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The Department of Defense

DoD DEPARTMENTS/AGENCIES:



Department of the Army



Department of the Navy



Department of the Air Force



Defense Advanced Research Projects Agency



Defense Nuclear Agency



Strategic Defense Initiative Organization

DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

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ABSTRACTS OF PHASE II AWARDS 1991

93-06714

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PREFACE

During Fiscal Year (FY) 1991 the Military Services, the Defense Advanced Research Project Agency (DARPA), the Defense Nuclear Agency (DNA), and the Strategic Defense Initiative Organization (SDIO) selected 333 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 year 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.

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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 exceed of \$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 was increased over four years to the present funding level of 1.25 percent.

Objectives:

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. 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 will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. In addition, proposals which identify a follow-on Phase III funding commitment from non-Federal sources will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period generally not to exceed 24 months, also subject to negotiation. The number of Phase II awards will depend 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 will require 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.

FY 1991 Phase II Program:

FY 1991 Phase II awards were made to firms that had Phase I awards from several past solicitations, but mainly from solicitations FY89, FY90.1 and FY90.2. 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 1991 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.

Phase II abstracts presented in this report are in alphabetical order by DoD Component.

ARMY	58 awards	pp 1-20
NAVY	67 awards	