric material system. This unique graft copolymer was fabricated into flexible films that have measured dielectric constants greater than 25 with low dissipation factors. The dielectric breakdown strength of the organic component was measured to be greater than 1.70 MV/cm. The Phase II program will develop capacitor stores for Air Force applications. Phase II will mature the organic/nonorganic graft copolymer by improving: inorganic particle size; the interface between the two phases; synthetic processing techniques; and film fabrication. Prototype capacitors will be fabricated at Sandia National Laboratories (SNL) under a CRADA Agreement between TPL and SNL. Prototype capacitors will be delivered to the Air Force for fire-set applications.

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Topic#: 92-173 ID#: 92WL0-167
Office: AD
Contract #: F08630-93-C-0067
PI: H. M. Staller
Title: The Development of an SCB Detonator for Fuzing, Safe, and Arm Systems
Abstract: The SCB chip is compatible with numerous explosives for primary and secondary detonators. The need exists to develop SCB technology for future AF in-line fuzing applications. TPL has demonstrated that a SCB/DXW-1 primary explosive detonator meets AF no-fire/all-fire requirements and a 500 micro Joules CDU will fire the detonator with 10 microseconds burn time. TPL has also developed a 25 mJ CDU to initiate a SCB/PETN secondary explosive detonator. In Phase II, TPL will complete the SCB primary detonator development including: new tungsten electrode plating and wire bonding; qualification of new chip bonding technique for better heat dissipation; development of a prototype design to meet environmental requirements; and complete definition of the threshold limits of a SCB/DXW-1 system for AF applications. TPL will expand the SCB technology to include secondary explosives to support requirements for 600-1000 V fuzing applications. This includes development of gold electrodes and wire bonds; design and testing of CDU assemblies to define timing and thresholds of selected explosives; development of a hermetic/coaxial SCB detonator; and design and manufacture of a SCB prototype system for AF fuzing applications. TPL will be supported by SCB Technologies, Inc. and the Energetic Materials Research and Testing Center, New Mexico Tech.

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Topic#: 92-157
Office: WL0
Contract #: F08630-93-C-0077
PI: Patrick E. Crane

ID#: 92WL0-127

Title: Integrated MMW Antenna/Transceiver for Coherent Focal Plane Imaging

Abstract: Efficient scanning and collection of focal plane data is a critical element in the use of modern digital baseband processing for image generation and other intelligence gathering purposes. Based on extensive background in two-plane, dual-polarized monopulse tracking systems, UBC Incorporated has developed a leap-ahead technology which promises a low-cost, high-performance solution for this vital function. Taking full advantage of several novel building-block technologies and proceeding from the embedded mixer techniques demonstrated in Phase I, UBC proposes to construct an experimental test array at W-Band and to develop associated processing algorithms and software capable of demonstrating image reconstruction. To complement the UBC-developed hardware and software, the experimental program will make full use of the Air Force Research and Seeker Emulator Radar (RASER) as a test bed for radar control, digitizing, storage, and other available functions. The program objective represents a major milestone in the advancement of polarimetric monopulse systems and in progress toward a full-up imaging radar.

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Topic#: 92-033
Office: ES2
Contract #: F19628-93-C-0226
PI: Arvind Goel

ID#: 92ES2-080

Title: NETMON - An advanced Fault Diagnosis and Correction System for CTAPS Network Management

Abstract: NETMON is an advanced fault diagnosis and correction system for real-time network management, monitoring, and control of CTAPS theater communications network. It provides significant capabilities above and beyond what is available in today's COTS network management tools. The Phase II implementation of NETMON will provide the Air Force with an integrated set of powerful network and system management tools for managing CTAPS elements, which include local and wide-area networks, a wide variety of interconnected distributed computing devices such as workstations (with peripherals), satellite, microwave, and radio terminals, routers, bridges, gateways, and the dedicated voice and data services. NETMON will be implemented on top of the industry standard Distributed Management Environment (DME) from Open Software Foundation (OSF). We believe that NETMON is the answer to CTAPS networking management needs for the present as well as the future due to the following reasons: advanced fault diagnosis and correction capabilities via expert system technology; manage diverse elements and detect faults before their occurrence; support for both TCP/IP and GOSIP-based networks; support industry standard DME and open systems architecture; runs on Unix/Posix workstations from IBM, Sun, HP, etc.; makes maximum use of COTS products; provides an extremely friendly user interface based on OSF/Motif GUI; and uses Ada as the development language. NETMON delivers the reliability needed to manage the mission-critical CTAPS network. The use of industry standard technologies ensures that new and more powerful COTS products can be easily integrated on the NETMON platform in the future.

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Topic#: 92-004
Office: AEDC
Contract #:
PI: Jonathan M. Hager

ID#: 92AED-030

Title: Heat Flux Calibration System

Abstract: One of the primary technical objectives will be to detail design, construct and commission a heat flux calibration system capable of performing calibrations at sensor temperatures up to 816°C. The heat flux calibration system will include an independent subsystem for heating and controlling the temperatures of mounting stages, one for the sensor being calibrated and another for a standard sensor. These stages will accommodate gages or sensors of 1.0 inch diameter or less. The equilibrium temperature of the sensor being calibrated (Teq) will be adjustable in 1°C increments up to 816°C. For calibrations in the range $20 \leq Teq < 260$°C, Teq will stabilize within ± 2°C; for the range $260 \leq Teq < 400$°C within ± 3°C and for the range $400 \leq Teq < 816$°C within ± 5°C. The equilibrium temperature of the reference standard will be maintained constant within ± 2°C. Another primary technical objective will be to specify and purchase a heat flux source for use with the heat flux calibration system. The heat flux source will be a high pressure xenon arc lamp with power supply and all necessary optical

elements and controls. The required components for control of pulse duration, irradiation intensity and uniformity will be supplied, along with the necessary mounting and control hardware to integrate the functions of the source with those of the rest of the heat flux calibration system. To achieve the maximum specified heat flux, the arc lamp may be overdriven in a pulse mode. If so, the heat flux source and its controls will be designed to do this in a safe and reliable manner.

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Phone: (617) 273-2820
Topic#: 92-081 ID#: 92PL4-030
Office: PL4
Contract #: F19628-93-C-0070
PI: Orr Shepard
Title: Lidar Detection of Space Debris
Abstract: We propose to develop a proprietary satellite-borne CCD imager for the purpose of detecting and measuring the velocity and size distributions of space debris particles in the critical size range of 0.1cm to 10cm. Adequate characterization of space debris is essential to a cost effective design since the impact of space debris, particularly in the 1cm range, can produce catastrophic failure. These particles are sufficiently numerous and large enough to present a serious threat to spacecraft. The proposed instrument will be capable of finding and measuring the velocities of several hundred debris particles during the course of a 6-12 month mission. This will constitute an adequate number of detections to carry out a meaningful assessment of the NASA standard model for debris size and velocity distributions. The technology used in the proposed passive CCD imager and the space debris data obtained by it can be directly applied to the development of a space debris lidar system which will provide enhanced particle measurements. The Phase I research resulted in preliminary designs for a satellite-borne lidar system for the detection of space debris and a related space debris imaging detector.

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Phone: (617) 273-2820
Topic#: 92-083 ID#: 92PL4-032
Office: PL4
Contract #: F19628-93-C-0119
PI: Orr Shepherd
Title: Targeting/Tracking Lidar Systems
Abstract: With the advent of compact solid state lasers, IR focal plane array imagers, and miniaturized electronics, it is possible for the first time to develop a simple transportable lidar capable of being manually pointed to targets of interest and for tracking moving targets. By using a new innovative Raman-shifting technique, a standard Nd:YAG laser can be used for eyesafe operation. This now permits a lidar to be used at any location with moderate safety requirements. It also means that this lidar can be developed as a commercial product to be marketed to university and industrial research organizations having an interest in remote sensing. Another innovative feature of this lidar is the capability to alternate the polarization of each pulse of the transmitted laser beam. Polarization analysis of the backscatter is performed in the receiver. With IR and video cameras on the lidar pointing platform, it will be easy to merge the passive IR/visible spatial data with lidar data at multiple wavelengths. The objective of the Phase II effort will be to develop this lidar which can then be produced in Phase III to meet DoD requirements and commercial market needs.

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Topic#: 92-030 ID#: 92AL -213
Office: AL
Contract #: F41624-93-C-5016
PI: Allen Batteau
Title: Frame/Work: Human Issues in CALS Implementation
Abstract: This proposal describes the creation of a tool that will: assist a manager in assessing the receptivity of a SPO or ALC to the implementation of CALS technologies, and recommend to the manager alternative implementation strategies based on experience in other SPOs and ALCs. Building on the findings of the Phase I Frame/Work research, it constructs a model of work group culture within the SPO or ALC, based on characteristics of the work group environment. In Phase I the key variables in the work group environment were identified, and several validated for one SPO; in Phase II, the validation of all variables will be extended to single program SPOs, basket SPOs, and ALCs. This ecological model of work group culture supplies the engine for the management decision support tool. The tool combines a self-assessment module, an experience base of successful strategies in SPOs and ALCs, and a recommender identifying which strategies are optimal in a given

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human/cultural environment. In the course of the Phase II research, we further propose to create a user community whose history of usage of the Frame/Work tool will further enhance the experience base.

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Topic#: 92-092 ID#: 92PL6-092
Office: PL6
Contract #: F29601-94-C-0012
PI: Kurt E. Golden

Title: Electromagnetic Transmission Through Plasma

Abstract: The application of GPS based navigation to future hypersonic vehicles potentially improves navigational performance compared with current approaches using advanced inertial instrumentation and at a much lower cost. The Phase I study clearly demonstrated that GPS applications in a hypersonic environment are feasible provided that the designers address critical issues relating to vehicle dynamics, GPS signal processing, coupling of inertial measurements with GPS, antenna coverage, reentry environment, GPS coasting during antenna coverage and reentry signal loss, and re-establishing GPS lock-on after coasting period. The inclusion of inertial navigation (INS) measurements with GPS greatly enhances navigation performance by aiding in GPS signal processing velocity and acceleration compensation, coasting during loss of signal, and after coast GPS lock-on. The Phase II effort will build on the Phase I study to develop and deliver a GPS/INS hypersonic environment engineering workstation that will analyze navigation performance of GPS/INS applications including GPS errors, range marking, ionospheric effects, antenna coverage, plasma sheathing, thermal noise, plasma noise, signal strength, signal processing, satellite coverage, antenna window aerothermal and present the dynamic simulation results graphically in terms of vector position, signal strength, satellite and hypersonic vehicle ground tracks, satellite tracks in antenna space, antenna patterns, reentry environment, GDOP's and PDOP's.

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Topic#: 92-047 ID#: 92ES3-095
Office: ES3
Contract #: F19628-93-C-0214
PI: Burton S. Abrams

Title: Anti-multipath System for Measurement of Ultralow Sidelobe Antenna Patterns

Abstract: Implementation and testing of a hardware feasibility model of a novel technique is proposed to resolve and suppress the multipath components of an antenna range measurement test signal. The technique achieves time delay resolution much finer than the reciprocal of the bandwidth of the test signal. As a result, ultra low sidelobe antenna measurements can be made in real time without using an ultra wideband test signal and without corruption by unavoidable multipath artifacts on the antenna test range. Computer programs that simulate the operation of this new anti-multipath system. AMPS have been used to optimize the system parameters for the accurate real-time measurement of ultra low sidelobes and nulls of a modern antenna array. During the Phase I effort, design definition of a hardware AMPS prototype was formulated to demonatrate implementation feasibility. Under this Phase II effort, a feasibility model will be implemented and tested to demonstrate in hardware the effectiveness of the novel technique. The proposed AMPS model is suitable for testing at most antenna ranges including Rome Laboratory sites at Ipswich, MA, and Newport, NY.

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Topic#: 92-033 ID#: 9210692
Office: DSO
Contract #: DAAH01-94-C-R007
PI: Kevin Stuffle

Title: Injection Stereolithography Method for Net Shape Fabrication of Reinforced Ceramic Components

Abstract: This program will develop a flexible manufacturing process for ceramic and ceramic fiber composite parts. The process is solid free-body forming (SFF) using fused deposition of "no-shrinkage" ceramic slurry formulations. In the process a computer converts CAD drawings to motions of a nozzle which delivers heavily loaded ceramic formulation. The component geometry is built through successive depositions. The green component is subsequently fired to produce the dense ceramic component. Phase I demonstrated a working system that directly read computer CAD drawings of simple components and then generated the actual green components. The green components were fired to high density and strength. In Phase II the SFF process will be upgraded to make complex three dimensional components directly from 3D-CAD drawings and will be extended to several other ceramic systems. Anticipated Benefits: This program will develop prototype manufacturing equipment for producing small volumes at very low cost for use with a wide variety of ceramic and composite systems. The process will be capable of producing high quality microstructures and good mechanical properties.

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Topic#: 91-024 ID#: 9110415
Office: MTO
Contract #: DAAH01-93-C-R158
PI: J. Wang

Title: Non-Destructive Evaluation of Impurities and Defects in Ultra-Thin Semiconductor Films

Abstract: The development and demonstration of a non-destructive technique to evaluate thin film semiconductor materials will be completed in this Phase II project. The proposed technique is based on the fact that inhomogeneities in a semiconductor produce bending of the energy bands in their vicinity. This band bending will separate any excess carriers in the region, producing a small voltage. Therefore, by using a probe light to generate excess carriers and measuring the photo voltage (PV) as a function of the probe location, a map of the inhomogeneities can be generated. ARACOR's innovations are directed toward optimizing this technique to (1) evaluate ultra-thin films, (2) extend the resolution to the theoretical limit, and (3) extract parameters of manufacturing significance from the data. In Phase II, (1) detailed theoretical analyses will be performed to quantify the technique and provide the basis for the algorithms needed for parameter extraction, (2) hardware will be modified to reduce noise, improve resolution, and shorten measurement times, and (3) the PV data will be correlated with the responsible contamination and defects. Although the PV technique can be applied to any semiconductor, Silicon-On-Insulator will be used in this project not only because of its commercial and military importance, but because excellent samples are available for the calibration and correlation studies. Anticipated Benefits: The proposed PV system will accelerate the development of improved SOI materials and provide a more accurate an cost-effective means to specify and qualify them. It will replace the destructive delineation etches now used to measure the defect density. It will assess the uniformity of the implant used to manufacture SIMOX and detect contaminants such as iron. It will provide a unique capability to measure the minority carrier diffusion length directly in the thin film. Since our objectives are based on requirements provided by Ibis Technology and Texas Instruments, successful completion of Phase II will ensure commercialization of this system.

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Topic#: 91-033 ID#: 9110397
Office: MTO
Contract #: DAAH01-93-C-R135
PI: Edward Franco

Title: X-ray Microlithography Collimator Development

Abstract: X-ray proximity lithography is a leading candidate for the fabrication of integrated circuits with characteristic dimensions below 0.35 microns. The transition of critically important Dynamic Random Access memories (DRAMs) from 64 Mbit to 1 Gbit devices becomes practical with this submicron fabrication capability. Point x-ray sources are presently being developed with ARPA and industrial support as the basis for modular lithographic systems that support the flexible microelectronic fabrication lines of the future. Phase I demonstrated that multilayer based, paraboloidal collimators offer wafer throughput advantages over the traditional divergent point source configuration. Phase II will empirically demonstrate the lithographic performance of a multilayer based collimator for x-ray proximity lithography. This objective will be met by the

fabrication of a collimator, its integration into a laser plasma proximity lithography test-bed, and the execution of benchmark experiments designed to quantify wafer throughput, x-ray transport and feature printing properties. Anticipated Benefits: A successful project will set in place the collimator technology, that when coupled with concurrent development of higher power x-ray sources and more sensitive resists, will allow point source proximity x-ray lithography to achieve an economically viable wafer throughput. This will provide the U.S. semiconductor industry with a practical, efficient, and cost effective means for printing devices with features below 0.35 microns. Anticipated Benefits/Potential Commercial Applications - A successful project will provide to the U.S. semiconductor industry a practical, efficient, and cost-effective means for implementing next-generation x-ray contact microlithography exposure techniques. It will additionally set in place an advanced x-ray optics technology that supports following-generation projection microlithography techniques.

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Topic#: 92-065 ID#: 9210480
Office: ASTO
Contract #: DAAH01-93-C-R279
PI: Ih-Houng Loh

Title: Electronically-Controllable Filter Based on Polymer Dispersed Liquid Crystal Materials

Abstract: Thin film materials consisting of random dispersion of nematic liquid-crystal microdroplets embedded in an isotropic transparent polymeric media (polymer dispersed liquid crystals or PDLC) were developed in the Phase I work for use in optical and electro-optical devices. In the Phase I program, we studied some of the possible PDLC fabrication techniques and how these affected the opto-electronic properties of the PDLC elements. We found limitations in the ability of the process to provide for very narrow droplet size distribution, and difficulties in achieving large droplets size for devices operating in the infrared part of the spectrum. The homogeneous nature of nucleation in the processes employed in the Phase I work provides for a single parameter, quench temperature, which controls the droplet sizes, size distributions, and concentrations. Two main goals are targeted in this Phase II proposal; the first is to devise new methods to control the concentration and size of liquid crystal droplets within the device matrix; this will allow for tailoring devices to operate optimally in different segments of the spectrum, including the infrared. The second primary goal is to develop manufacturing techniques enabling the production of large area devices to provide device availability for large area applications. An additional goal will be to determine how these fabrications will affect the opto-electronic properties of the PDLC materials. Finally, several potential device applications based on PDLC materials will be demonstrated. Anticipated benefits: Commercial applications for PDLC materials are expected in the fields of large area electro-optical displays, thermal indicators, light valves, solar control windows, IR modulators, switchable windows, and high definition spatial light modulators.

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Topic#: 92-044 ID#: 9210980
Office: DSO
Contract #: DAAH01-93-C-R285
PI: David Kurtz

Title: In-Situ X-Ray Detector

Abstract: In-situ monitoring of critical material properties would greatly enhance process control of numerous manufacturing technologies. ATM, working with Pennsylvania State University, was fully successful in making use of an in-situ x-ray device for real-time monitoring of chemically vapor deposited metals and oxides. The device, referred to as a position sensitive scintillation detector (PSSD) was modified in Phase I for use in a reactor environment to simultaneously measure critical film parameters such as phase composition, degree of crystallinity, texture, thickness and residual stress. All Phase I objectives were met. Compared to traditional x-ray diffraction systems, the PSSD system has very, very rapid sampling times (7 times faster than traditional systems). In Phase II the angular range and sensitivity of the in-situ PSSD system will be further enhanced to allow for incorporation into commercial scale CVD reactors. Active feedback loops will be incorporated for process control capability. Vapor-deposited thin films of diamond and metals, critical to MCM technology, will be investigated in a large area CVD reactor. Completion of this effort will result in a prototype commercial detector which ATM will market to the semiconductor industry. Anticipated benefits: A commercial in-situ x-ray diffraction device would be applicable to process monitoring, analysis, and control for numerous manufacturing technologies. Major impacts on quality and yield will lead to rapid industry acceptance of this device in thin film coating, metal forming, ceramic sintering, fiber/composite manufacturing and non-destructive evaluation (NDE) applications.

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Topic#: 92-123 ID#: 9210703
Office: ASTO
Contract #: DAAH01-93-C-R184
PI: Richard Miake-Lye

Title: Study and Demonstration of Contrail Suppression by Controlling Fuel Sulfur

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: 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, either in frequency of occurrence or magnitude, would have broad ranging application to low observable aircraft. Applications to commercial aviation could also be possible in the future as contributions of such flights to atmospheric pollution become better understood.

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Topic#: 91-239 ID#: 9120091
Office: MSTO
Contract #: DAAH01-93-C-R348
PI: Otto Adlhart

Title: Load Responsive Hydrogen Generator for UUV Application

Abstract: A program for the development of a hydrogen generator for use with PEM fuel cells in UUV applications is proposed. Pressurized hydrogen is generated by reacting alkali-metal hydrides with water to be derived from the PEM fuel cell. Energy densities approach 1 Kw-hr/lb. The proposed effort is concerned with the design, fabrication, and evaluation of a generator with 50 Kw-hr. capacity capable of sustaining PEM cell operation at the 3 KW output level. The hydrogen generator is gas cooled, unaffected by vehicle position and motion and serves as a precursor for a generator to be developed for the 21" vessel. Furthermore, under the proposed effort, subsystem design and test data are being developed, which are aimed at maximizing space utilization. This information is incorporated in the design of a generator with 500 Kw-hr. capacity to be used in the 44" vessel. Anticipated benefits: The hydrogen generator to be developed under the proposed program, if combined with PEM fuel cells for power generation, offers energy densities substantially superior to batteries in UUV, man portable, or standby applications.

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Topic#: 92-049 ID#: 9210391
Office: DSO
Contract #: DAAH01-93-C-R297
PI: Robert Tenney

Title: Wavelets and Failure Prediction for Helicopters

Abstract: Phase I of this effort demonstrated the technical feasibility of using continuous wavelet transforms to detect and classify failures in a helicopter gearbox using single-channel accelerometer data from Navy bench tests. The key technical advance in Phase I was the construction of an analyzing wavelet that: 1) provided appropriate resolution in time/scale space for this class of mechanical systems, 2) allowed features characterizing each fault type to be readily identified, and 3) permitted efficient

(150)

calculation of feature values from sensor data. Feeding these features into a conventional three-level, feed-forward neural net with deferral led to perfect detection, perfect classification, no false alarms, and modest (<5%) deferral rates. Phase II will extend this approach to more realistic helicopter systems. The principal issues to be addressed will be: 1) use of phase information available from multichannel systems to separate signals from different sources, 2) scheduling feature selection based on the operational mode of the helicopter, and 3) the detailed design of a real-time feature extraction device employing off-the-shelf electronic technology. These will permit the technique demonstrated in Phase I to be applied to gearboxes with several dozen moving elements on-board a helicopter with many other vibrating components, operating over a wide range of flight regimes. Anticipated benefits: Successful completion of Phase II will yield a relatively inexpensive approach to highly reliable detection and classification of gearbox faults for helicopters in both commercial and military fleets, resulting in high crew and passenger safety along with significant cost savings through minimal scheduled maintenances (having been supplemented with condition-based maintenance), decreased maintenance troubleshooting time, decreased spares inventories, and increased aircraft availability.

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Topic#: 92-081 ID#: 9210673
Office: SSTO
Contract #: DAAH01-93-C-R301
PI: Chris Maeda

Title: Loosely-Coupled Network Database for Information Retrieval

Abstract: We propose to implement an inexpensive, high-performance, distributed substrate for Information Retrieval (IR). The substrate will use networked microcomputers to do parallel searches over large text databases using IR client/server models. Our Phase I design was found to be feasible, and documented specific management functionality in detail. It also provided performance models based on queueing theory to aid prototype evaluation. The principal advantage of our network substrate is its generality. Since it is IR method-independent, it will be able to accommodate the new, advanced IR methods being developed by government and industry. Moreover, its heterogeneity enables different platforms to be incorporated into the IR network. Special attention was given towards ensuring that the prototype could overcome problems associated with the management of distributed systems. In Phase II, we propose to develop the generic network substrate and to implement IR methods for it. The prototypes constructed in Phase II will serve as a vehicle to evaluate the system's management framework. They will also enable us to: experiment with management methodologies, construct automated management tools that alleviate a number of management difficulties, and assess our system's performance so that it may be compared with other IR systems. Anticipated benefits: This project can lead to cost-effective platforms, scalability, and fault-tolerance for IR applications that are better than centralized implementations and easier to manage than current distributed IR systems. The eventual technology could be applied to the healthcare and research fields -- reducing the costs of IR systems in each area.

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Topic#: 91-018 ID#: 9110502
Office: NMRO
Contract #: DAAH01-93-C-R159
PI: Victor Tom

Title: IMS Imagery Workstation for Detection & Analysis of Mining Sites

Abstract: This Phase II SBIR proposal focuses on advanced automated techniques for detecting mineral development sites from remotely sensed imagery. The proposed program builds directly on the results of Atlantic's Phase I work, in which morphology-based algorithms were shown to detect mines and areas of change in mines using SPOT multi-spectral and panchromatic imagery. Our approach exploited spectral, size, shape and texture features to detect open mines in rural and urban landscapes. In addition we demonstrated color and spatial enhancement algorithms which improved image interpretability. Our proposed work in Phase II is aimed at providing this sophisticated image processing capability to the Intelligent Monitoring System (IMS). We propose to accomplish this by integrating an advanced imagery workstation based on off-the-shelf technology, commercial image processing software and our own custom software and/or hardware to perform the advanced mine detection algorithms. The primary purpose of the proposed system would be to assist the IMS analyst in understanding seismic activity by allowing the analyst to correlate this activity with above surface features such as open mines. Anticipated Benefits: The mine detection and change detection system developed under the proposed program will demonstrate robust image screening and cueing capability on low-cost high-performance workstation platforms. This same technology has a direct application to intelligence imagery analysis (wide area search) and tactical battlefield reconnaissance (detection of military vehicles). Other

applications include document screening in which documents are automatically analyzed, prioritized and presented to analysts for examination.

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Topic#: 90-119 ID#: 9020507
Office: ASTO
Contract #: DAAH01-93-C-R166
PI: Verne Lynn
Title: Automatic Detection of Scud Tracks from MTI Radar Data
Abstract: In Phase I, a new class of detection algorithms was successfully developed and demonstrated, using morphology-based signal processing methods, for detection of associated discrete and extended linear objects. These were respectively towers and power lines but the algorithmic techniques are general. In Phase II the techniques will be extended and applied to the automated detection of SCUD tracks in MTI radar observations and their association with buildings or structures where the missile launchers are hidden. JSTARS was used for the first time in Desert Storm and was in a position to observe approximately 30 SCUD launches. For well understood reasons, no SCUDs were observed but at least some data were recorded and are available for analysis. In Phase II, a methodical examination of these data will be undertaken without the pressures of conflict, to try to identify SCUD observations. The data will then be used to design adaptation of the algorithms developed in Phase I to detection of SCUDs. This application was selected for Phase II because it combines the critical need for automated processing for this sensor, the importance of the target and the general applicability to solution of wide area surveillance problems being pursued by the ARPA War Breaker program. Anticipated Benefits: The proposed Phase II addresses one of the major technological problems identified in the War Breaker program as essential to success of wide area surveillance against time critical targets. As such, it is anticipated that successful achievement of the goals will directly apply to War Breaker objectives. This is essentially a military problem but has general applicability to commercial use as well.

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Topic#: 91-119 ID#: 9120539
Office: DSO
Contract #: DAAH01-93-C-R002
PI: Adrian Smith, Jr.
Title: X-Ray Pinhole Camera for Electron Beam Welding
Abstract: Welding using high-energy electron beams (HEEBs) offers potential advantages over conventional electron-beam welding (EBW) technologies, including making very high quality welds in very thick and/or large workpieces at or above atmospheric pressures (i.e., no vacuum vessel required) within a variety of controlled working gas environments. Thicker workpieces can be accommodated more easily than with conventional EBW technologies because HEEBs offer more robust and deeper propagation into the workpiece. The objective of this effort is to (1) fabricate and demonstrate a real-time process monitor that uses the x-rays emitted by the beam to "illuminate' the weld in progress and (2) analyze further the interaction between the high-energy electron beam and the workpiece. A preliminary monitor design developed in Phase I is discussed in this report. The results of this effort will be (1) a firm basis for the engineering design and construction of prototype HEEB welding x-ray monitor hardware, and (2) a improved understanding of the HEEB/workpiece interaction physics that provides the basis for a judgement concerning the fundamental utility of high-energy beam welding processes. These end products are basic constituents of a prototypical HEEB demonstration facility. Anticipated Benefits: Industries that would benefit directly from HEEB welding and materials processing include auto makers, airplane manufacturers, composite manufacturers, the nuclear industry, the railroad industry, ceramics manufacturers, shipbuilders, and the electric transformer industry, to name a few. The x-ray imaging monitor is a critical element of a feasible HEEB system in that it provides a real-time, remote means of assessing welding or materials processing operations.

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Topic#: 91-020 ID#: 9110495
Office: ESTO
Contract #: DAAH01-93-C-R185
PI: Eric Strid
Title: High-Density, High-Speed Wafer Probe Technology
Abstract: Conventional wafer probe technology is hampering the development of large, fast ICs and MCMs. When conventional

needle probe cards are pushed to hundreds of needles, they are too fragile and too expensive, and are not capable of the high-frequency operation required. The mission of the proposed program is to develop a next-generation, cost-effective, high-density, high-speed probe technology. This technology builds upon Cascade Microtech's existing thin film expertise for the critical membrane fabrication, Cascade's experience in high-performance probing, and Hewlett-Packard's membrane probe technology developments, which are licensed to Cascade. This program will demonstrate wafer probes with hundreds of I/O lines with multi-GHz bandwidth and ground and power lines with much lower impedance than needles (both required for high-speed signal integrity), practical manufacturing costs, and probing of area arrays of IC pads. This program will also perform probe evaluations at IC production houses and ensure compatibility with probers and testers. Costs will be shared with Cascade Microtech, Inc. Anticipated benefits: These next-generation wafer probes will be broadly used in high-performance commercial and military semiconductor foundries for research, development, and production measurements and testing.

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Topic#: 91-178 ID#: 9120400
Office: ESTO
Contract #: DAAH01-93-C-R140
PI: Anantha Krishnan

Title: Virtual Prototyping Tools for Semiconductor Fabrication Equipment

Abstract: The goal of this project is to integrate existing software tools from a variety of disciplines (such as CAD/CAM, Fluid Dynamics, Structures, Graphics and Expert Systems) to develop an environment capable of virtual prototyping reduces the time and expense involved in developing new designs with the added advantage of being able to optimize equipment performance. The Phase I study demonstrated the proof-of-concept of virtual prototyping by integrating software from CAD/CAM, Process Analysis and Graphics/Visualization. The integrated tool was used to optimize deposition uniformity for a Varrel Chemical Vapor Deposition (CVD) reactor by suitably varying the operating conditions. The proposed Phase II work involves further development in: (a) Interfacing with commercial TCAD models; (b) Refining the process model to account for plasma chemistry and particle generation and transport; (c) Developing Standards and Interfaces between models; (d) Extensive Application and testing of the integrated tool; and (e) Customizing, documenting and packaging the tool for use by the industry. Implementation of a Knowledge-Based Expert Control System is also proposed as an optional task. The development and testing of the integrated software will be done in collaboration with a number of organizations such as SEMATECH, TMA Inc., SVG, Inc., and Genus, Inc. The final product will be demonstrated in a workshop organized by SEMATECH. Anticipated Benefits: Virtual prototyping will eliminate/reduce the necessity for time consuming and prohibitively expensive experimentation with hardware. The application of the developed tool will result in dramatic improvement in product design and development time and thus have a direct impact on the competitive position of the U.S. semiconductor industry.

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Topic#: 91-001 ID#: 9110487
Office: ASTO
Contract #: DAAH01-93-C-R136
PI: Sammy Henderson

Title: Development of a Compact 2 um Coherent Laser Radar Vibration Sensor

Abstract: Remote sensing of vibrations using coherent laser radar has been identified as a means of identifying remote targets by analysis of characteristic vibration spectra. CO2 laser technology has been used in efforts up to the present. Recent advances in eyesafe solid-state 2 micron laser and laser radar technology make possible a more sensitive, compact, shorter wavelength alternative, highly compatible with the requirements if a ruggedized remote vibration sensor. Operation at this wavelength results in a minimum detectable vibration amplitude which is roughly one fifth that of comparable CO2 systems. In the Phase I effort it was analytically demonstrated that a short wavelength coherent laser radar has the inherent ability to sense surface displacement of a target object as small as a few microns and velocities of millimeters per second at ranges of several kilometers. It was argued that such measurements could in principle be made from a moving aircraft of ground or airborne targets. Experiments were also performed showing feasibility for a 1-2 W cw 2 micron laser having the required coherence. In this Phase II effort the motion detection capability of a 2 micron coherent laser radar will be experimentally demonstrated using a low-power 2 micron coherent laser radar. A 1-2 W 2 micron laser source having the required coherence will also be developed. An assessment will be made of the potential of a laser radar diagnostic or detection adjunct to a passive IR and/or microwave radar ground or airborne target surveillance system. Anticipated Benefits: Numerous military and commercial applications exist for a compact, efficient eyesafe remote vibration sensor. Machine vibration analysis in industrial environments would

directly benefit from the proposed instrument. Similar transmitters employing pulsed operation would find immediate use in helicopter wire avoidance, meteorological research, on-board windshear avoidance, pollution monitoring, and ground-based wind sensing systems.

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Phone: (603) 643-3800
Topic#: 91-178 ID#: 9120161
Office: ESTO
Contract #: DAAH01-93-C-R074
PI: James Barry
Title: Advanced Software for Virtual Prototyping of Semiconductor
Abstract: Application of simulation and modelling to the design of semiconductor fabrication equipment will reduce development time and costs and promote innovation in semiconductor manufacturing. We propose to develop advanced software for virtual prototyping of chemical vapor deposition (CVD) and etch reactors for integrated circuit manufacturing. The software, will perform physical modelling of fluid flow, heat and mass transfer, and chemical reactions within the reactor, and will feature an intuitive graphical user interface, embedded data specific to CVD/etch reactors, and automated operations. The features will provide a quantum improvement in ease of use by engineers in industry, enabling widespread application of virtual prototyping to equipment design. An existing commercial CFD code will function as the computational engine. Appropriate hooks will be included in the software for extension and communication with other numerical modelling tools. Anticipated Benefits: The virtual prototyping software will reduce costs of semiconductors to the DOD by making development of semiconductor fabrication equipment faster and less costly. New concepts can be tested more easily and quickly, spurring innovation. The program will have wide applicability to both military and civilian products and will enhance the viability and competitive position of domestic suppliers of semiconductors and equipment.

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Topic#: 92-031 ID#: 9210041
Office: DSO
Contract #: DAAH01-94-C-R009
PI: Sankar Virdhagriswaran
Title: Collaborative Concurrent Engineering - Phase II
Abstract: In the initial stages of product conceptualization and prototyping of mechanical products with complex assemblies, much time is wasted because the impact of cross functional constraints between design, engineering, and manufacturing is not considered. Further, integration between engineering information systems and tools used in this stage does not exist. Crystaliz Inc. developed a Phase I conceptual prototype that addressed these problems. This Phase II proposal is to extend the conceptual software prototype into a set of products. The Phase II software will: Support cross functional constraints modeling by: providing a data representation that allows modeling through features, mechanisms, assemblies, and configurations; supporting representation of geometric constraints, kinematic constraints, product configuration constraints, process constraints, and a mechanism to relate all of the above; maintaining dependencies between functional concepts and by allowing conflict resolution through notifications; collaborating with 3rd party software modules (modeling kernel, dynamic simulation engine, renderer, mailer, database) to compute domain specific solutions; inter-operating with other 3rd party software through PDES/STEP SDAI interfaces and application protocols. Anticipated Benefits: The Phase II effort will produce a cross functional constraint management kernel and a set of applications that take advantage of this kernel. This will allow software developers and end user customers to add constraint management functionality to their existing mechanical design automation systems. The integration will result in infrastructure support for "tiger teams". Market size (1995): $300M

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Topic#: 91-231 ID#: 9120631
Office: MICOM
Contract #: DAAH01-94-C-R028
PI: Kourosh Mehr-Ayin
Title: Ultra Low Cost Fuel Control System for Expendable Turbojet Engines
Abstract: The on-demand thrust control, for a turbojet engine, translates into the ability to control the operation speed of the gas turbine power-head and meet the fuel schedule requirements necessary for acceleration/deceleration from one operating speed to another. In order to do so, the fundamental objective becomes the control of fuel flow to the engine as a function of speed,

inlet pressure, and inlet temperature. By directly utilizing the compressor discharge pressure as the primary control feedback, one can eliminate the need for control system sensors and expensive electronic controllers. Based on the knowledge of gas turbine engine operation and through a series of development testing, conducted during the Phase I program, the technical feasibility of this concept has been demonstrated. It is proposed to follow up with the Phase I development effort in an attempt to refine the heavy wall fuel control system. The Phase II activity will allow for crucial partially developed concept into a low cost, flight-weight, commercially producible system, that meets the engine requirements through out its operating temperature range. In addition, an optional development of a dynamic closed loop engine simulator is proposed. Anticipated Benefits: In addition to Tactical Missiles, the Ultra Low Cost Fuel Control System can be used on gas turbine engines with a number of commercial applications. Such applications include, Small Ground Based Power Units, RPVs for climatic observations, and Small Thrustors for launching glider planes.

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Topic#: 91-112 ID#: 9120765
Office: MTO
Contract #: DAAH01-93-C-R181
PI: Palash Das

Title: Development, Demonstration and Testing of a Production-Worthy ArF Excimer Laser for a Projection Scanning Lithography System

Abstract: The objective of this effort is to develop and test a high performance production-worthy 193 nm ArF excimer laser illumination source for a projection scanning type lithography system that will be used for printing sub -0.25 um design rule features for the next generation of I.C. devices. Specifically, this laser will meet the requirements of the SVG-L Micrascan III lithography tool. This laser will operate at a repetition rate of 600 Hz, at an output power of 10 W with a pulse-to-pulse energy variation of $<1.3\%$(1 o). It will have a scheduled gas exchange interval of >20 x 10(6) pulses, and an electrode life of >1.5 x 10(9) pulses. In addition, the output will be spectrally narrowed (<130 pm) and polarized. The spectral narrowing is necessary to mitigate the formation of ozone in the optical path. A majority of the effort will be made to optimize the performance of the discharge chamber, pulse power module and the spectral narrowing module. We will also test a SRL all solid-state pulse power driver for possible improved performance. Phase II work will be based on the results obtained in Phase I and the performance of the prototype laser delivered to MIT Lincoln Lab. After the completion of Phase II program, Cymer will be in a position to manufacture a fully production-worthy 193 nm laser for integration with a lithography tool. Anticipated benefits: The benefit of this program to ARPA will be the availability of a cost effective and fully production worthy 193 nm illumination source for a projection scanning type lithography system. The laser is one of the key elements of the 193 nm optical lithography process. This lithography process is the simplest and the most cost effective means to print sub-0.25 um design rule features for the next generation of I.C. chips.

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Topic#: 91-243 ID#: 9120038
Office: ASTO
Contract #: DAAH01-93-C-R344
PI: Steven Everett

Title: UAV Airfoil & Control Surface Manufacturing with a Pulsed-Pressure Continuous Manufacturing Machine

Abstract: The purpose of this project is to continue the examination of the feasibility of UAV airfoil and control surface manufacturing machine fabricated that successfully produced standardized airfoil cross-section material. The purpose of Phase II is to build a full-scale prototype pultrusion manufacturing system for composite airfoil shapes. The full-scale machine would automate the manufacturing process and further improve the quality of the finished product. The overall design of the Phase II machine will emphasize an "open system" approach to facilitate continuous improvement, and to provide the flexibility necessary to accommodate a variety of designs and required materials. The Naval Research Laboratory FLYRT wing will be used as a production sample and aerodynamic data developed for the sample product. Also, stand-alone options to develop a platen and manufacture thick sectioned airfoils for an ongoing ARPA research project is proposed. Anticipated Benefits: Successful production of the FLYRT wing will benefit the ongoing NRL FLYRT project. In addition, material produced by the full-scale machine will be provided to UAV and other aerospace manufacturer for evaluation as to other potential applications. Also, production of an airfoil with a potential 50% thickness will be performed for an ongoing ARPA project.

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Topic#: 91-199 ID#: 9120893
Office: CSTO
Contract #: DAAH01-93-C-R109
PI: Elizabeth Lagnese
Title: Rapid Prototyping Through Architectural Partitioning
Abstract: The goal of this project is to demonstrate the applicability of DASYS' system level design tools to FPGA design for rapid prototyping. The result of the proposed work will be a market-ready toolset that partitions the behavioral/structural descriptions onto FPGAs, providing all the information for downstream tools to complete a fast prototype of a board containing FPGAs and standard parts. We will demonstrate a complete design through DASYS' toolset from a mixed behavioral/structural description to an actual board design using FPGAs, standard parts, and a programmable board. The present toolset is general, but modifications and additions must be made to customize them for FPGA design. Modifications/additions to existing tools include the addition of FPGA-specific information to DASYS' existing architectural partitioner, and development of a tool to map the design to the appropriate input for FPGA software. In this work, we will target a standard cell library, which will provide the basis for easy expansion to alternate technologies. Anticipated Benefits: A major problem in electronic system design is the need for functional verification. Simulation is not sufficient since most functional problems are caused by a lack of understanding of the environment in which a system will operate. As a result there is a strong demand for rapid prototyping tools such as those being developed under this contract.

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Topic#: 91-184 ID#: 9120464
Office: SSTO
Contract #: DAAH01-93-C-R118
PI: Melvyn Hunt
Title: Small Vocabulary Tactical Speech Recognizer
Abstract: The aim of this work is to develop a speaker-independent small-vocabulary continuous speech recognizer using computationally efficient algorithms that is robust to a range of types of back-ground noise and to voice changes induced by stress and noise. Only single-sensor methods will be considered in this work. The performance of current Dragon technology will form an initial benchmark against which performance can be measured. Sub-word and whole-word modeling will be considered, as well as possible combinations of the two. A variety of established and novel techniques for coping with noise and voice changes will be explored. When simulation experiments have permitted a suitable set of techniques and parameter values to be determined, they will be implemented in a real-time demonstrator. Anticipated Benefits: The technology to be developed here should increase the feasibility of using speech recognition in a variety of militarily and commercially important environments including aircraft, factories, tanks and road vehicles. Continuous speech recognition makes for faster input; and speaker-independence allows delay-free switching between users. Much of what is learned should be transferable to large-vocabulary systems.

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Topic#: 91-231 ID#: 9120181
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Contract #: DAAH01-94-C-R018
PI: Karl Swonger
Title: Ultra Low Cost Engine Control System
Abstract: Present turbojet engine control systems, which are comprised of: controller, fuel metering device, sensors, connectors, and harnesses are the single most expensive subsystem on expendable turbojet engines. The size and cost of expendable turbojet engines has steadily decreased. However the engine control system cost has remained relatively constant. Electronic concepts proposes to demonstrate that significant cost reductions can be realized in expendable turbojet engine control systems by: (1) applying highly integrated circuit technology, (2) utilizing a derivative of automotive fuel metering technology, and (3) by integrating the control electronics, engine sensors and fuel metering devices into a single enclosure thus eliminating expensive harnesses and electrical connectors. The Phase I project succeeded in producing a heavy walled prototype of a working control system. The prototype system successfully controlled an expendable turbojet engine during starting, acceleration, and steady state governing. The successful Phase I control system provides the baseline for the Phase II flight weight control system development. Successful completion of the Phase II effort will lay the foundation for the commercialization of an Ultra Low Cost Engine Control System. Anticipated Benefits: An Ultra Low Cost Engine Control System and associated technology can

be directly applied to Commercial and Military turbine engine powered ground start carts, power generating units, and air conditioning carts. In addition a majority of aircraft Auxiliary Power Units (APU's) are powered by small turbine engines which represent an ideal application for Ultra Low Cost Engine Control Systems.

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Topic#: 91-017 ID#: 9110329
Office: NMRO
Contract #: DAAH01-93-C-R251
PI: Douglas Baumgardt
Title: Seismic Discriminants in Eurasia
Abstract: This Phase II research project will continue our investigation of Eurasian regional discrimination, using a much increased database from the IMS and with emphasis on bringing to prototype in ISEIS the statistical analysis and visualization techniques we found useful in Phase I. The statistical analyses will investigate what waveform feature measurements are most effective and why. The visualization studies will provide techniques for the analyst to analyze regional waveform patterns and to be able to better understand the information contained in multivariate data. The major focus of this work will be the application of probabilistic Bayesian belief networks for combining multiple evidence for event identification, using the results of our statistical studies. In this approach, beliefs about the causal connections between source identify (explosion, earthquake, etc.) and observables are modeled as a network of interconnected conditional probabilities. When new evidence is obtained, the various probabilities are computed and combined to derive an overall belief about the source identification in terms of a probability. The belief network approach provides probabilistic rigor to the event identification process, will help in maintaining the modularity and understandability of the knowledge base, and can be modified and extended as new data and knowledge are obtained. Anticipated Benefits: This project will result in a much improved understanding of regional seismic event identification. Techniques developed in this study will also be highly beneficial to non-proliferation monitoring. All techniques which prove effective will be included in prototype form as part of the IMS and ISEIS software for event identification. Anticipated Benefits - The results of this study will provide a better understanding of regional discriminants on a statistical basis. The analysis of the large IMS database, collected from the new regional arrays and single seismic stations located in Eurasia, will provide an evaluation of the capabilities of the new seismic data sources for event identification. The results of this research will be directly incorporated in the ISEIS system at the CSS.

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Office: ESTO
Contract #: DAAH01-93-C-R142
PI: Jeff Pan
Title: A Modeling and Integration Framework for Semiconductor Manufacturing
Abstract: We propose to develop a modular family of CIM software for "agile" semiconductor manufacturing. The software consists of modules known as Unified Factory Modules (UFMs) that communicate through a distributed information service (DIS). Each UFM is a building block that models one element of a flexible factory, such as a piece of equipment, a workcell, or event the entire fab line. It encapsulates all of the application software, parameters and state associated with its component, providing a consistent view of that component from both a virtual and physical factory perspective. The approach will also encourage manufacturing personnel to build and maintain their own factory models, allowing "plug-and-play" equipment or workcell to be modularly installed in a factory. UFMs will be implemented on DIS, an OMG-compatible service for messaging and information sharing originally developed by EIT for Stanford. UFMs register their interests and capabilities with DIS, which is then responsible for routing a module's messages to others with the appropriate expertise or need to know. Systems structured in this way are inherently open, scalable, and reliable. The DIS framework is fully compatible with open protocols emerging from standardization efforts by CFI, Sematech and others. Anticipated Benefits: UFM enables industry to meet DOD's need for agile (high mix, low volume) production, with modularized equipment that can be readily plugged into the CIM environment - a first step toward ARPA's CSPED vision. UFM's view of an integrated physical/virtual factory will open up new opportunities for TCAD vendors to apply their simulation technology on the factory floor. UFM will be developed in collaboration with a government-operated R&D fab line, and will provide a continuing pipeline for transferring ARPA-sponsored research results to the semiconductor industry.

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Topic#: 91-038 ID#: 9110418
Office: CSTO
Contract #: DAAH01-93-C-R192
PI: Rodney Johnson
Title: Parallel Signal Processing Library
Abstract: Parallel processors have long been viewed as potential general purpose signal processing computers, and there are many examples of algorithms that run efficiently on parallel computers. However, because software has become a dominant factor in signal-processing R&D, issues of software reusability and portability have become as important for productivity as the development of efficient parallel algorithms. Several problems have constrained progress in software engineering for parallel signal processing: First, most applications are written originally for serial machines -- "porting" to a parallel computer often means a full redevelopment (not just the revision of a signal processing kernel). Second, a programming method suitable for one parallel architecture is often unsuitable for other architectures. This is compounded by a third problem: there are many alternative parallel architecture under development; there is no clear winner, and there may be many winners. In Phase I, we designed abstractions and interfaces to solve these problems by allowing programming much of the application in a uniform way regardless of whether the underlying implementation runs on a serial machine or any of various parallel architectures. In Phase II we will develop test implementations to demonstrate the feasibility of our approach on a variety of parallel architectures, to evaluate its performance, and to adjust the design. A full library will be built in (optional) Phase II-A. Anticipated Benefits: The Parallel Signal-Processing Library (PSPL) project will benefit the Federal Government because of the considerable signal-processing and parallel processing R&D work it supports. The PSPL will facilitate the widespread use of parallel processing in signal processing R&D. Because the PSPL will be developed in a manner compatible with an existing commercial product already in wide use in signal-processing laboratories, the probability of commercial success is high.

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Topic#: 92-045 ID#: 9210581
Office: DSO
Contract #: DAAH01-94-C-R010
PI: Mark Miller
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: The results of the proposed Phase II 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 #: DAAH01-93-C-R182
PI: Jacqueline DiNuccio
Title: Development of Smart Material Structures with Piezoelectric Composites
Abstract: This Phase II program will demonstrate directly the effectiveness and efficiencies of 1-3 tubular piezocomposites in both enclosed systems and in flat panels. A second result of the Phase II program will be the piezocomposites for specific applications. The low acoustic impedance, high effective piezoelectric constants and very low electrical impedance of 1-3 tubular

piezocomposites make them ideal candidates for electroacoustic applications. The piezoelectric responses are tunable by adjusting the wall thickness of the tube. Very low voltages are needed to pole and actuate the thin wall tubes which suggest that electrostrictive materials may be suitable as well. The Phase I study will be extended to consider off-angle tubes and their response to unequal dynamic mechanical loads. The utility of the tubular piezocomposites will be demonstrated by their use for acoustic field modifications and noise control in adaptive structures. Large panel 103 piezocomposites for two dimensional vibration mode sensing and suppression will be evaluated. Anticipated benefits: The proposed smart material structure will have numerous applications in government and industry. It can be used for flow pattern modification to reduce flow resistance and eliminate flow noise, in large area vibration isolation, improving the contact between irregular surfaces and to reduce the friction of motion between two surfaces.

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Topic#: 92-025 ID#: 9210551
Office: DSO
Contract #: DAAH01-93-C-R330
PI: Charles Carey
Title: Compact High Frequency Antenna Program
Abstract: There is a keen interest in the Electronic Warfare community in small antenna systems for use in the HF band. The fundamental purpose of this effort is to apply the best available High Temperature Superconducting (HTSC) materials and rf design techniques to the problem of producing antennas which approach 0.01 wavelengths in dimension at frequencies from 3 to 30 MHz. As antennas get as small as the sizes being considered here, the radiation resistance decreases markedly and the input impedance starts to look highly capacitive. The goal is to develop a matching network through which these antennas can be coupled to standard transmitters. When normal metal conductor is used in these networks, the losses are great as to make the system uselessly inefficient. Phase II of this effort will continue the dual tasks of developing the design methodology needed to predict the behavior of these small systems and developing the materials needed to implement the designs. We propose to develop and demonstrate a small folded dipole design, a tapped matching network which will provide some tuning ability through the band and a two element array aimed at providing both directionality and a means of reducing loss in the ground plane. Anticipated Benefits: Upon successful completion of the proposed program Foster-Miller and CeraNova will support Harris Corporation in an effort to insert the small HF band antennas developed into Army jamming and communications equipment. Satellite HF bands are currently not viable due to the unfavorable antenna size/power tradeoff imposed by normal metal technology. Foster-Miller believes that the HTSC antennas developed under this program will make utilization of HF bands for satellite based communications possible.

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Topic#: 92-092 ID#: 9211075
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Contract #: DAAH01-94-C-R008
PI: Thomas Chen
Title: Common Intelligent Tutoring System Architecture for Simulation-Based Training
Abstract: Global Information Systems Technology, Inc. proposes to continue the development and implementation of an Intelligent Tutoring System (ITS) begun in Phase I. The proposed ITS is based on a generic, modularly-structured system using object-oriented and knowledge-based techniques in an adaptable architecture. The training paradigm employed uses a simulation-based approach of student interaction with domain-specific scenarios for both diagnosis of student performance and tutoring. We are continuing work started with the Intelligent Embedded Operator Assistant (IEOA), developed in part by Global for the U.S. Army Missile Command. This architecture can be applied to embedded-training operations for a family of tactical weapon systems, as well as many other diverse applications and domains; in fact, parts of it were previously used in an ITS integrated with a pre-existing, workstation-based simulator of the space shuttle's robotic arm. As a test of its adaptability, we propose to use in Phase II a critical military domain, equipment maintenance and diagnostics training, in place of the Phase I domain of air-defense operator training, which was used as a proof-of-concept. Anticipated Benefits: The Intelligent Tutoring System architecture is general enough to model many types of domains which use an interactive simulation approach, and is suitable for stand-alone as well as embedded training systems. Additional benefits include: Training-system mobility due to embedded training capability; less expensive and less dangerous to both student and environment than working with real equipment; does not depend on availability of qualified instructors; adapts scenario generation based on student performance and diagnosis, pushing the student towards mastery; offers instant feedback on performance; enables repeated training and evaluation

under identified conditions; easier to maintain, extend, and revamp for a new domain than existing Intelligent Tutoring Systems or simulators.

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Topic#: 91-042 ID#: 9110414
Office: SSTO
Contract #: DAAH01-93-C-R082
PI: R. Glenn Wright
Title: Knowledge-Based System Interoperability Standard
Abstract: The objective of the proposed effort is the development of an interoperability standard for knowledge-based systems used in sensor-based processing applications. The Phase II work effort addresses the many and diverse knowledge representation schemes and database structures that currently exist, as well as data exchange protocols that facilitate the exchange of information between these and other system components. In addition, we will address the expression of information and knowledge content at the domain level for sensor-based applications of knowledge-based systems. Five Phase II technical objectives have been identified, including continued development of the proposed standard defined in draft during Phase I, investigation of complementary standards efforts, and development of an experiment to demonstrate the implementation of the standard. In addition, assessment of additional otologies and/or refinements to existing otologies for the knowledge-based system interoperability standard will be considered, as will the development of a demonstration of the proposed standard in an identified DoD application. Anticipated Benefits: The proposed interoperability standard will enhance the capability of sensor-based processing systems to work together in large scale applications, as well as to improve the support and maintenance of these systems. Numerous commercial applications exist for the product of this effort in distributed control systems that use sensors in the petroleum, chemical, and other industries.

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Topic#: 91-052 ID#: 9110117
Office: SSTO
Contract #: DAAH01-93-C-R275
PI: Bruce Cottman
Title: A Framework for Mechanical Engineering Information Systems
Abstract: Phase I resulted in the design and prototype development of a mechanical CAD/CAE/CAM (MCA*) tool integration framework, called Catalyst. However, Concurrent Engineering (CE) cannot be achieved through the integration of individual tools unless it also improves the entire product development process. Phase II of Catalyst emphasizes enabling large scale, organization-wide product development information systems. Catalyst includes facilities for MCA* tool integration, fault-tolerant product data management, distributed system configuration management and workflow automation and management. The key components of Catalyst are: 1. I-Gates enable the integration of in-place vendor and proprietary in-house application into a CE system framework. 2. An I-Bridge, enables applications that support one inter-application communication and control framework standard to interoperation with applications that support another framework standard. However, an I-Bridge can be developed for approximately the same cost as integrating two different applications. Integrating frameworks instead of individual applications realizes a significant reduction in system lifecycle costs. 3. FrameScript workflow specifications assist different workgroups in automating complex series of control and data flow transactions between different MCA* tools and support services. This key innovation enables the management of Concurrent Engineering methodologies with explicit workflow scripts that can be developed, shared, and evolved. Anticipated Benefits: Phase II will result in an integration toolset for turning disjoint, stand-alone applications into a coherent distributed information system. Market segments that would benefit from Catalyst include: concurrent engineering, integrated manufacturing, financial services, and many federal agency information systems.

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Topic#: 91-188 ID#: 9120134
Office: SSTO
Contract #: DAAH01-93-C-R155
PI: Bruce Cottman
Title: A Framework for Integrating Object-Oriented DBMS with Knowledge-based Planning and Scheduling Systems
Abstract: Knowledge-based planning and scheduling (KBPS) systems require the ability to manage and share large amounts of

data and knowledge. Phase I implemented the data models of a conventional scheduling and a knowledge-based scheduling system in both an OODBMS and a relational DBMS. A comparative analysis of these implementations was performed using both actual NASA Orbiter launch activity and simulation-generated time-phased scheduling data. Phase II will focus on integrating OODBMSs with KBPS systems being developed in the ARPA/RL Planning Initiative. Military transportation and NASA launch scheduling both share extreme data management requirements. Both will benefit from the advanced data representation and performance offered by OODBMSs. Phase II targets three prominent KBPS data management requirements: (1) enable OODBMSs to support a large installed base of SQL-compliant applications; (2) enable KBPS system mediators, such as the Intelligent Data Interface, to utilize native OODBMS features (n-normative data types, dynamic schema, and versioning); (3) implement reliable data management using replicated OODBMS servers.

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Topic#: 91-069 ID#: 9110622
Office: MTO
Contract #: DAAH01-93-C-R283
PI: Gregory Neugebauer

Title: Intelligent Control of Bridgman CdZnTe Crystal Growth

Abstract: Current techniques that are used to produce CdZnTe crystals often fail to meet the requirements of state-of-the-art epitaxial HgCdTe devices. Unanticipated process transients in the crystal growth process have a large effect on yield because of the nonlinear coupling between the heat, mass, and momentum transfer in the crystal growth system. Advanced control techniques are needed in order to increase the producibility and repeatability of the crystal growth process so that the performance requirements of advanced IR sensing and imaging systems are met. During Phase I of this project, an advanced process control system based on the Intelligent Processing of Materials (IPM) paradigm was designed. Experiments were performed that demonstrated that eddy current (EC) sensors are able to measure the shape and position of the melt/solid interface during Bridgman crystal growth. An IPM system, based on eddy current technology, was designed; therefore, the goal of Phase I was fully met: the IPM system was designed and the necessary sensor technology was developed. In Phase II of this project, we will install an IPM control system based on eddy current sensors in a commercial CdZnTe production furnace. Anticipated benefits: Better control of the CdZnTe manufacturing process will improve yields, overall quality, and reproducibility of epitaxial substrates. This will favorably impact the users of IR focal plane arrays by lowering the cost and by improving the predictability and uniformity of device performance.

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Topic#: 92-038 ID#: 9210408
Office: DSO
Contract #: DAAH01-93-C-R193
PI: Robert Kosut

Title: Control of Industrial Processes Via Convex Optimization

Abstract: Process control would greatly benefit by merging recent advances in process modeling, sensor development, and computer-aided-control-engineering (CACE). The benefits would include increased yield and quality, improved productivity at lower costs, and increased manufacturing flexibility, i.e., to rapidly tune the manufacturing process to meet changing market needs. For these benefits to be actualized it is necessary to develop CACE tools which can be easily integrated with process plant real-time information and control computers. In addition, these tools will allow process control engineers to benefit from advanced theory, algorithms, and computation, without the need to understand all the esoteric details of the implementation. The Phase II Technical objectives are: (1) to extend the techniques for static linear controller design developed in Phase I of the project to dynamic controller design, (2) to develop a graphical-user-interface (GUI) tool to automate/simplify the development of these optimized controllers, and (3) prove the utility of these tools on a target manufacturing system. Several approaches to (1) have already been examined in Phase I. The GUI tool (2) will allow the user to provide a non-linear model of the system, as well as a linearized version or linearizing equilibrium point. The tool will then construct a series of interactive modules to provide a convenient interface between the designer, the plant description, and the mathematical design techniques developed in (1). Anticipated Benefits: 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. Certain processes will also require custom-built tools utilizing these techniques.

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Topic#: 91-099 ID#: 9121123
Office: ASTO
Contract #: DAAH01-93-C-R191
PI: Rene' Larriva
Title: Ceramic Shields for Satellite Protection Against Hypervelocity Impact
Abstract: Interferometrics proposes to develop a ceramic shield prototype to protect satellites in low earth orbit from orbital debris and anti-satellite weapon attack. Material selection, armor design, and design optimization will create a prototype armor that will dramatically improve present satellite armors at equal armor areal density. In Phase I, Interferometrics showed that multilayer, shock isolated (B4C) ceramic/aluminum shielding provides improved protection over standard aluminum shielding of the same areal density. In Phase II, we will investigate additional ceramic armor materials, such as silicon carbide, aluminum nitride, alumina, and titanium diboride. Hydrocode and analytical modeling will be used to determine the best combination of materials and configurations. The armor design configurations will be optimized through computer modeling and hypervelocity impact testing to achieve the best shock isolation, best confinement metal configuration, and best percentage of mass allocation for the ceramic core. Phase II will yield an optimized material/optimized configuration prototype. The prototype will be validated through hypervelocity simulated orbital debris and anti-satellite warhead fragment impact testing. An equal areal density modified aluminum Whipple Shield will be tested and will serve as the baseline for comparison for the prototype ceramic based armor. Anticipated Benefits: Prototype shielding could be marketed to manufacturers of any long-term low earth orbit satellite. The shielding could be incorporated during manufacture or added on to increase existing protection.

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Topic#: 91-211 ID#: 9120604
Office: SSTO
Contract #: DAAH01-93-C-R278
PI: Ramon Acosta
Title: Domain Specific Software Process Automation Technology
Abstract: International Software Systems, Inc., proposes to build a process simulator to define, model, and analyze processes. The prototype to be implemented in Phase II will use the Visual Process Modeling Language (VPML) developed in Phase I. The system will consist of three major components -- a modeling subsystem, a simulator subsystem, and system support. Two graphical editors, a process editor and an infrastructure editor, will be developed to attain the basic process definition power of VPML needed for simulation. Both will be built by using ISSI's proprietary graphics editor generator. The prototype for the simulation subsystem will leverage off of ISSI's prototyping tool, DProto. We will use its simulator kernel and adapt it to the simulation requirements. These components will use an object manager to load, save, and exchange information. The prototype will use an object-oriented database, but will be set up so that the database can be replaced with a portable common tool environment (PCTE) later on. In addition, provisions will be made for integrated process technology support. The system will be developed so that integration with an enactment environment will be relatively straightforward. Anticipated benefits: The proposed process simulator provides the modeling and simulation capability for process definition, analysis, and modification. It will assist organizations in their process improvement effort. Currently, no tool exists that integrates modeling and dynamic analysis and produces results that can be used directly for enactment.

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Topic#: 91-232 ID#: 9121069
Office: MSTO
Contract #: DAAH01-93-C-R300
PI: James Castracane
Title: Advanced Intensified High Density CCD Arrays
Abstract: In a wide variety of military missions, the detection and imaging of extremely low levels of light is necessary. Present day systems such as the Kodak KM2 megapixel camera incorporate high density sensors based on charge coupled device (CCD) architecture with pixel sizes as small as 9 x 9 microns. For example, these detectors form the heart of the non-penetrating periscope (NPP) and are invaluable because of their real time video frame rates and high sensitivity. However, the inclusion of a light amplification stage before the CCD can extend its low level response range significantly. An attractive choice is the microchannel plate (MCP), but the conventional optical fiber based construction of the plates can be the limiting factor because of the large pore size and component spacing in typical intensifier architecture. Alternate architecture and the incorporation of small pore MCPs and fiber interfaces can lead to a significant improvement. The successful Phase I effort studied the coupling

of an MCP to a CCD to illustrate high spatial resolution with significantly increased sensitivity. Phase II involves a collaboration between InterScience and Kodak for the development of an intensified version of the KM2 and will lay the groundwork for the full exploitation of this compound sensor. Anticipated benefits: The development of an improved detector system based on the combination of CCDs and MCPs will have an immediate impact in a wide variety of research and commercial applications. Remote sensing, low light level image formation and spectroscopy are several examples of direct commercial applications. The compound detector could be marketed as a separate unit or be incorporated into various optical systems.

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Topic#: 91-218 ID#: 9120681
Office: SSTO
Contract #: DAAH01-93-C-R293
PI: Mark Peot

Title: Standard Decision Analysis Modules for Knowledge-Based Planning

Abstract: In this program, Knowledge Industries will design and implement a set of decision-planning under uncertainty, and diagnosis of complex systems. Decision-theoretic reasoning provides a theoretically sound and extensible technical basis for 1) integrating diverse, uncertain information sources (sensor readings, intelligence reports, etc.) for situation assessment or diagnosis; 2) expressing complex preferences among various world states and outcomes (achievement of mission objectives, monetary costs, civilian and military casualties, etc.); 3) forecasting the effects of actions or plans when world models are incomplete or uncertain. This Phase II research develops the final detailed design and initial implementation of an integrated, flexible toolkit for decision-theoretic planning support. Initial software requirement analysis and design (completed under Phase I funding) will be implemented in a decision-theoretic inference kernel written in C++ providing applications. Diagnostic capabilities will be demonstrated in the area of wind assessment, forecasting, and support for planning under uncertainty will be demonstrated in the context of a crisis action planning scenario associated with the ARPA/Rome Lab Planning Initiative. Anticipated benefits: Decision-theoretic software capability has numerous applications in diagnosis of commercial aircraft systems (propulsion, avionics), electric power generation, electronics, and medicine. Integrated diagnosis, assessment, and forecasting is applicable to maintenance planning for transportation services (air, sea, rail, truck), computer and energy supply systems.

LANXIDE ARMOR PRODUCTS, INC.
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Topic#: 91-150 ID#: 9120689
Office: ASTO
Contract #: DAAH01-93-C-R328
PI: Robert Franz

Title: Laminated, Stackable Ceramic Composite Armors

Abstract: Proposed Phase II program combines the results of two Phase I programs and utilizes similar methodology to further understand how to reduce ceramic failure in order to design deployable, stackable laminated armor blocks. A base program and two options are included. The base program employs high voltage flash x-rays to study penetration by the 14.5mm BS-41, the 20mm FSP, and the 0.50 cal SLAP, into a three layered, bonded laminate with two backplates, 5083 Al and a Kevlar reinforced plastic composite. Embedded peizoresistance stress gages and surface pin gages determine requisite shear bond strengths. Manufacturability is assessed using finite element code calculations validated with fabrication experiments. The program culminates with the design, manufacture, and ballistic evaluation of a laminated base armor block. Option 1 uses similar measurements to design, manufacture and test another stackable armor block. Two blocks stacked onto the base armor is evaluated against the 30mm Rarden at O°, and one block is evaluated at 45°. Option 2 evaluates the effectiveness of three Option 1 blocks stacked on the base armor for O° protection against the 30mm COMVAT simulant and two blocks stacked for protection at 45° obliquity. Anticipated benefits: Upon completion of the program a deployable, stackable, light-weight laminate armor system will have been designed, manufactured, and tested. The system will be of particular usefulness on multiple-use military vehicles which require different levels of protection for different assignments.

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Topic#: 91-126 ID#: 9120732
Office: ASTO
Contract #: DAAH01-93-C-R280
PI: Michael Aghajanian

168

Title: Novel Ceramic/Metal Composites for Armor Applications
Abstract: Novel cost effective and mass efficient composites, successfully developed for light threats during Phase I, will be scaled to sizes capable of defeating heavier (30mm) tungsten and steel threats, and will subsequently be transitioned to manufacturing. In parallel, a materials optimization effort will be performed to yield excellent performance versus hard WC/Co projectiles. The composites will be fully characterized, including ballistic testing. The proposed Phase II effort is based on a Phase I program in which all objectives were successfully accomplished. In this Phase I program an innovative processing technique was developed for the fabrication of net shape ceramic/metal composites for armor applications. The process entails two steps. First, metal matrix composites are produced via the pressureless metal infiltration technique. Second, proprietary processing steps are applied to enhance the ceramic content of the composites. In Phase I, the process was shown to be economical and capable of producing a range of composites in various sizes. The products were found to be hard and strong, with excellent ballistic performance versus a 7.62 mm (tool steel) projectile and moderately good performance versus a 14.5 mm (WC/Co) projectile. Anticipated benefits: These novel composite materials are anticipated to offer cost effective protection versus the threats encountered by armored vehicles. Potential commercial applications include heat engine components, electronic substrates, wear parts, heat exchangers, and high performance refractories.

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Topic#: 91-061 ID#: 9110074
Office: DSO
Contract #: DAAH01-93-C-R165
PI: Douglas Tanimoto

Title: Semiconductor Laser Excited Upconversion Transitions in Holmium (SLEUTH)
Abstract: This Phase II program has the potential to realize, for the first time, room temperature red-green-blue stimulated emission from an all solid-state laser. This technology employs two conventional diode laser pump sources operating at different wavelengths to obtain the ESA-based upconversion mechanism in Pr3+. Two CW Ti:A12O3 lasers will be utilized to simulate semiconductor laser pumping of the upconversion laser. CW stimulated emission is expected at 479 nm, 522nm, 605nm, 640nm, and 721 nm, as calculations derived from the Phase I experiments, show low threshold operation is achievable at room temperature. As a follow-on option to the Phase II basic program InGaAs and AlGaAs diode laser will be used to pump a monolithic upconversion laser. This will result in a compact, efficient, CW RGB laser which will be ready for commercialization. Anticipated Benefits: The successful demonstration of the proposed RGB laser will point the way toward the development of compact, inexpensive sources with potential applications including reprographics, optical storage, and biomedical diagnostics. Additionally, coherent RGB lasers are desired as white light projection sources. Arrays of these devices hold the promise for high power CW, electronically steerable systems.

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Topic#: 91-225 ID#: 9120469
Office: MICOM
Contract #: DAAH01-93-C-R164
PI: David Shannon

Title: Efficient Coupling of Gallium Arsenide Laser Diode Output into a Fiber Optic for Remote Power Transmission
Abstract: An efficient optical power module is needed as the main component in a remote electrical power system. This proposal outlines the design, construction, and characterization of a fiber-coupled, gallium arsenide diode laser power module that will meet or exceed the specifications set forth by ARPA. The power module will consist of two 20 W gallium arsenide diode laser bars (40 W total) coupled into a 400-600 um diameter optical fiber. The output power will be in excess of 30 watts (80% coupling efficiency goal) with a numerical aperture of <0.30. The wall plug efficiency will exceed 10% defined as the optical power emitted by the fiber divided by the electrical power (at 120 VAC) required to operate the device. This work will incorporate many of the technical achievements of the 8 watt power module delivered to ARPA during the successful Phase I effort. Anticipated Benefits: High power fiber optic sources of diode laser light have strong commercial application in the areas of remote power transmission, diode-pumped solid-state lasers, contact surgery, and micro-machining. The low output divergence of this optical source will permit high intensity focusing as well as low-loss power transmission over long distances.

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Topic#: 92-033 ID#: 9210505
Office: DSO
Contract #: DAAH01-93-C-R350
PI: Curtis Griffin

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

Abstract: The opportunity to use one technique, laminated object manufacturing (LOM) as a base for a flexible manufacturing process for structural ceramics was identified by Lone Peak Engineering (LPE) in a Phase I SBIR proposal submitted to ARPA in January 1992. During the Phase I project, LPE demonstrated that advanced structural ceramics can be produced using a LOM technique. High purity, high-density alumina ceramic test bars were prepared using the LOM process. The properties of the laminated object manufactured (LOMed) components were similar to the physical and mechanical properties of alumina ceramics that were prepared by a conventional pressing process. During the Phase II project, the equipment will be design specifically for ceramic components. The process and procedures required to manufacture ceramic parts by laminated object manufacturing will be developed using this equipment. Once the ceramic laminated object manufacturing (CerLOM) system has been engineered and it has been proven that LOMed ceramic parts have suitable physical and mechanical properties, a complex component will be manufactured. This component will have an industrial application and will be used to demonstrate the system's capabilities. This demonstration will illustrate the flexibility and cost and time savings aspects of the process. A goal of the demonstration will be to produce the complex-shaped component from a drawing (print-to-part) in less than four weeks. Anticipated Benefits: The LOM process being developed by LPE is suitable for any ceramic material in virtually any configuration. It will vastly expand the range of applications being considered for ceramic materials.

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Topic#: 91-216 ID#: 9120271
Office: SSTO
Contract #: DAAH01-93-C-R113
PI: Lynne Gilfillan

Title: Evaluation Methods and Metrics for Image Processing and Understanding Systems

Abstract: The proposed project will refine and extend methodologies and methods developed in our Phase I proposal for the evaluation of Image Understanding systems so that they can be applied for the overall and diagnostic evaluation of performance of machine vision systems developed under the auspices of the ARPA UGVTEE Phase II Program. This will involve development of a scaleable core set of metrics and methods that can be cost-effectively applied to development efforts. The identification of standard input data and tasks sets and a complete evaluation plan are also proposed. In addition, the project will develop and test metrics and methods that can be used to document minimum technical capabilities for proposals for machine vision applications, again with specific focus on ARPA UGVTEE Phase II Program activities. The goal is to develop metrics which do not unnecessarily restrict design approaches. Modifications to metrics and methods required to extend the utility of these evaluation approaches to the ARPA RADIUS program and to commercial applications of machine vision technology will also be identified. Finally, the project will produce an operational version of the database application demonstrated in our Phase I effort. The database application will provide support to evaluation design and implementation, and facilitate retrieval of evaluation data. It will be implemented on a MAC platform. The proposed metrics and methods will be reviewed for conformance to technical standards, such as precision and validity, for overall utility and for resource requirements. Anticipated Benefits: There are four major benefits anticipated: 1) A standard set of evaluation metrics for UGV development. 2) A standard set of metrics for evaluation of the technical capability of proposers in machine vision areas. 3) Identification of modifications required to extend UGV standard metrics for unmanned ground vehicles to both RADIUS and commercial machine vision applications. 4) An operational database to support design, implementation, and review of evaluation data. There are two major benefits anticipated. The first is the development of a standard set of unbiased metrics that will permit cross-system comparisons. This will be particularly useful for procurement decisions. The second is the development of a set of standard metrics for the evaluation of system components that will permit both performance assessments of separate components.

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Topic#: 91-221 ID#: 9120357
Office: MICOM
Contract #: DAAH01-93-C-R150
PI: Lawrence Grzyll

Title: Development of a Rapid Screening Technique for Second-Generation Halon Alternatives

Abstract: This effort will focus on the use of computational chemistry software (ADAPT) to develop a rapid-screening technique to assess untested candidate fire-suppression agents. ADAPT will correlate key properties of fire suppression agents with their molecular structure. These correlations are then used to predict the key agent properties of untested compounds. During the Phase I effort, we determined that it was feasible to use such an approach for the screening and development of Halon alternatives. The proposed Phase II effort will expand the list of compounds considered (we will include only those compounds with zero ozone-depletion potential), develop models for other key fire-suppression agent properties, predict the key properties of untested agents, experimentally validate the predicted properties of untested agents, and recommend a list of second-generation candidate agents for more advanced fire suppression testing. A pilot-plant for the manufacture of the recommended agents will also be designed. Anticipated Benefits: The development of a rapid screening tool will save time and money in the development of alternative agents. The effort will benefit the government by recommending a list of candidates with a high margin for success as second-generation Halon alternatives. The results of this effort will dramatically lessen the time and resources required for commercial development of these agents. Thus, there is increased incentive for commercial producers of these compounds to carry on the development effort.

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Topic#: 91-142 ID#: 9120600
Office: ASTO
Contract #: DAAH01-94-C-R004
PI: Steve McDonald

Title: Modular Software and Hardware for Rapid Creation of DIS Simulators

Abstract: Distributed Interactive Simulation (DIS) simulators, developed by ARPA under the SIMNET program, are currently being used for combined arms tactical training, as well as a controlled testbed for hypothetical weapon systems. By inserting a simulator of a hypothetical vehicle into the DIS world, tradeoff studies can be performed on the vehicle, refining the weapon system concept. Great cost savings are enjoyed by cutting down interactive prototyping of real hardware. A major problem with this methodology, however, is that the designer of these weapon systems has no tool to rapidly create the simulators himself. Hardware and software developers need to be brought in to the loop, wasting time and money. This tool would also be useful for keeping low-cost training systems up-to-date. Maintenance personnel could rapidly redesign components to keep pace with operational counterparts. In Phase I, Mak proved the feasibility of a Weapon Generation Tool (WGT) to help weapon designers create their own simulators from a library of parts. Using Object Oriented design and standardized object interfaces, this tool can dynamically link software and hardware modules at the request of the designer, through an easy to use graphical user interface. The main goal of Phase II is to augment WGT functionality such that a DIS experiment (Light Contingency Vehicle) and a training simulator (Bradley M2) can be constructed. Anticipated Benefits: The WGT will accelerate the process of weapon system refinement, multiplying the power of the DIS simulate-before-you-build procurement methodology. It will also reduce the cost of maintaining up-to-date training systems. The WGT can be used by commercial vehicle manufacturers for tradeoff studies in simulation. Video game makers can use WGT to develop characters for their games.

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Topic#: 92-061 ID#: 9210941
Office: ESTO
Contract #: DAAH01-93-C-R322
PI: Justin Bolger

Title: High Interconnect Density Substrate for 3-D Packaging

Abstract: The objectives of this two year, Phase II, SBIR program are to produce prototype quantities of high density MCM-L's, using the materials and methods developed in Phase I, to demonstrate cost savings and repair procedures, and to test these MCM-L's for electrical performance and long term reliability. During Phase I, 22 multi-layer copper-Kapton substrates were assembled entirely with low temperature (160°C) curing epoxies, including high Tg PTF inks for signal circuits, silver filled epoxy via pastes, and a copper filled contact ink to form solderable pads. Final encapsulation used a new type of high Tg, low CTE epoxy powder. A module with 9 flipped chips was also made to demonstrate a new type of z-axis adhesive preform for die and substrate attach. These preforms are high strength epoxy tape adhesives, containing precisely located regions of an electrically conductive epoxy adhesive. The preforms eliminate the need for solder bumps. They bond at low temperature and pressure to form a void free shock resistant area bond. In Phase I, these preforms were used to attach substrates and test panels to circuit boards. Phase II would make and test preforms with smaller conductive regions, to attach flipped chips and 3D memory stacks. Anticipated Benefits: This process will lower the cost of faster, multichip modules.

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Topic#: 92-055 ID#: 9211214
Office: ESTO
Contract #: DAAH01-93-C-R296
PI: Wendell Petersen
Title: Advanced High Power InP Millimeter-Wave Devices and Circuits
Abstract: Short gate length GaAs 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 at high efficiency. InP based lattice matched modulation doped FETs, however, possess properties, including high thermal conductivity, high saturated electron velocity, and potential high breakdown voltage, which could allow truly spectacular performance. In Phase I, Microwave Monolithics Incorporated and the University of California at San Diego have identified and fabricated InP based test structures, and preliminary measured performance combined with large signal modeling and computer aided design techniques were used to demonstrate feasibility. It is proposed that prototype half Watt 35 GHz millimeter wave power devices and monolithic circuits be developed in program Phase II based on this technology. It is projected that ultimately one Watt or more could be attainable. Anticipated benefits: The proposed power amplifiers are a true "dual use" technology. High resolution radars will find use in collision avoidance applications, and in modified form will also be applicable to proximity detectors, altimeters, and level sensors. Point to point communications links will serve a variety of short haul voice, video, and data links and local area networks. After extension to 38 GHz, the new technology will be directly applicable to Personal Communications Networks (PCNs).

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Topic#: 92-099 ID#: 9210822
Office: MICOM
Contract #: DAAH01-94-C-R021
PI: Jamesam McKee
Title: High Speed Image Capture of the 3-D Peel Point Geometry During Optical Fiber 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: 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.

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Topic#: 91-242 ID#: 9120569
Office: ASTO
Contract #: DAAH01-93-C-R145
PI: Alison Brown
Title: GPS Autolanding System
Abstract: A GPS Autolanding system was designed under the Phase I effort that is capable of meeting the CARS requirements to support UAV operations from both land-based and shipboard facilities. A highly reliable, accurate landing system was designed through the use of pseudolites to augment the GPS constellation. An innovative pseudolite design is proposed that provides an additional highly accurate measurement to aid the navigation solution, a highly reliable 1000 bps communication link to the aircraft to pass differential corrections, and does not interfere with the GPS satellite signals, even at close range. An innovative Advanced GPS Receiver design is also proposed to be employed that is capable of making highly precise code and carrier measurements from both satellites and pseudolites, and optimally combining these in a differential GPS solution. The system integrity is assured through the use of a Receiver Autonomous Integrity Monitoring (RAIM) algorithm. The combination of the satellite and the pseudolite signals provide sufficient redundancy and geometry that 100% availability is provided for navigation and also for reliable failure detection through RAIM. Under the Phase II effort, a prototype GPS Autolanding system will be built and tested to demonstrate the performance of the GPS landing system under laboratory test conditions. An option is also included to integrate the system in a UAV and perform flight tests to demonstrate the system

performance. Anticipated Benefits: The proposed system will provide the capability to support close, short, medium, and long-range UAV missions from both land-based and ship-board facilities. The equipment is highly portable and very cost-competitive with alternative systems.

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Topic#: 92-196 ID#: 9220728
Office: MTO
Contract #: DAAH01-94-C-R026
PI: Robert Kalman
Title: Packaging Optoelectronic Integr... d Circuits
Abstract: High-speed optical interconnections are becoming increasingly important in government and commercial processing and communication systems. High-performance cost-effective optical interconnects require the use of opto-electronic integrated circuits (OEICs). A major impediment to the widespread use of OEICs is the poor performance and high cost of their packaging. In the proposed project, we will develop low-cost, high-performance packaging for OEICs. The features of this packaging include: (1) multiple low-loss single mode optical interfaces to fiber, (2) high-density high-speed electrical interconnects, (3) temperature control of the OEIC and high power dissipation, (4) ruggedness and small size, (5) low cost and high manufacturability, and (6) flexibility to accommodate a wide variety of OEICs. Our packaging approach is based on the use of tapered planar optical waveguides (TPOWs) on a silicon substrate to interconnect fibers to the OEIC. In year 1 of the proposed effort, we will develop optimized tapered waveguides and component positioning techniques leading to low optical losses. In Year 2, we will package a specific OEIC: a 4x4 optical crossbar chip based on semiconductor optical amplifiers. This chip requires 8 single mode optical interfaces, >20 electrical interfaces, and dissipates 2W of power. Anticipated Benefits: The primary benefit of the research will be packaging technology and techniques applicable to a wide class of OEICs, including various material families, applications and environments. Commercial applications for optical interconnects span the interconnect hierarchy from WANs to MANs to LANs to computer backplanes.

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Topic#: 91-109 ID#: 9120274
Office: DSO
Contract #: DAAH01-93-C-R162
PI: Larry Burton
Title: Biological Signal Processing: Biological Signal Transforms for Neural Networks Performing Sonar Signal Classification
Abstract: The goal of the research is to achieve effective classification of transient acoustic signals using signal processing structures motivated by our understanding of human and animal auditory systems. The approach takes advantage of extensive ORINCON work on the application of artificial neural networks to underwater acoustic problems. The ultimate goal is to develop an automatic detection and classification capability that can reliably recognize important diesel-electric submarine signature components. The overall approach is use of an artificial neural network fed by a prefiltered data stream. Several prefiltering approaches, including one corresponding to the Lyon-Mead Cochlear model, will be compared for a variety of signal types in the process of optimizing prefiltering. Other prefiltering approaches are FFT, wavelets, and a new hybrid wavelet-FFT approach developed by ORINCON. This new approach achieves resolution properties similar to wavelets but with computational speeds like FFTs. Success in this SBIR effort will have a direct impact on autonomous detection of diesel-electric submarines in shallow water and in reducing manpower requirements for current systems. Anticipated Benefits: The techniques evaluated here may lead to the development of high-speed, low-power, ultracompact processors for better automatic classification systems, particularly when there are few training patterns, many interfering signals, and noisy backgrounds. In addition to acoustic recognition of submarines, helicopters, low-flying aircraft, relocating missiles, and tanks, the technology may also be applied to a variety of nonacoustic sensors.

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Topic#: 92-100 ID#: 9211278
Office: MICOM
Contract #: DAAH01-93-C-R349
PI: Jimmy 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 develop,

fabricate and deliver two prototype identification friend or foe (IFF) systems for combat vehicles. Each system will consist of the transceiver/transponder units for shooter/victim, respectively; operating instructions; schematics; parts lists and troubleshooting guide. A brassboard version of the system was demonstrated during the Phase I contract. The IFF system can be interrogated by laser pulses or by an RF "request to transive use of low cost, highly reliable, commercially available components. The interrogation commences with a laser pulse (one only), followed by a DES-encrypted (or non-encrypted, as commanded) RF message. The transponder is alerted by the single laser pulse, and awaits the RF message at a specified time delay. Receiving the proper message, the "Victim" operator is alerted to the operation. Meanwhile, the message is validated and answered with a message containing extensive information about the Victim, such as vehicle number. Upon receiving this message, the interrogator validates the reply, signals a Don't Fire to the Shooter, and sends another RF message containing at least the recognition of the Victim as a Friend. The Victim operator gets a signal that it has been safely identified as a Friend. Anticipated benefits: 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. The system being proposed makes extensive use of low cost, highly reliable, commercially available components. Retrofit costs would be relatively low since all combat vehicles utilize the RF equipment upon which the system is based. NATO interoperability issues would be very minimal.

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Topic#: 91-182 ID#: 9120723
Office: ESTO
Contract #: DAAH01-93-C-R143
PI: John Kibarian
Title: Integrated Technology Computer Aided Design
Abstract: Improving the yield of integrated circuits is critical to the profitability of semiconductor manufacturers. Higher yields are the result of two tasks: designing more robust processes and products, and continuously monitoring and improving the manufacturing process. Technology CAD (TCAD) can be used both to develop more robust designs and to uncover the causes of yield loss during manufacturing. PDF Solutions has developed a TCAD tool, called pdFab, that is a manufacturing based process and device simulation environment. Customers are currently using pdFab for in-line control limit design, worst case device characterization, and process design for manufacturability. Phase I research, discussions with customers, and development experience with pdFab has revealed a substantial need for the development of software that helps engineers apply TCAD tools to manufacturing tasks. PDF Solutions proposes to answer this need by building a software system that facilitates the application of physically based models to both the design of semiconductor manufacturing processes and, most importantly, the analysis of measured data. Engineers will use the system to perform predictive tasks such as deigning robust processes and predicting worst case SPICE model parameters as well as tasks in which measured data is analyzed, such as process diagnosis, process control, and early product disposition. The proposed TCAD framework will dramatically affect a semiconductor manufacturer's ability to deliver high quality, robust components in a timely manner. The effort will help to establish an entirely new software industry dedicated to delivering powerful prediction and analysis tools to semiconductor manufacturing groups. Anticipated Benefits: TCAD tools have traditionally been used by small groups of engineers responsible for process development and device design. While process/device is designed over a short period, it is manufactured for many years. Thus a much larger market is available to TCAD tools if they can be applied to the problems faced by the sizeable product, yield, and manufacturing engineering communities. Since the ratio of product engineers to circuit designers is approximately 1-1, we anticipate a market close in size to ECAD ($200M).

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Topic#: 91-198 ID#: 9120799
Office: CSTO
Contract #: DAAH01-93-C-R169
PI: John Kibarian
Title: Interoperable Technology Computer-Aided Design (CAD) Tools for Electronic CAD
Abstract: Simplistic characterization of process capability by providing nominal SPICE parameter model cards to circuit designers results in a significant bottleneck to the transfer of technology. The characterization of a process must go beyond SPICE model parameter extraction. We propose to develop tools that will make thorough characterization of the entire process possible with simulated data as well as with measured data. These new tools will improve the accuracy of device characterization, including the modeling of variations due to operating temperatures, intra-chip variability, and statistical

variations of process controls. Finally, to facilitate technology transfer, we propose to develop a process capability server (technology server) for circuit design environments. Anticipated benefits: Integrated circuit producers (both designers and manufacturers) will realize the following benefits: realistic manufacturing variations will be accounted for during design, higher yields of product early in the manufacturing cycle will be possible, manufacturers can "advertise" production capability before a process is fully developed, and concurrent circuit and process design can be undertaken to maximize product performance.

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Topic#: 91-192 ID#: 9120427
Office: CSTO
Contract #: DAAH01-94-C-R011
PI: Tomasz Jannson

Title: Highly Parallel Real-Time Fiber Optical Multi-Wavelength Network for Longer Distance Personal Multi-Media Conferencing

Abstract: Packet-transport-based systems using ATM (asynchronous transfer mode) are developing as a broad-band technology for long-distance multimedia communication networks. Their application to short-distance local area networks (LANs) and metropolitan area networks (MANs) is not attractive, because ATMs require expensive high-performance high-speed electronic interface circuitry at each node of a network. LANs and MANs have many nodes, and therefore require too many electronic interfaces for an ATM approach to be practical. Physical Optics Corporation (POC) proposes a highly parallel realtime fiber-optic multiwavelength network, to solve this problem. POC's approach is based on wavelength division multiplexing, and is an alternative short distance technique to the longer-distance ATM fast packet switching systems. In Phase II, POC will develop a wavelength integrated broad-band interface (WIBI) to solve ATM problems. Phase II efforts will focus on integrating high performance FDDI- and SONET photonic layer electronic interfaces with POC's advanced WDM technology. POC's proposed approach will more fully utilize the enormous bandwidth (approaching 30,000 Gigahertz) of the fiber optic media. This approach is readily expandable to OC-96, or even OC-144, using only OC-12 electronic interfaces and 12 photonic layer WIBI channels. Anticipated Benefits: Anticipated benefits of Phases II and III include a family of Wavelength Integrated Broadband Interfaces (WIBI) for increased capacity FDDI, SONET and multimedia communications. It will be based on POC's 4, 8, and 16-channel WDMs. As with virtually all communication technologies, a tremendous private sector market exists for broadband open system products, such as POC's proposed WIBI.

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Topic#: 91-114 ID#: 9120766
Office: MTO
Contract #: DAAH01-93-C-R153
PI: Dariush Modarress

Title: Advanced A/D Monolithic Chip Architecture Designs for Wide Dynamic Range and Gigasample Conversion Rates

Abstract: Feasibility of a 6 bit, 10-14 Gigasamples/second monolithic integrated circuit analog to digital converter using GaAs HBT technology was established during the Phase I effort. The developed design uses a "Ping Pong" architecture with matched ADC units. Innovative detailed designs were developed for the track and hold circuits, frequency synthesizer circuit and folding amplifier/flash ADC circuits, which were identified as the critical subsystems. Performance simulations of these subsystems demonstrated the feasibility of reaching the design goals. In Phase II the critical subsystem designs will be refined and the detailed system design will be prepared. Critical subsystem designs will be tested by fabricating the subsystems as ICs in GaAs HBT and measuring the performance. Because of interest in future use of the design, Rockwell International will provide fabrication support at no cost to the program. The experimentally determined subsystem characteristics will be used to complete the monolithic system design and provide accurate performance predictions. Monolithic fabrication and testing of the ADC design is proposed as an optional extension to Phase II. Anticipated Benefits: Sampling at 10-14 Gs/s with 6 bit resolution with a low power requirement will be substantial improvement on current monolithic ADC capabilities, with many applications for military and commercial users. Preliminary discussions with manufacturers of high speed data acquisition systems and other digital equipment indicate a substantial commercial market will exist. Commitments for support of further development have been made. The purpose of this research is to investigate more efficient architectures in terms of chip size, power consumption, and 8-bit resolution at 1 gigasamples per second using new advanced process technologies such as HBTs. The results of the innovation proposed herein can be used for many military and commercial applications ranging from the MMIC/VHSIC interface to radar signal processing, electronic counter measures, and instrumentation.

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Topic#: 92-194 ID#: 9220156
Office: MTO
Contract #: DAAH01-94-C-R013
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 commutation 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 keV 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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Topic#: 90-107 ID#: 9020505
Office: MTO
Contract #: DAAH01-93-C-R154
PI: George Taylor
Title: Improved Ferroelectric Thin Films for Nonvolatile Memories
Abstract: The objective of the Phase II Program is to utilize the very promising Phase I results obtained on ferroelectric thin films of XXXX for building a 1Kb non volatile CMOS memory chip. This memory would have immediate application for RF/ID Electronic Tags and as a Proof of Concept for 1 Mb and larger memories. Initial Phase I studies of some ferroelectric XXXX thin films showed that these materials have at least 3 orders of magnitude greater endurance, switch faster and have a higher signal to noise ratio than comparably prepared PZT thin films. From the measured data, useable endurances well in excess of 10 sq12 polarization reversals for the best XXXX composition selected in Phase I can be predicted. The Phase II Program will: 1. Investigate in more detail the XXXX thin film ferroelectric family to determine whether there is a more optimum composition than the one selected in Phase I. 2. Establish a viable integrated circuit process for manufacturing a non-volatile FRAM-CMOS chip utilizing the optimum thin film XXXX composition selected from 1 above. 3. Fabricate 1 Kb integrated PSZT memory arrays using the mask sets previously designed, developed and proven by Symetrix Corporation. The operating performance of the non-volatile 1 Kb XXXX memory chip will be compared with a non-volatile 1 Kb memory chip based on Symetrix's proprietary thin film ferroelectric composition (Y1). Anticipated Benefits: Program will demonstrate performance of a viable, high endurance, 1 Kb integrated XXXX ferroelectric - CMOS non-volatile memory chip. This memory will be used in RF/ID Electronic Tags for security access, animal identification and inventory control for military, industrial and consumer applications. Program will also serve as Proof of Concept for 1 Mb and larger non-volatile memories for many government and commercial applications.

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Topic#: 91-045 ID#: 9110031
Office: SSTO
Contract #: DAAH01-93-C-R083
PI: Paul Abrahams
Title: Software Reverse Engineering Tools for Inclusion in Open Architecture Environments
Abstract: Reverse engineering is the task of deriving the specification of a software system from its implementation. In Phase I we developed an approach to reverse engineering using SEDL, the Software Engineering Design Language developed by Gerald Fisher at IBM, as our specification language and using the Pan editor, developed at UC Berkeley, as our transformation tool. We designed extensions to the Pan search/replace operations that support syntax-based and semantics-based transformations. We used C as the test case for our approach and designed a dialect of C called C' that can be macro-expanded into C and translated into SEDL. In Phase II we propose to port Pan to the IBM RS/6000; prepare Pan-style syntactic and semantic descriptions of C' and SEDL; write the supporting C' macro definitions and a C' to SEDL translator; develop a library of canned transformations; develop program analysis tools such as call-graph analysis and integrate them into Pan; and perform a case study of a specific C program. Anticipated Benefits: The proposed toolset will help solve the problem of upgrading and adapting old computer programs. Commercial organizations could offer reverse engineering services to other organizations not

prepared to do it for themselves. Because SEDL is a superset of Ada that can be translated down to Ada, the toolset will be particularly helpful in converting programs to Ada.

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Topic#: 91-094 ID#: 9120510
Office: DSO
Contract #: DAAH01-94-C-R001
PI: Daryoush Allaei

Title: Application of Localized Vibration and Smart Materials in Controlling the Dynamic Response of Structures

Abstract: In the treatment of the dynamic problems of structures, two alternate testing methods, based on external and embedded sensors, exist in the literature. If the sensors respond to the changes in the dynamic characteristics of the structure, and/or the environment, then they are referred to as "smart" structures. Smart sensors and smart materials have been used for detecting structural damages and/or controlling the vibration characteristics of structures. Recent developments in new materials, and in vibration phenomenons, such as mode localization and transition, have made the researchers look for ways of combining the two in order to more effectively alter structural response. The objective of this Phase II project is to develop more efficient and precise smart structures based on smart materials, such as shape memory alloys, advanced sensors, such as optical fibers, and vibration phenomenons such as loci crossing and phenomenons will be enforced on the structures so that the undesired vibrations are confined to a smaller region, and therefore, easier to detect and control. Optical fibers and shape memory materials will be used to detect and control the parameters that are more crucial in vibration response of the structure. Such a combination will result in a huge reduction in the number of the sensors, significant gain in computational speed, and improving the accuracy of the control system. Anticipated Benefits: The outcome of this SBIR project will result in significant advancement in the field of smart structures. It will enhance the capabilities of the systems used by DOD, NASA, aerospace, and commercial industries. The commercial applications of such a development include damage control, confinement of structural vibrations, and vibration control which significantly improve the performance and reliability of structures.

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Topic#: 91-212 ID#: 9120167
Office: SSTO
Contract #: DAAH01-93-C-R302
PI: Ruben Prieto-Diaz

Title: DARE: A Domain Analysis and Reuse Environment

Abstract: Domain analysis (DA), systems analysis for multiple related systems, is necessary for the systematic, formal, and effective practice of software reuse. Proposed approaches and methods for DA assume that domain knowledge exists and is readily usable. Experience indicates, however, that acquiring and structuring knowledge is the bottleneck of DA. Phase I of this study assessed the potential for automating this bottleneck activity. Existing techniques and tools, in particular those from information retrieval and expert systems development, were found to potentially provide support for activities in the DA process. Phase I identified a high level architecture for a domain analysis support system (DARE) which integrates these techniques and tools. Phase I adapted the STARS DA methodology into a step by step repeatable procedure supported by the DARE architecture. The goal of Phase II is to further explore DARE's architecture and subsystems. Some of the subsystems will be implemented and tested. Others, which are less well understood, will be researched, and requirements and designs will be written for them. This proposal details the plan to develop a preliminary prototype for DARE and describes the technology that will be used and developed in the process. Technology transfer, utilization, and commercialization issues are discussed. Anticipated benefits: Clear understanding of the domain analysis process and a framework for standardizing and automating some of its activities. Commercial applications include tailoring of the DARE method and environment to support specific domains, development of interfaces between DARE and other ARPA reuse support tools, and development of domain specific reusable components and architectures DARE can use for application development.

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Topic#: 92-041 ID#: 9210544
Office: DSO
Contract #: DAAH01-93-C-R170
PI: Sadeg Faris

Title: Multilayer CLC Optical Disc Drive for Work Stations

Abstract: In Phase I, Reveo experimentally demonstrated the viability of a novel multi-layer mass storage technology based on the selective reflective property of cholesteric liquid crystal (CLC) material. In addition, a novel material blend was invented which makes it possible to perform the write/erase operations. This is a Phase II proposal which extends the results of Phase I in order to develop and demonstrate the world's first five-layer optical disc drive to be used for work stations mass storage. In subsequent phases, this program will ultimately lead to 100-layer storage media, multiple TeraByte capacity and using massive parallelism, data rates approaching T-bit/sec. In order to achieve the program objectives, several tasks will be performed including the development of CLC material and processes, laser and detection subsystems, disc drive electronics, software and integration in a workstation environment. The part of this program leads to a write once read many system in a 3" format, while the second part deals with exploration and development of erasable media. The demonstration of the five-layer prototype will advance the state of the art of mass storage and will lead to commercialization of innovative memory products which will satisfy the military and civilian needs in computing, databases, communications and many other scientific and engineering applications. Anticipated benefits: Increased memory capacity at high data rate leads to innovative commercial products which advance computing, database management, communication, science and engineering.

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Topic#: 90-120 ID#: 9020509
Office: MSTO
Contract #: DAAH01-93-C-R144
PI: Fraser Smith

Title: *Optical-Interfaces for Integrated Chip-Based Hydrophones*

Abstract: The Center for Engineering Design (CED) has an ongoing ARPA-sponsored project to build Micro Electro Mechanical Systems (MEMS). One of the evolving facets of the project is the development of non-planar (cylindrical in particular) lithography techniques. This technology lends itself naturally to the development of electro-optic interfaces for hydrophone systems, which typically use cylindrically-shaped fiber-optic data lines. This allows the attachment of a multitude of sensor modalities directly to a fiber optic line. In particular, Sarcos Research Corporation (SRC) for the Phase I portion of this SBIR explored the viability of FET-based microsensors for hydrophone applications, with particular concern for bandwidths, sensitivities and resolutions. The Phase I effort considered of system analysis, experimentation, preliminary sensor and packaging designs, and proposed fabrication protocols. The conclusion of the report is that FET-based hydrophones can compete with bulk PZT-based hydrophones, but at less size and weight. Thus, the objective of Phase II is to build a prototype of a FET-based pressure-sensitive hydrophone, and to develop optical interfaces to the FET-based sensor using appropriate combinations of cylindrical and planar fabrication techniques. The prototype will be compatible with existing hydrophone communication protocols and power sources. SRC will emphasize an integrated, complete system approach rather than isolated demonstrations of feasibility. It is anticipated that the technical benefits of this research effort will extend beyond the government-oriented hydrophone arena (such as towed arrays or large ocean-floor arrays), and into the commercial sector as security-oriented sensors, medical-grade pressure sensors, and deep-well sensors. The optical interfaces could benefit the auto and aircraft industries where the trend is toward more sensors and multiplexed data lines.

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Topic#: 91-222 ID#: 9121225
Office: DSO
Contract #: DAAH01-93-C-R254
PI: Stephen Peterson

Title: Personnel Status Monitor

Abstract: Sarcos Research Corporation proposes the development of a personnel status monitor (PSM). The miniature monitor will measure the vital signs of a soldier and determine the soldier's functional status. Psycho-physiological parameters such as fatigue and exertion level could be computed from the vital signs information. Information to assist medical personnel in evaluating a soldier's post injury condition would be readily available to medics and could be transmitted to physicians for additional assessment. Further, the soldier's position, along with the medical information could be transmitted to command personnel. This information has considerable battlefield utility and could be used to influence battlefield strategy. The Phase II work will demonstrate proof of concept of the miniature PSM and provide prototype hardware for field evaluation. Anticipated Benefits: The development of the PSM should greatly reduce morbidity of military personnel and provide a strategic edge on the battlefield. Civilian uses of the technology would assist environments. The vital signs component of the PSM would be useful for monitoring ambulatory patients.

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Topic#: 91-064 ID#: 9110633
Office: DSO
Contract #: DAAH01-93-C-R320
PI: David Welford

Title: Application of Erbium-Doped Amplifiers to Eye-Safe, FM Lidar

Abstract: The proposed effort is centered on advancing the technology of eye-safe lidar based on semiconductor diode lasers. In Phase II, technology developed for the fiber-based communications industry will be integrated into the system to develop compact, rugged transceivers. Of particular interest is the potential to significantly enhance performance by using erbium-doped fiber amplifiers as power amplifiers and/or preamplifiers. The proposal includes a Core Program and two optional studies (Option A, Option B). The core program is centered on advanced development of the FM lidar concept that was demonstrated in the Phase I program. Option A extends the work to an AM format suitable for range-imaging lidar applications. It includes construction of a novel fiber-coupled detector array. The array is considered a critical enabling component in Option B, under which a fully functional, eye-safe, range-imaging lidar transceiver would be constructed to satisfy the ARPA requirements for the RSTA mission. Anticipated Benefits: The subject technology has immediate application to remote sensing including ranging, imaging, and velocity measurement. A potential manifestation is a hand-held Doppler lidar transceiver. Commercial uses include traffic monitoring, sensors for machine automation, and vehicle-mounted detectors for automatic collision avoidance and braking systems.

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Topic#: 91-235 ID#: 9120615
Office: ASTO
Contract #: DAAH01-94-C-R012
PI: John Flint

Title: Airborne 2-micron Lidar for Clear Air Turbulence Detection

Abstract: Clear air turbulence (CAT), which can contain differential wind velocities of 100's of meters per second, are a severe danger to aircraft which encounter them without warning traveling at 400 knots. The sensor detects the presence of air turbulence by measuring the variance in the Doppler-shifted backscatter off aerosols in the vicinity of the flight path. Examining the variance of the Doppler spectrum allows for the detection of turbulence in real-time. The Phase II effort will specifically define the recommended implementation, predicted performance and practical utility of the proposed technology for the detection and avoidance of clear air turbulence hazards. In support of this goal, the Phase II activity will (a) define the performance specs for each of the critical components/subassemblies in the system, (b) include a preliminary design of the mid-IR solid-state LIDAR transceiver and real-time signal/data processor, and (c) develop strategies for optimal utilization of CAT detection data for airborne platforms. Anticipated Benefits: Applications of the proposed research relate to two areas: (1) the further development of mid-infrared solid-state laser technology for scientific studies, and (2) use of the remote sensing technology in atmospheric research, commercial aviation, and pollution/toxic gas monitoring.

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Topic#: 92-091 ID#: 9210472
Office: MICOM
Contract #: DAAH01-93-C-R284
PI: Marshall Cohen

Title: A Universal Multiplexer Readout for Automated Testing of Infrared Focal Plane Arrays

Abstract: We propose to design and build a universal silicon multiplexer for high dark current photodiode arrays in order to support the development of infrared focal plane arrays, FPAs. This device will operate with all detector materials (e.g., InGaAs, HgDcTe, InSb, multiple quantum wells) and will be far superior in terms of readout noise and charge storage capacity to anything now available. The innovation consists of combining novel CMOS technology with design improvements to make a multiplexer that will be available to the entire scientific and defense community. During Phase I, we evaluated several candidate architectures, chose an optimum readout scheme, designed a unit cells, and evaluated the expected performance. We expect a readout noise less than 100 e" with a charge handling capacity greater than 28x10(6) e". This performance will advance the state-of-the-art for both short wave and longwave infrared FPAs. During Phase II, we will complete the design of the full muliplexer, lay out the mask set, and fabricate working devices. The multiplexers will be integrated with Sensors Unlimited's InGaAs photodiode arrays for evaluation. Lester Kozlowski of Rockwell International and Prof. Walter Kosonocky of NJIT will consult on the program. Anticipated benefits: Commercial hybrid multiplexers for infrared focal plane arrays have limited

availability and do not have state-of-the-art performance. This program will develop a universal MUX which will allow automated testing of various IR-FPAs with a single test station for the scientific community, in general, and DoD in particular and will 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: ASTO
Contract #: DAAH01-93-C-R220
PI: James Harris

Title: Feasibility Demonstration of a Novel Concept to Provide Positive Combat Identification Among Diverse Friendly Forces Devices

Abstract: The earlier Phase I SBIR research has identified DoD user interest in the potential ability of info-geometric IFF devices such as "MIST" (Multi-application Anti-friendly Fire IFF System Employing Proprietary SW&RM Technology) to resist detection and possible exploitation by hostile forces. Two exploitation possibilities have been identified as presenting potential IFF user risk. MIST users must be protected against stimulation by threat units capable of covertly interrogating MIST hardware and of extracting user location information. Further, MIST users must be protected against potential subversion by imitating battlefield 'repeaters'; since this would potentially permit hostile forces to pose as friendly forces and would also permit the potential introduction of compromising misinformation into the IFF network. Emulated security applique design candidates (baseline proposal) will be evaluated. The most promising candidate will be selected for an (optional) hardware field demonstration. Security applique hardware resulting from the subject Phase II research option will interface compatibly with 'MIST' hardware being developed and field demonstrated under separate ARPA funding. Anticipated Benefits: The research effort associated with this Phase II Small Business Innovative Research proposal is expected to demonstrate the practicality of providing network and informational security protection (of both types) for the into-geometric combat identification approach of the earlier SBIR Phase I research. During the proposed Phase I effort, SESCO expects to work closely with the Sponsor and with many of the following organizations: ARPA 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.

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Topic#: 91-212 ID#: 9120460
Office: SSTO
Contract #: DAAH01-93-C-R151
PI: Edward Comer

Title: Sahib: Automated Librarian Supporting Domain Analysis and Software Reuse

Abstract: A set of thesaurus-based information retrieval tools, named Sahib, are proposed for development during Phase II. The toolset is named in honor of Rao Sahib S.R. Ranganathan, the recognized father of library science and information retrieval. The approach is based upon an innovative repository technology, termed thesaurofacets, that integrate a faceted classification with an information retrieval thesaurus. The Sahib toolset enhances existing reuse repository mechanisms by providing an automated librarian capability supporting domain analysis and supporting domain-directed software reuse. The toolset provides semi-automated classification derivation and maintenance, and completely automated asset and domain reference cataloging. The Sahib toolset addresses many of the cost-benefit impediments to large-scale transition of software reuse technologies, by lowering the cost of acquiring and organizing domain knowledge during domain analysis and by lowering the cost of classification and cataloging activities while improving the effectiveness of reuse libraries. The Phase II activity proposes the development of the initial Sahib automated librarian toolset that will be commercialized during Phase III. Software Productivity Solutions is a proven SBIR contractor with successful Phase III commercializations. A commercialization plan for Sahib is presented. Anticipated Benefits: Sahib will enable cost-effective domain-directed reuse that will reduce software development costs and schedules and lead to increased reliability, maintainability and interoperability. With yearly software expenditures in the DOD alone exceeding 20 billion in the 1990s, there is widespread applicability of the technology. Because the commercial

sector suffers from the same "software crisis", Sahib has a commercial potential of even greater size.

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Topic#: 91-025 ID#: 9110119
Office: MTO
Contract #: DAAH01-93-C-R126
PI: Alan Stanton
Title: Plasma Process Control Using Multiple Optical Sensors
Abstract: The development of real-time process control for semiconductor device fabrication is critical to advancing the technology in manufacturing microelectronic circuits. In this research, recent advances in tunable diode laser fabrication and detection technology will be exploited to develop compact and cost effective instrumentation for plasma process monitoring and control. In Phase I, a prototype diode laser sensor was used to obtain in situ measurements of neutral radicals, gas phase products, and feed gas dissociation during etching of silicon and silicon dioxide in a fluorocarbon-based system. Using chemometric methods, correlations between spectral features measured with the diode laser and process characteristics such as end point, etch rate, and etch selectivity were identified. In Phase II, comprehensive sets of in situ data will be taken with the diode laser in both a GEC Reference Cell Reactor and an experimental test reactor operated by a manufacture of plasma etching systems. These data will form the basis of a chemometrics-based model for predicting etch selectivity and other process parameters. Based on these data, a machine interface will be designed and tested for on-line control of the etching reactors utilizing real-time inputs from the diode laser sensor. Anticipated Benefits: The diode laser sensor has very strong potential for commercial applications in monitoring and control of microelectronic device fabrication processes. The techniques and instrumentation could potentially be applied to a wide variety of plasma processes, including either etching or deposition processes, and a wide range of materials, including semiconductors, insulators, metals, etc.

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Topic#: 91-062 ID#: 9110449
Office: DSO
Contract #: DAAH01-93-C-R130
PI: Anion Greenwald
Title: Non-Linear Optical Polymers for Frequency Doubling
Abstract: Spire Corporation proposes a Phase II program to combine polymer-based frequency doubling with existing laser array bars to generate multiwatt coherent blue light. Solid state blue lasers presently have very low power; frequency doubling can increase output power by a factor of ten, although single crystal non-linear optics are very expensive. In Phase I Spire demonstrated inexpensive polymers with non-linear optical coefficients comparable to those of single crystal lithium niobate. Doubling efficiency of devices to be built in Phase II should exceed 5%, to generate high power coherent blue light at low cost. Phase II will investigate improvements of second order response coefficients, determine life-limiting effects, and prepare demonstration devices with coupled arrays of at least 40 AlGaAs lasers. A compact, rugged, high power blue light source would have significant applications to communications and optical data storage because of its shorter wavelength compared to existing infrared sources. Anticipated Benefits: Frequency doubled lasers will find applications at the high end of the performance market for electro-optical devices where smaller focus and/or higher frequencies are mandated.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 91-097 ID#: 9121218
Office: DSO
Contract #: DAAH01-93-C-R294
PI: Piran Sioshansi
Title: Simplified Diamond Polishing Using an Ion Implantation Assisted Technique
Abstract: Rough diamond surfaces present a major obstacle to application of diamond technology in a number of areas such as optical windows and domes and heat sinks. Spire has developed ion beam assisted polishing (IBAP) for producing ultra-smooth surfaces on synthetic diamond. In the IBAP process, ion bombardment is used to create soft, amorphous layers in diamond. The soft layers are then easily polished away, yielding an optically smooth surface. The Phase I program was tremendously successful. Scratch tests showed ion implanted diamond to be 10-20 times softer than untreated diamond. Consequently, the ion implanted surface polished easily with alumina. Ultimately, a surface roughness of 32 A R was achieved using the ion beam assisted technique. Phase II will optimize the ion beam assisted polishing process. The influence of various ion implantation

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parameters on amorphization of diamond (and thus surface softening) will be fully quantified. This data will then be used to establish optimized processes for diamonds of varying surface finishes. The surface finish and other relevant properties (optical transmission, heat conduction) will be evaluated. Anticipated benefits: Ion beam assisted polishing is a revolutionary process for producing ultra-smooth surfaces on synthetic diamonds. It is an enabling technology which will expand the use of diamond in many applications and improve it in others. Both Norton and Raytheon have already expressed strong interest in the technology.

SQM TECHNOLOGY, INC.
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LA JOLLA, CA 92038
Phone: (619) 481-7182
Topic#: 91-004 ID#: 9110150
Office: ASTO
Contract #: DAAH01-93-C-R341
PI: Walter Podney
Title: Development of Piezomagnetometer Arrays
Abstract: Phase I demonstrates feasibility of a PiezoMagnetometer, a small, rugged low cost magnetometer that promises a resolution of 1 pT/Hz at a power of 1 mW. It is a composite of magnetostrictive and piezoelectric materials. A change in magnetic field strains the magnetostrictive layer, which in turn stresses the piezoelectric layer. Stress polarizes the piezoelectric material, separating electric charge in proportion to the magnetic field variation. The composite converts variations in magnetic field to variations in electric charge. Their small size, low power, and low cost make arrays of PiezoMagnetometers practical. Phase II development divides into three parts: (1) a Base Plan, (2) Option I, and (3) Option II. The Base Plan develops a magneto-electric sensor, with a volume of 1 cc, that can resolve a magnetic induction of 1 pT/Hz, below 100 Hz, uses it to form vector, scalar, and differential magnetometers, and sets designs for linear and planar arrays of PiezoMagnetometers. Success of the Base Plan leads to development of linear and planar arrays in Options I and II. Anticipated Benefits: Successful development of a PiezoMagnetometer provides a small, rugged, low cost magnetometer with high sensitivity at low power that makes arrays of magnetometers practical. Their uses commercially are manyfold. They include mineral prospecting, nondestructive evaluation of materials, instruments for scientific research, and monitoring electromagnetic emissions from power transmission lines.

SYMETRIX CORP.
5055 MARK DABLING BLVD., SUITE 100
COLORADO SPRINGS, CO 80918
Phone: (719) 594-6154
Topic#: 91-077 ID#: 9110505
Office: MTO
Contract #: DAAH01-93-C-R190
PI: Larry McMillan
Title: High Dielectric Constant Capacitors for ULSI DRAMS
Abstract: Using information gained from Phase I and other research, Symterix Corporation will build and characterize materials designed at the molecular level to be of value towards the development of devices such as ULSI DRAMs, decoupling capacitors (on-chip and multi-chip modules), charge holding capacitors in IR focal plane arrays and other devices with military applications. Our experience in synthesis, deposition and integration of these complex compounds is key to this effort. Technology transfer to a DRAM manufacturer concurrent to this program is an important aspect of this proposal. Anticipated Benefits: Integrated high dielectric constant materials in thin-film form (300A-4000A) are applied in a variety of electronic device applications. This work advances the state-of-the-art in materials synthesis, deposition and integration with IC processes.

TECHNOLOGY MODELING ASSOC., INC.
300 HAMILTON AVENUE, THIRD FLOOR
PALO ALTO, CA 94301
Phone: (415) 327-6300
Topic#: 91-027 ID#: 9110661
Office: ESTO
Contract #: DAAH01-93-C-R080
PI: Michael Kump
Title: A Standards Based Semiconductor Process Representation Server
Abstract: Semiconductor technology design programs today are characterized by exorbitant costs, protracted design cycles, and manufacturability problems. The use of technology computer-aided-design tools (TCAD) is essential to solving these problems. However, the tools available today do not interoperate well, are difficult to use, and do not support distributed computing. These problems are a significant barrier to the effective use of existing TCAD tools. TMA is working with the CAD Framework Initiative Semiconductor Process Representation (SPR) Working Group to develop an industry-wide SPR standard to address these problems. TMA proposes to develop an alpha version of an SPR server, based on the industry standard, that will consist

of a process repository with process editing and simulation management services. Object-oriented software engineering principles will be applied in the analysis, design, and implementation of the server. The server will be implemented in C++. At ARPA's option, TMA further proposes to work with major U.S. semiconductor manufacturers to extensively alpha and beta test the SPR server, complete a commercially releasable version, and insert this technology into key U.S. semi-conductor organizations. The result of this development effort will be a commercially available SPR server. Anticipated Benefits: The SPR server will reduce the barriers to effective use of TCAD tools in the key areas of interoperability, ease of use, and distributed computing. This will reduce the cost, time, and complexity of semiconductor technology design programs. Since the server will be based on an industry standard semiconductor process representation and will meet demonstrated industry needs, the potential for wide-spread industry adoption and use is great.

TECHNOLOGY SYSTEMS, INC.
P.O. BOX 717, WATER STREET
WISCASSET, ME 04578
Phone: (207) 882-7589
Topic#: 92-015 ID#: 9211111
Office: ASTO
Contract #: DAAH01-93-C-R295
PI: Charles Benton
Title: Development of the VISIONMAN System
Abstract: Development of a system and architecture targeted specifically for Head Mounted Displays and a personal synthetic environment (virtual world) interface is proposed. Further development of this capability under Phase II will enable users to gain access to Synthetic Environments (Virtual Realities) at low cost, free users from the hysical requirement to be co-located with a fixed base Image Generator, and enable users to gain access to multiple environments and applications with a single user-portable display interface. The overall Phase II objective is to develop VISIONMAN to a fully operational level. Phase II objectives can be broken down into two general areas. The first constitutes the core tasks of the effort, which are creation of the CIG hardware, along with final development and integration of the CIG, Sensors, Power, and Server. The second constitute options which go beyond the initial Phase II core effort. These include development and integration of sensor technologies, development of mass storage options, and replication and/or extension of the core Phase II product to support emerging ARPA and DOD technologies and requirements. No similar system exists today. The creation of this capability will enable significant advances in training, visualization, user interfaces, and related research and development. Anticipated benefits: This effort will have short-term benefits in that it will provide a low-cost, revolutionary system for gaining access to the Virtual Battlefield. 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.

TINI ALLOY COMPANY
1621 NEPTUNE DRIVE
SAN LEANDRO, CA 94577
Phone: (510) 483-9676
Topic#: 92-058 ID#: 9210828
Office: ESTO
Contract #: DAAH01-93-C-R298
PI: A. David Johnson
Title: Micro-Actuator Valve Employing Shape-Memory Alloy Film
Abstract: Devices of micromachined silicon with nickel-titanium shape-memory alloy films form actuators for micro-valves for use in industrial pneumatic controls, implantable drug delivery systems, miniature robots and portable chemical analysis systems. Micro-electro-mechanical systems will have a profound effect on the way people work. Key technologies are structural miniaturization, electronic control, and transduction by mechanical actuators and sensors. Improved actuator technology is essential. Thin films of shape memory are suitable for miniature actuators. Current research effort is focused on developing SMA micro-actuators for pneumatic and fluidic valves. In Phase I, improvement in microfabrication techniques established feasibility of micron resolution in defining shapes of titanium-nickel and silicon devices. Prototype poppet valve actuators and orifices were fabricated and assembled into test units. The Phase II objective is development of shape-memory actuated valves which are small and robust enough to be integrated into embedded microsystems, which operate at voltages and power levels compatible with integrated micro-electro-mechanical components, and which are inexpensive to manufacture. Operational sub-millimeter prototypes will be built and tested. Valves will be produced for evaluation by potential customers and an experimental program undertaken to optimize this device for medical uses. Anticipated benefits: Micro-valves will have commercial applications 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.

TORREY SCIENCE & TECHNOLOGY CORP.
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SAN DIEGO, CA 92121
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Topic#: 91-233 ID#: 9120606
Office: MSTO
Contract #: DAAH01-93-C-R221
PI: Sean Yang

Title: Fast Array Readout Architecture (FARA) for CCD's

Abstract: Charge-Coupled-Device (CCD) detectors have been steadily increasing in resolution as well as other parameters offering significant performance improvements. Although 512x512 and even 1024x1024 pixel CCD cameras are available with real-time readout, 2048x2048 pixel or larger CCD's presently cannot achieve the required 30 frames per second. In applications such as surveillance, tracking and high definition television, both speed and resolution are critical. Therefore, an elegant and cost effective solution must be found to support 2048x2048 pixel CCD arrays and even larger devices already being developed. The proposed method to increase the on chip readout rate will use innovative parallel readout architectures in concert with novel high speed sample and hold circuits. This is a significant breakthrough in technology offering performance previously thought not possible. This solution can be easily scaled up to even higher resolutions while maintaining real-time readout rates which will reduce if not eliminate the resolution versus read rate tradeoff in specific cases. Anticipated benefits: Applications in surveillance, tracking, scientific imaging and high definition television (HDTV) will benefit from a "real-time" 2048x2048 CCD camera. The proposed solution also anticipates and offers a solution to readout rate limitations of even larger CCD coming on the horizon.

VENDELIN ENGINEERING
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Phone: (408) 867-2291

Topic#: 91-156 ID#: 9120234
Office: ESTO
Contract #: DAAH01-93-C-R219
PI: George Vendelin

Title: Large-Signal CAD Models of Schottky Barrier Structures

Abstract: Present semiconductor device large-signal models are limited in accuracy because each voltage-dependent device model parameter is generally specified by a single mathematical function over the entire range of the external bias voltages. These device models are unable to accurately account for the non-uniform doping distributions which are found in modern high-performance microwave devices. As a result, modern CAD programs cannot be used to accurately design and optimize the performance of circuits which contain these devices. This contract has generated a set of device model equations with voltage-dependent device model parameters for the four-layer Schottky barrier diode. The model parameters depend upon the non-uniform doping profile of the diode structure. These parameters change in a non-uniform manner as the depletion layer boundary passes from one doping region to the next. In this manner, the device can be accurately modeled for use in both linear and nonlinear applications. Using the improved model in conjunction with powerful CAD simulation programs, the most important performance parameters of the microwave circuit, such as the intermodulation distortion, may be optimized by relating the performance parameters directly to the non-uniform doping profile. This physical-based model provides new ins.ghts to the development engineers designing next generation MMICs. Anticipated Benefits: The improved nonlinear model of both Schottky diodes and MESFETs can be added to microwave CAD software presently available from Packard, EEsof, Compact Software, Microsim, Meta Software, and others.

WIZDOM SYSTEMS, INC.
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Topic#: 91-052 ID#: 9110358
Office: SSTO
Contract #: DAAH01-93-C-R222
PI: Dennis Wisnosky

Title: WIZARD: A Feature-Based Integrated Design Tool

Abstract: Feature technology has been widely recognized as a key element to bridge the integration gaps between CAD, CAPP, and CAM. This proposal suggests to develop WIZARD, a prototype features-based integrated design tool for mechanical design. WIZARD is an openly configured design tool and hardware-independent application. It provides a complete product representation based on an object-oriented approach. It combines both design with feature and feature recognition/extraction methodologies. It provides the possibility to integrate design and manufacturability assessment, assembly feasibility analysis in design process to optimize the design. It also facilitates the quick transfer of research results to industrial applications. Phase II research will specify both the software and hardware requirements for the implementation of WIZARD, define a complete data object model for the representation of a product, design the communication protocols between the system and distributed

data base system, develop both designs with feature sub-system and feature recognition/extraction sub-system, and provide utilities which allow a designer to configure the system and plug his/her applications into the system. Anticipated benefits: WIZARD will allow designer to generate new products with better quality and lower cost. It provides a better modeling capability and captures design intent. The common data structure will facilitate information sharing and standardization. The feature information available at design stage can be easily communicated with downstream manufacturing-related activities. There will be wide potential for WIZARD as a small business innovator.

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BOZEMAN, MT 59715
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Topic#: 91-111 ID#: 9121001
Office: DSO
Contract #: DAAH01-93-C-R287
PI: Robert Hunter

Title: Biomimetic Process for Hazardous Waste Remediation

Abstract: This research will provide an initial proof-of-concept demonstration of a novel biomimetic process for bioremediation of hazardous waste. A reactor engineering approach will be used to facilitate eventual scale up of the process. Appropriate influent and effluent consitutent concentrations, reactor configurations, and process models will be identified. Chemostat and batch experiments will be consulted to quantify model parameters for one anoxic process step (denitrification) and two anaerobic process steps (sulfate reduction and ethanogenesis). A calibrated process model will then be used to design a bench-scale prototype of the process. The prototype will be fabricated and its performance evaluated during a 30-day demonstration run. Independent laboratory testing will be used to confirm the ability of the process to accomplish bioremediation of target compounds. Anticipated benefits: DOD and DOE will spend hundreds of billions of dollars over the next 30 years cleaning up hazardous waste sites. Over 3,500 public and private sites currently await remediation in the United States. The proposed process and/or the information this research will develop about biotransformation of aromatic and chlorinated hydrocarbons under denitrifying, sulfate-reducing, and methanogenic conditions will find commercial application in cleaning up such sites.

EIC LABORATORIES, INC.
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NORWOOD, MA 02062
Phone: (617) 769-9450
Topic#: 91-007 ID#: 91DNA-002
Office: DNA
Contract #: DNA001-93-C-0052
PI: James D. Klein
Title: Optically Monitored Ferroelectric Memory Films
Abstract: Computer memory arrays are extremely vulnerable to electromagnetic disturbances resulting from accidental or hostile actions. Hardening from such effects can be impacted either by adding external protection to existing systems or by incorporating survivability in new designs. Inherent hardness can be impacted to random access memory arrays by using thin film ferroelectric materials as memory elements. A new deposition technique would allow epitaxial stoichiometric thin films of perovskite ferroelectric phases such as PZT to be obtained on a variety of semiconductor substrates. Real-time control of thin film deposition processes based on intelligent in situ optical spectroscopic monitoring during the deposition of epitaxial ferroelectric thin films is proposed. This non-invasive technology will provide direct indications of film thickness and chemical stoichiometry and define other factors influencing microstructure and crystallographic orientation. The utilization of an optical spectroscopic fiber optic sensor allows the actual process, rather than externally set and monitored parameters, to be used as the basis for control. The process is designed to address issues such as cation stoichiometry, phase stability, film/substrate epitaxy, substrate temperature, process fingerprinting, and real-time feedback control. Characterization of basic electronic properties is proposed in addition to the usual ferroelectric behavior and memory retention and endurance trials.

GEO-CENTERS
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NEWTON CENTRE, MA 02159
Phone: (617) 964-7070
Topic#: 91-005 ID#: 91DNA-004
Office: DNA
Contract #: DNA001-93-C-0062
PI: Bruce N. Nelson
Title: High Frequency Air Blast Pressure Sensor For UGT Measurements
Abstract: The proposed Phase II program will develop fiber optic based procure measurement systems for use in free field airblast measurements of both aboveground and underground tests. In this program, a total of six airblast pressure sensors (three shock hardened and three radiation/shock hardened) and three opto-electronic interfaces will be developed and evaluated in both the laboratory and the field. Three of the measurement systems will be field evaluated on a DNA sponsored aboveground test at the Permanent High Explosives Test Site. The airblast pressure measurement systems that will be developed for this program will provide long duration measurement capability with a sub-microsecond rise time. This will be achieved using a "thin gauge" configuration. This provides a significant improvement to existing Hopkinson bar gauges. The measurement systems will allow improved height of burst curves to be generated from experimental data. The fiber optic measurement systems that will be developed under this program provide immunity to the effects of EMI and EMP, immediate compatibility with fiber optic data transmission lines, and a difference/sum output detection scheme that has proven reliability in both the conventional and the nuclear weapons test measurement environment.

IBIS TECHNOLOGY, INC.
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DANVERS, MA 01923
Phone: (508) 777-4247
Topic#: 91-118 ID#: 91DNA-005
Office: DNA
Contract #: DNA001-93-C-0051
PI: Dr. Bernhard Cordts
Title: Development of a TXRP Depth Profiling Method for Use as a Quality Control Manufacturing Tool
Abstract: This Phase II proposal extends the capabilities of the depth profiling feasibility demonstrated in Phase I for application as a quality control tool in SOI manufacturing. An existing computer program for fluorescence vs. depth analysis will be incorporated in the proposed research and development. Extensive standards work will be performed and applied to both single and multiple implant substrates. Exact identification of the buried oxide interface will be determined. The depth profiles as a function of materials processing will be examined. The application of this work in the manufacturing process is expected to greatly improve SIMOX material quality and related commercial and military circuit performance.

SCIENCE RESEARCH LAB, INC.
15 WARD STREET
SOMERVILLE, MA 02143
Topic#: 92-015 ID#: 92-P1-45
Office: DNA
Contract #: DNA001-93-C-0216

Phone: (617) 547-1122 PI: Dr. Rahul R. Prasad
Title: Instrument Suite to Measure Space & Time Resolved XUV and X-Rays from Z-Pinches
Abstract: It is proposed to design, build and test a novel suite of XUV and X-ray measuring instruments for radiation from Z-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 soft X-rays (1-10 keV). This suite consists of an X-ray crystal spectrometer, an X-ray pinhole camera and XUV pinhole camera. The basic detector element for all these instruments is a 2-dimensional array of silicon p-i-n 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. During the Phase I effort a prototype X-ray crystal spectrometer with an 8-element, linear p-i-n diode array detector was developed and successfully tested at SRL. In Phase II we will upgrade the linear detector to a 2-dimensional p-i-n 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 DECADE simulator. 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 aboveground simulators.

SYSTEMS CONTROL TECHNOLOGY, INC. Topic#: 92-010 ID#: 92-P1-81
2300 GENG ROAD Office: DNA
PALO ALTO, CA 94303 Contract #: DNA001-93-C-0218
Phone: (402) 293-1559 PI: John Mordeson
Title: Automated TERCOM Placement and Evaluation
Abstract: TERCOM placement is a multifaceted problem which affects the STRATCOM (U.S. Strategic Command) cruise missile planners, the STRATCOM data managers, and the Defense Mapping Agency (DMA). Candidate TERCOM sites frequently (according to DMA, as many as 90%) fail the terrain roughness criterion at DMA. This not only creates unnecessary time consuming work for DMA, but it also leaves the planners with unsatisfied TERCOM needs. In Phase I, SCT developed a prototype, interactive graphics program which integrates our operationally proven cruise missile routing algorithms with DMA-endorsed TERCOM site validation criteria. This prototype provides a window-based user interface with graphical plots, optimal path computations, data management of past and current TERCOM requests, and TERCOM site validation tests. Clearly, the feasibility of automated TERCOM placement and evaluation has been demonstrated. In Phase II, SCT will complete development of TPEP to include digital map backgrounds, request form production, database interfaces, and message handling between DMA and STRATCOM. Additionally, Phase II will allow documentation and implementation of TPEP at STRATCOM to include testing and user training. The completed TPEP project will not only streamline routine TERCOM procurement but also provide new capabilities for world-wide cruise missile operations.

TETRA CORP. Topic#: 91-015 ID#: 91DNA-016
3701 HAWKINS STREET, N.E. Office: DNA
ALBUQUERQUE, NM 87109 Contract #: DNA001-93-C-0199
Phone: (505) 345-8623 PI: Chris M. Young
Title: Advanced High Power Switching Technology
Abstract: Repetitive, high current switching in high voltage systems represents a major challenge to the switching community. The requirements for long life, fast recovery, high voltage hold-off, high current, high rate of current rise, and long conduction times are difficult to satisfy with a single device. The pseudospark switch has been shown to satisfy all of these requirements except that it lacks scalability to very high currents. It is proposed to investigate a new type of pseudospark switch called the linear pseudospark switch. This switch allows current scalability without the degradation of voltage hold-off characteristic of conventional pseudosparks. Feasibility of the linear pseudospark discharge was demonstrated in Phase I and this effort is directed toward understanding and demonstrating this technology at higher currents.

ADVANCED FUEL RESEARCH/ON-LINE TECHNOLOGIES
P.O. BOX 380379
EAST HARTFORD, CT 06138
Phone: (203) 528-9806
Topic#: 92-003 ID#: 92-118
Office: SDC
Contract #: DASG60-93-C-0027
PI: Peter Solomon
Title: Miniaturized FT-IR Sensor for Infrared Measurements
Abstract: Phase II will develop an advanced dynamically-balanced "isolation interferometer" whose mirror motion is decoupled from external vibrations. Such an interferometer can be employed to make an FT-IR instrument which is immune to vibration and is permanently aligned. Advanced Fuel Research,Inc./On-line Technologies, Inc. will test both the plane mirror and corner cube designs, choose the best one and fabricate and test an FT-IR spectrometer for delivery to the Army. Phase II will result in a break-through improvement in portable, rugged, FT-IR instrumentation with the following performance improvements: factor of 30 in vibration suppression; factor of 10 increase in signal-to-noise ratio; factor of 10 increase in scan speed; and a factor of 3 reduction in size and weight. Applications of a passive IR sensor include: identification of rocket launches from satellites, battlefield chemical detection, toxic chemical monitoring, monitoring of emission from superfund sites and monitoring of smoke stack and auto effluents.

ADVANCED PHOTONIX, INC.
1240 AVENIDA ACASO
CAMARILLO, CA 93012
Phone: (805) 484-2884
Topic#: 92-014 ID#: 92-312
Office: SDC
Contract #: DASG60-93-C-0128
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.

ADVANCED SCIENTIFIC CONCEPTS, INC.
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SANTA BARBARA, CA 93103
Phone: (805) 966-3331
Topic#: 92-003 ID#: 92-065
Office: SDC
Contract #: DASG60-93-C-0098
PI: Roger Stettner, PhD
Title: High Quantum Efficiency Visible to Near Infrared Photocathode
Abstract: Phase II 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 Sensivity: 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.

ADVANCED SCIENTIFIC CONCEPTS, INC.
2020 ALAMEDA PADRE SERRA, SUITE 123
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Phone: (805) 966-3331
Topic#: 92-003 ID#: 92-066
Office: AFPL
Contract #:
PI: Roger Stettner, PhD
Title: Super Sensitive Solid-State Detector
Abstract: Phase II will develop a breakthrough in a Infrared (IR) detector, called the Super Sensitive Solid-State Infrared

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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.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 92-014 ID#: 92-740
Office: SDC
Contract #: DASG60-93-C-0151
PI: Brian A. Vaartstra
Title: Bimetallic Precursors for Chemical Vapor Deposition
Abstract: Metalorganic chemical vapor deposition (MOCVD) is the most widely accepted manufacturing technique for electronic quality thin films due to its inherent control over film composition, purity, conformality, uniformity and deposition rate. Thin film technology for ferroelectric material such as lead titanate and lead zirconate titanate (PZT) is in great demand due to many applications in pyroelectric and optoelectronic devices. In Phase I of this program, unprecedented heterobimetalic lead-titanium and lead-zirconium precursors were synthesized, characterized and established as promising MOCVD sources by virtue of their physical properties and composition control during deposition. Due to the imposed 1:1 stoichiometry of lead to Group IVB metal, these compounds provide control over film composition at a molecular level. In contrast, MOCVD using commercially available precursors is very sensitive to process variables, which translates to poorly controlled elemental stoichiometry, compromising the electronic properties of the thin film. In Phase II we will evaluate three different classes of bimetallic precursors, optimize their physical properties, develop scale-up procedures, establish their superiority for the deposition of thin films and demonstrate a prototype device from the films. In Phase III we will partner with two major semiconductor manufacturers to move the source reagent and CVD technology developed in Phase II into commercial device fabrication processes.

ADVANCED TECHNOLOGY MATERIALS, INC.
520-B DANBURY RD
NEW MILFORD, CT 06776
Phone: (203) 355-2681
Topic#: 90-014 ID#: 40728
Office:
Contract #: N00014-93-C-0264
PI: Charles P Beetz Jr
Title: Diamond Cold Cathodes for Flat Panel Displays
Abstract: Low power, rapid turn-on electron sources are critical to the commercialization of novel flat panel CRT displays. Cold cathodes fabricated from thin film semiconducting diamond promise to be robust, manufacturable, low cost, and high performance electron sources. The Phase I growth investigations showed that semiconduction diamond has electron emission properties which makes its incorporation into a cold cathode, and ultimately a flat panel display, both technically feasible and commercially viable. Recognizing that the cathode and its supply of electrons is but one, albeit essential, element of a new display technology, ATM has teamed with flat panel display manufacturers who provide the components to control the electrons and convert them to visible light, as well as provide marketing expertise to sell and distribute the finished product. Our proposed Phase II research and development program addresses the optimization of the display and morphology of emissive diamond films, the design of display device structures compatible with the required diamond growth conditions, and the incorporation of a diamond cold cathode in a prototype display. In Phase III, ATM and its partners will address the scale-up and manufacturability of the cathode structures.

ADVANCED TECHNOLOGY MATERIALS, INC.
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DANBURY, CT 06776
Phone: (203) 355-2681
Topic#: 91-014 ID#: 91-479
Office: SDC
Contract #:
PI: Charles P. Beetz, Jr.
Title: High Conductivity Silicon Carbide Substrates
Abstract: Preeminence in wide bandgap semiconductor materials technology is critical for the United States to reassert leadership in next generation power semiconductor and short wave length optoelectronics. Unfortunately, the quality and availability of

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substrates - the basis of any semiconductor technology - has not kept pace with either technical or commercial requirements. In a uniquely successful Phase I, ATM explored the growth of highly doped SiC single crystals using both open and closed crucible sublimation growth techniques. We also identified and demonstrated a novel sublimation method that will reduce defect densities and permit controlled doping of high quality SiC single crystals. In Phase II, we will optimize the design and process parameters for the production of highly n- and p-doped substrated for LED and discrete power applications. A fundamental SiC technology leap will be achieved by correlating growth conditions with the occurrence and subsequent elimination of specific defect structures. In Phase III ATM will scale the crystal growth process to enable the manufacture of specific devices and to supply substrates in order to accelerate the growth of an SiC based semiconductor industry.

APPLIED SCIENCES, INC.
800 LIVERMORE STREET
YELLOW SPRINGS, OH 45387
Phone: (513) 767-1477
Topic#: 91-013 ID#: 91-169
Office: SDC
Contract #:
PI: Max L. Lake
Title: Diamond Fiber for Thermal Energy Management
Abstract: Applied Sciences, Inc. (ASI) has been active in the development of a novel graphite fiber with a thermal conductivity approaching that of diamond. This fiber has been produced by chemical vapor deposition (CVD) processing in a fashion similar to the reported technique for diamond whisker production. Also, ASI has contributed to the diamond film technology, developing methods of deposition of diamond on a variety of materials. In a Phase I SBIR program sponsored by BMDO, ASI has combined the techniques for production of both of these carbon allotropes to produce a diamond filament. It is herein proposed to exploit this finding to develop a commercially viable diamond fiber for use in metal matrix and carbon/carbon, and diamond/epoxy composites for high thermal conductivity. Successful development of this type of fiber could allow the fabrication of a dielectric heat sink material having a thermal conductivity of 600 W/m-k in three orthogonal directions, as well as having a CTE which is tailorable within the range of 2 to 8 ppm/C over a temperature range from 25 C to 400 C. This material would have extensive applications in electronics and high performance space and aerospace vehicles.

ASTRALUX
2386 VASSAR DRIVE
BOULDER, CO 80303
Phone: (303) 492-7327
Topic#: 92-014 ID#: 92-292
Office: DNA
Contract #:
PI: Chang-Hua Qiu
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 macroprocessor is possible. The vast potential market for these devices includes monitoring and control of engines: diesel engine on trains, ships, subs, trucks and buses; also rocket engines, power stations, nuclear plants, and heating systems.

ASTROPOWER, INC.
SOLAR PARK
NEWARK, DE 19716
Phone: (302) 366-0400
Topic#: 92-014 ID#: 92-434
Office: ONR
Contract #: N00014-93-C-0262
PI: Robert B. Hall
Title: GaP(1-x)ZnS(x) 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 in 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.

BELTRAN, INC.
1133 EAST 35TH STREET
BROOKLYN, NY 11210
Phone: (718) 338-3311

Topic#: 92-014 ID#: 92-660
Office: SDC
Contract #:
PI: John Carter, PhD

Title: Organometallic Monomer Precursors and Intrafilm Annealing for a Production Process Development

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.

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 #: DASG60-93-C-0066
PI: Sudhir Trivedi, PhD

Title: CdTe:V and CdTe:Ge for High Data Rate Coherent Optical Receiver and Optical Data Processing Devices

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. Photorefractive gain in InP is very sensitive to temperature and is reduced due to the electron-hole competition 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.

CIENCIA, INC.
111 ROBERTS STREET
EAST HARTFORD, CT 06108
Phone: (203) 528-9737

Topic#: 92-001 ID#: 92-663
Office: SDC
Contract #: DASG60-93-C-0030
PI: Salvador Fernandez, PhD

Title: Adaptive Multispectral 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.

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

Topic#: 92-015 ID#: 92-257
Office: AFWL
Contract #: F23615-93-C-2362
PI: Kent Goeking, PhD

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 small and 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 #:
PI: G.M. Loiacono
ID#: 92-007

Title: Crystal Growth in KTIOPO(4)-NATIOPO(4)

Abstract: The critical phase matching angle was found to decrease the increasing [Na] in KTP. Between 18 and 47% Na, Non-critical phase matching (NCPM) at 1064nm was achieved along the X-axis. The increased birefringence produced by Na doping of KTP also lowered the Y-axis propagation cutoff from 994nm for pure KTP to 981nm for 47% Na doped KTP. This program demonstrated that the phase maching conditions in KTP can be tuned by Na doping and a detailed program to refine crystal growth parameters and establish reproducible compositions is presented. The development of KNTP is expected to present a host of applications in efficient doubling of compact diode pumped Nd:YAG lasers, semiconductor diode lasers and high efficiency devices for both military and commercial optical communications, detection and ranging systems.

CSA ENGINEERING, INC.
2850 WEST BAYSHORE ROAD
PALO ALTO, CA 94303
Phone: (415) 494-7351
Topic#: 92-012
Office: AFAL
Contract #:
PI: Conor D. Johnson
ID#: 92-732

Title: Ultra-Quiet Platform for SDI Sensors

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.

ELECTRO ENERGY, INC.
19 HILLANDALE RD.
BROOKFIELD, CT 06804
Phone: (203) 740-7369
Topic#: 92-005
Office: AFWL
Contract #: F33615-93-C-2343
PI: Martin Klein
ID#: 92-336

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.
3152 KASHIWA STREET
TORRANCE, CA 90505
Phone: (310) 534-3666
Topic#: 92-014
Office: DNA
Contract #:
PI: V.K. Raman
ID#: 92-127

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/cm^2 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.

ELECTROCHEMICAL SYSTEMS, INC.
118 SHERWOOD ROAD
RIDGEWOOD, NJ 07450
Phone: (201) 670-8397
Topic#: 92-014
Office: DNA
Contract #: DNA001-92-C-0067
PI: Igor V. Kadija
ID#: 92-252

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.

ELECTRON TRANSFER TECHNOLOGIES, INC.
PO BOX 160
PRINCETON, NJ 08542
Phone: (609) 921-0070
Topic#: 91-014
Office: ARO
Contract #:
PI: William M. Ayers
ID#: 91-528

Title: On-Site Phosphine Generator for Electronic Devices Fabrication

Abstract: Phosphine (PH3) is a gas necessary for making compound semiconductors as well as a dopant source of silicon semiconductor. It is very toxic with at TLV of 0.3 ppm. Environmental regulations make the transport, storage, and handling of compressed gas cylinders of phosphine increasingly difficult and expensive. This project will develop a point source generator for phosphine to eliminate the necessity to transport and store this toxic gas thereby making semiconductor manufacturing safer and more environmentally secure. The phosphine generator will also offer a competitive advantage over organophosphorus sources which have slower materials growth rates and are much more expensive than phosphine. In Phase I we demonstrated that it is possible to generate phosphine at the rates and purity needed for semiconductor manufacturing. In Phase II effort we focus on improving the phosphine generation rate, designing and fabricating the prototype phosphine generator, and through a collaborative effort, grow and characterize InP. A comparative study of InP grown from both traditional gas cylinder phosphine and phosphine from the generator will test the ability of the generator to produce high quality materials. Through a series of iterative InP grow runs and generator modifications, the phosphine generator design will be optimized. The Phase III commercial phosphine generator design will be based on the results of these tests.

EMCORE CORP.
35 ELIZABETH AVE.
SOMERSET, NJ 08873
Phone: (201) 271-9090
Topic#: 92-014
Office: ONR
Contract #: N00014-93-C-
PI: Heng Liu, PhD
ID#: 92-483

Title: Atomic Layer Epitaxy of GaN in a Multi-wafer Rotating Disc Reactor

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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.

FEDERAL ELECTRO-OPTICS, INC.
PO BOX 241261
MEMPHIS, TN 38124
Phone: (901) 458-3017
Topic#: 92-003 ID#: 92-734
Office: ONR
Contract #: N00014-93-C-0246
PI: Roy Williams
Title: Multi-aperture Vision System Coupled to Neural Networks
Abstract: Federal Electro-Optics, Inc. (FEO) proposes to develop a novel, effective tracking system utilizing neural network processing of the signals from a multi-aperture vision system. This approach, inspired by insects and other arthropods, represents a departure from conventional techniques which are modeled after complex human visual system. Some of the proposed task are extensions of the successful efforts of Phase I, while others are innovative improvements conceived from the study conducted in Phase I. the proposed tasks enhance the performance of the tracker by improving the neural network processing, the optical system and by simulation with realistic scene information including multiple targets and noise. A hardware prototype of the tracker will be implemented.

HNC, INC.
5501 OBERLIN DRIVE
SAN DIEGO, CA 92121
Phone: (619) 546-8877
Topic#: 92-016 ID#: 92-688
Office: ARO
Contract #:
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. We are using two new results: a theory relating the tolerable level of reconstruction error to the maximum possible level of compression, and 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 of from 100:1 to 1000:1 for speech and imagery with broadcast quality reconstruction.

IMEC
1214 OXFORD ST
BERKELEY, CA 94709
Phone: (415) 841-3585
Topic#: 90-010 ID#: 40738
Office:
Contract #: DASG60-93-C-0024
PI: Dr Richard Spitzer
Title: Magnetic Mass Memory without Mechanical Motion
Abstract: The feasibility of a fundamentally new magnetic mass storage system without mechanical motion for data transfer was established in Phase I. A conceptual design of a breadboard device that incorporates the essential features of such a Permanent Random-Access Memory (PRAM) was delivered. The results of the Phase I effort strongly support the presumption that production-level PRAMs can be manufactured. The Phase II project will provide detailed design of the breadboard, fabricate and test the breadboard, take systematic measurements on the breadboard, and provide detailed design of a prototype.

IONWERKS
2472 BOLSOVER, STE. 255
HOUSTON, TX 77005
Phone: (713) 522-9880
Topic#: 92-014 ID#: 92-212
Office: ONR
Contract #: N00014-93-C-0256
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 #: DASG60-93-C-0130
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 the scene is dither 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.

MULTILAYER OPTICS AND X-RAY TECH., INC.
452 WEST 1260 NORTH
OREM, UT 84057
Phone: (801) 225-0930
Topic#: 92-001 ID#: 92-442
Office: NRL
Contract #:
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.

NONVOLATILE ELECTRONICS, INC.
12800 INDUSTRIAL PARK BLVD., SUITE 110
PLYMOUTH, MN 55441
Phone: (612) 550-0913
Topic#: 92-014 ID#: 92-183
Office: SDC
Contract #: DASG60-93-C-0042
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

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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 #: N00014-93-C-0251
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). Areal densities of ten thousand million bits/cm^2 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.

OPTIGAIN, INC.
140 POINT JUDITH RD, UNIT C45 MARINER SQ
NARRAGANSETT, RI 02882
Phone: (401) 783-9222
Topic#: 92-011 ID#: 92-443
Office: SDC
Contract #: DASG60-93-C-0065
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.

OPTIVISION, INC.
4009 MIRANDA AVENUE
PALO ALTO, CA 94304
Phone: (415) 855-0224
Topic#: 92-011 ID#: 92-113
Office: SDC
Contract #: DASG60-93-C-0040
PI: Behzad Moslehi, PhD
Title: Ultra Fast Fiber-Optic Modulator/Switch
Abstract: In Phase I, we demonstrated the feasibility of using surface plasmon polarition (SPP) waves, confined to a metal-dielectric interface, and electro-optic (EO) polymers for realizing a novel modulator/switch. We fabricated experimental proof-of-concept SPP devices, planar-optic and fiber-optic substrates. The SPP devices in prisms were designed, analyzed, fabricated, tested, and characterized, and exhibited SPP resonances. We also tested and characterized several polymeric opto-chips from leading polymer companies (Akzo, Hoechst-Celanese and Lockhead). Phase I results demonstrated that these polymers can be integrated with SPP structures to realize practical devices. During Phase II, we propose to optimize the design, fabricate, test and evaluate a switch/modulator by integrating EO polymers and SPP structures on a common substrate. Both integrated-optic and fiber-optic implementations are possible. We will concentrate on integrated-optic implementation for its potential ease of integration. Phase I design software will be improved to function as a complete design tool. We have obtained from Akzo in writing a willingness for collaboration on polymers and Phase III commercialization. Phase II effort will be geared toward developing a device for commercial local area network (LAN) applications. Potential applications exist for DOD's

communications networks. The proposed devices are simple in structure and fabrication and potentially involve low power consumption and low cost.

ORTEL CORP.
2015 WEST CHESTNUT STREET
ALHAMBRA, CA 91803
Phone: (818) 281-3636
Topic#: 92-014 ID#: 92-166
Office: SDC
Contract #: DASG60-93-C-0050
PI: Jeffrey Ungar, PhD
Title: High Power/High Reliability Laser Diodes with Degradation Resistant Facets
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 TELECOMMUNICATIONS SYSTEM
ROUTE 2, BOX 188
LA HONDA, CA 94020
Phone: (415) 857-9655
Topic#: 92-012 ID#: 92-585
Office: AFAL
Contract #:
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.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 92-011 ID#: 92-500
Office: ONR
Contract #: N00014-93-C-0223
PI: Freddie Lin, PhD
Title: Electrooptic Modulation Structure for Optical Signal and Comm Application
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
Topic#: 92-014 ID#: 92-345
Office: SDC
Contract #: DASG60-93-C-0142

Phone: (310) 530-1416 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. Topic#: 92-003 ID#: 92-383
20 NEW ENGLAND BUSINESS CENTER Office: AFRL
ANDOVER, MA 01810 Contract #:
Phone: (508) 689-0003 PI: William J. Marinelli
Title: Infrared Imaging Spectroradiometer
Abstract: Physical Sciences Inc. has successfully demonstrated the operation and application of an imaging Fabry-Perot interferometer for the detection of spectrally structured objects and gas clouds in the infrared region. In Phase II we propose to design, build, and field test a commercial prototype of the imager. The distinguishing feature of our approach is operation of the interferometer such that continuous images of the objects are produced with high sensitivity. This configuration enables: 1) extended free spectral range (up to 1 to 2l), 2) narrow spectral bandwidth (approximately 2% of l), 3) flexible and adaptive sampling/processing of the image, 4) high spatial resolution and throughput, 5) common pixel registry for all wavelengths, and 6) extended field-of-view (<15 degrees full angle). Full spectral coverage of both the 3 to 5 um and 8 to 12 um atmospheric transmission windows in provided at a spectral resolution consistent with the detection of structured molecular absorption/emission and thermal emission. An experimental program was conducted to demonstrate the operation and active control of the imaging Fabry-Perot interferometer. We also used performance characteristics of both the interferometer and commercially available InSb and MCT focal plane arrays to predict the sensitivity of a typical detection system. The systems are projected to have NESR values of 1.2 and 12.5 uW (cm)^-2 (sr)^-1 at 4.5 and 10 um respectively. These sensitivities were used to estimate performance characteristics for viewing of a rocket exhaust and hazardous chemical plumes.

PHYSITRON, INC. Topic#: 92-001 ID#: 92-108
3304 WESTMILL DRIVE Office: SDC
HUNTSVILLE, AL 35805 Contract #: DASG60-94-C-0007
Phone: (205) 534-4844 PI: David B. O'Hara
Title: Broad Bandwidth Benders, Concentrators and Collimators for X-rays and Neutrons
Abstract: Physitron, Inc. proposes to fabricate a new type of optic for low energy x-rays and neutrons which will allow broad energy bandwidths to be bent through large angles, concentrated in short focal lengths, and collimated. This Phase II program will be a follow-on of the successful Phase I in which we designed, fabricated and tested some of these optics on a small scale. These optics use many planar microchannels stacked on top of each other where each has an extraordinarily smooth reflecting surface. X-ray or neutrons can propagate in these long channels via many grazing incidence reflections. By bending the channel assembly and shaping the entrance and exit apertures we can bend, concentrate, or collimate the radiation. Production of these channel assemblies depends upon the ability to produce very thin (12 to 25 um) substrates which have a surface roughness of 1 to 3 A rm and the ability to stack these substrates without producing waviness. These abilities were demonstrated in Phase I. During Phase II, we will produce large aperture optics for specific applications ranging from x-ray elemental analysis systems to nuclear weapon simulators.

PROPULSION RESEARCH, INC.
4511 DALY DRIVE
CHANTILLY, VA 22021
Phone: (703) 968-0200
Topic#: 92-002 ID#: 92-094
Office: SDC
Contract #: DASG60-93-C-0074
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. Microsecond 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.

Q-DOT, INC.
1069 ELKTON DR
COLORADO SPRINGS, CO 80907
Phone: (719) 590-1112
Topic#: 90-003 ID#: 40766
Office:
Contract #: DASG60-93-C-0060
PI: Dr Stephen D Gaalema
Title: Low-Power Floating-Point Analog-to-Digital Converter
Abstract: Q-Dot proposes an innovative, low-power floating-point (f/p) analog-to-digital converter (a/d) which will enhance SDI's space-borne sensors systems and break through the commercial cost barrier. Surveillance sensors such as those used for SDI applications typically span wide dynamic ranges in order to perform their tasks in varying environments. Different objects may return signals with dramatically different strengths in the same frame of data. When a conventional linear a/d is employed, the combination of large dynamic range and even modest range of 100:1 combined with a 1% resolution yields a total dynamic range of 10,000:1 or 14 bits. Alternatively, a floating-point a/d tracks signal range and resolution separately, resulting in nearly constant percent-of-point resolution. This situation preserves the overall wide input dynamic range while significantly simplifying the a/d circuitry. The monolithic, charge-mode, f/p a/d will attain full performance over a 300 K (or 300 C) temperature range from 50 K (cryogenic) to 350 K (77 C) while tolerating a modest radiation environment. Unlike conventional techniques, the inherent precision of the f/p a/d produces data suitable for mathematical processing (e.g., DSP) without correction. The proposed Phase II program will result in a monolithic, stand-alone f/p a/d suitable for many space and commercial applications.

QSOURCE, INC.
239 BURNHAM STREET
EAST HARTFORD, CT 06108
Phone: (203) 291-0120
Topic#: 91-003 ID#: 91-155
Office: ONR
Contract #:
PI: Peter P. Chenausky
Title: Compact, High PRF CO2 Transmitter
Abstract: CO2 range-doppler lidars can accomplish a part of SDIO's mission of finding ballistic missiles in flight by utilizing an output format compatible with extracting precision range (short pulse) and precision doppler (long pulse, low chirp) information from the target. One way to accomplish this mission would be to combine an energetic short pulse format with a long low chirp pulse format by using a sealed-off laser transmitter which has an intracavity modulator and an excitation approach which is compatible with very high level pulsed and gated CW pumping. Until now, these discharge pumping characteristics were not available from a single CO2 laser. With RF/dc excitation, very high level discharge pumping can be achieved by applying a short high peak power RF pulse to a pair of transverse electrodes; this in turn causes an energy storage capacitor to discharge into the pulsed RF discharge with a level of pumping that was shown in the Phase I program to be several times the CW level for 1 microsecond. At similar pressures, the same device was pumped with gated CW excitation with only an RF source. The Phase I program also showed this type of pumping could be combined with an intracavity modulator to generate pulses with peak powers over 1000 times the CW output level. The Phase II program will advance this work to design, deliver and test a fully programmable CW, gated CW or multipulse format lidar transmitter.

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RESEARCH OPPORTUNITIES, INC.
2200 AMAPOLA COURT, SUITE 101
TORRANCE, CA 90501
Phone: (310) 533-5149
Topic#: 92-007 ID#: 92-218
Office: NSWC
Contract #:
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) 345-9555
Topic#: 92-011 ID#: 92-258
Office: SDC
Contract #: DASG60-93-C-0049
PI: Sadeg Faris
Title: Multilayer Mass Storage
Abstract: In Phase I, Reveo experimentally demonstrated the viability of a novel multilayer mass storage technology based on the selective reflection property of cholesteric liquid crystal (CLC) material. In addition, a novel material blend was invented which makes it possible to perform the write/erase operations. This is a Phase II proposal which extends the results of Phase I in order to develop and demonstrate the world's first five-layer storage media and system. In subsequent phases, this program will ultimately lead to 100-layer storage media, multiple TeraByte capacity and using massive parallelism, data rates approaching T-bit/sec. In order to achieve the program objectives, several tasks will be performed including the development of CLC material and processes, laser and detection subsystems, robotic disc changer, and system controller. The demonstration of the five-layer prototype will advance the state of the art of mass storage and will lead to commercialization of innovative memory products which will satisfy the military and civilian needs in computing, databases, communications and many other scientific and engineering applications.

ROCKY RESEARCH
P.O. BOX 61800
BOULDER CITY, NV 89006
Phone: (702) 293-0851
Topic#: 92-007 ID#: 92-140
Office: AFWL
Contract #: F33615-93-C-2302
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.

SARCOS RESEARCH CORP.
390 WAKARA WAY
SALT LAKE CITY, UT 84108
Phone: (801) 581-0155
Topic#: 92-003 ID#: 92-120
Office: SDC
Contract #: DASG60-94-C-0008
PI: Ian McCammon, PhD
Title: Micro Disk Systems for Inertial Sensing and Optical Beam Control

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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 stable, 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.

SCHMIDT INSTRUMENTS, INC.
2435 NORTH BLVD.
HOUSTON, TX 77098
Phone: (713) 529-9040

Topic#: 92-014
Office: ONR
Contract #:
PI: Mark S. Hammond, PhD

ID#: 92-513

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.

SCIENCE RESEARCH LAB, INC.
15 WARD STREET
SOMERVILLE, MA 02143
Phone: (617) 547-1122

Topic#: 92-006
Office: NASA
Contract #:
PI: Xing Chen, PhD

ID#: 92-255

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(E)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.

SENSORS UNLIMITED, INC.
51 CHERRYBROOK DR.
PRINCETON, NJ 08540
Phone: (609) 520-0610

Topic#: 92-014
Office: ONR
Contract #: N00014-93-C-0254
PI: Gregory H. Olsen, PhD

ID#: 92-508

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.

SIOUX MANUFACTURING CORP.
P.O. BOX 400
FORT TOTTEN, ND 58335
Phone: (701) 766-4211
Topic#: 92-013 ID#: 92-211
Office: SDC
Contract #: DASG60-93-C-0140
PI: Dana T. Grow, PhD
Title: Carbon-Carbon Composites Fabrication
Abstract: The project will continue to develop a novel processing method for carbon-carbon composite manufacture with reduced processing time and, therefore, reduce costs. Current carbon deposition processes are unacceptable slow and expensive. The new feature of the process is the deposition of an iron oxide (magnetite) catalyst onto a preform of carbon fibers to catalyze the decomposition of methane and deposition of carbon on the surface of the fibers. Phase I tests have shown that this unique catalyst can increase the rate of carbon formation by more than an order of magnitude. This represents a dramatic breakthrough in carbon-carbon processing technology. Phase II will: A. Scale-up Phase I using larger preforms of carbon fiber and existing equipment. B. Produce carbon-carbon composites in the furnaces of a major U.S. Manufacturer. C. Measure properties, such as density, oxidative stability, thermal conductivity and wear resistance, of the composites for comparison to current values. D. Determine properties as a function of processing parameters. E. Fit applications to properties.

SPACE POWER, INC.
621 RIVER OAKS PARKWAY
SAN JOSE, CA 95134
Phone: (408) 434-9500
Topic#: 92-006 ID#: 92-735
Office: NASA
Contract #:
PI: See-Pok Wong
Title: Power Conditioning Unit for 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 have over 90% efficiency.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 92-004 ID#: 92-240
Office: SDC
Contract #: DASG60-93-C-0117
PI: Edward Burke
Title: Radioisotope-Powered Voltaic Cells
Abstract: Operating InP-based alpha- or betavoltaic cells above room temperature to take advantage of high annealing rates allows higher source activity to be used; higher power density results. Conversion efficiency decreases with temperature, however, and eventually begins to fall faster than source strength can be increased. The point at which this occurs is about 200 C; above this a net loss in power density is expected. This is therefore the temperature at which maximum energy density can be realized. If operational considerations fix cell temperature at some lower value, energy density will be lower than the maximum but will still exceed that of conventional batteries by many orders of magnitude. Alpha emitters, by virtue of the greater energy they release in each nuclear event offer higher intrinsic energy densities than do beta emitters. The very short range of alpha particles better matches current photovoltaic construction than does that of the more penetrating betas; commonly available alpha emitters also have longer half-lives. Less than 1% of alpha cell volume would be taken up by the source material itself. Costs for RTGs and radiovoltaic cells are expected to be similar. In marked contract to thermoelectric generators, however, a large temperature difference is not needed to attain high efficiency in radiovoltaic devices. Consequently, radionuclide cells can be arbitrarily scaled down in size without loss of efficiency, suggesting that true distributed power can be achieved without a cost penalty. Radiovoltaics can be expected not only to replace chemical batteries, but could power isolated systems such as the total artificial heart which are not presently feasible.

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SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 92-005 ID#: 92-164
Office: DNA
Contract #:
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.
ONE PATRIOTS PARK
BEDFORD, MA 01730
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.
PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 91-014 ID#: 91-625
Office: SDC
Contract #:
PI: Stanley M. Vernon
Title: Quantum-Wire Lasers from Vertical Strained-Layer Superlattices
Abstract: High-speed optical computing, optical communications, and fiber-optic gyroscopes utilize Erbium-doped fiber amplifiers pumped by 980-nm lasers. We propose to develop display quantum-wire lasers emitting at this wavelength, using a fabrication process which is greatly simplified over those being studied elsewhere. Quantum-wire lasers offer performance advantages over more conventional designs; carrier-confinement in two dimensions can result in laser current threshold densities being nearly zero, thus enabling greatly reduced heat dissipation requirements, vastly improved efficiencies, and higher paching densities in optoelectronic integrated-circuit applications. By using a vertical strained-layer superlattice (VSLS), quantum wires are formed during semiconductor deposition on a planar substrate, thus eliminating the need for complex nanometer-scale device processing or substrate patterning. The strained-layer vertical superlattice is grown by low-pressure metalorganic chemical vapor deposition (MOCVD), using wafer-surface atomic steps to control nucleation of each layer, as successfully demonstrated in Phase I. Materials comprising the strained-layer vertical superlattice will be In Ga As and Al Ga As. The superlattice forms the active layer of the laser, with other layers in the structure grown by MOCVD.

STRUCTURED MATERIALS INDUSTRIES
240 MARTIN LUTHER KING BLVD.
NEWARK, NJ 07102
Phone: (201) 471-3589
Topic#: 92-014 ID#: 92-213
Office: SDC
Contract #: DASG60-93-C-
PI: S.I. Kim, PhD
Title: Light Emitting Thin Films Containing Germanium Quantum Dots
Abstract: In Phase I of this research effort, we confirmed the feasibility of a new Quantum Nano-Crystal (QNC) passivating

matrix light emitting material system. The band structure of the QNC system is ideally suited for light emitting devices. The QNCs form ideal 3-dimensional quantum well, since they are surrounded by the silicon oxide. Even though, the bandgap of the QNC increases due to quantum confinement effects, the confinement is still maintained because of the larger bandgap of silicon dioxide. Thus the high electron density confined in QNCs will promote high efficiency light emitting devices. In comparison, porous Si (PS) is seen to be a leaky structure which will generally be inefficient for emitter applications. In Phase I, we formed the QNCs from the CVD grown supersaturated SiO2 film. Good intensity and very narrow spectrum width were obtained on the films, annealed either in conventional oven or in rapid thermal annealing furnace. In Phase II, the higher density and more uniform size distribution of QNCs will be pursued by the independent in-situ injection of QNCs.

TORANAGA TECHNOLOGIES, INC.
2236 RUTHERFORD ROAD, SUITE 123
CARLSBAD, CA 92008
Phone: (619) 931-7091

Topic#: 92-014 ID#: 92-195
Office: AFWL
Contract #: F33615-93-C-2400
PI: M. Albert Capote

Title: High Strength Soldering Compounds Produced from Gas Atomized Powdered 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 temperatures. 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.

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

Topic#: 92-015 ID#: 92-711
Office: AFRLS
Contract #: F19628-93-C-0195
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 in state-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.

TRYMER COMPANY
14301 BAGDAD ROAD
LEANDER, TX 78641
Phone: (512) 259-1141

Topic#: 91-005 ID#: 91-148
Office: DNA
Contract #:
PI: Jon M. Schroeder

Title: High Energy Density Electrical Storage Device

Abstract: The primary object of the Phase I effort was to design a Million Ampere, energy-storage device, using a novel, close-coupled thermopile concept. Three different energy storage variants were developed and tested during Phase I. Each was based on the close-coupled, thermopile storage principle. First, direct current was stored in a thermopile ring, which was open-switched into a dummy load to measure the energy release. In the second variant, alternating magnetic energy was stored, caused by pumping alternating current in the thermopile circuit, connected as an LC oscillator. Both methods stored energy

and delivered pulse power with a twenty-to-one gain between energy-stored and energy-in. Power was drawn from these systems in a millisecond, using a specially developed, sequentially opening switch that takes full advantage of the MOSFET's nanosecond operating speed. Further work led then to the development of the inductor-to-inductor (L^2) electromagnetic storage system. This device out performs the first two concepts by two orders of magnitude in storage capacity, and can even be tuned to operate at frequency steps between 50 HZ and 50 MHz, possibly into the GHz range. Phase II development of the L^2 technology will test a full-scale power supply demonstrator.

WARE TECHNICAL SERVICES, INC.
42 LORRAINE ROAD
WESTWOOD, MA 02090
Phone: (617) 320-0291
Topic#: 92-014 ID#: 92-035
Office: ARO
Contract #:
PI: Rowland Ware
Title: Bulk Growth of InxGa1-xAs
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
REDMOND, WA 98052
Phone: (206) 486-0973
Topic#: 92-001 ID#: 92-013
Office: SDC
Contract #: DASG60-93-C-0083
PI: Richard Minch
Title: Smart High Heat Flux Mirrors
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.

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 #: DASG60-93-C-0028
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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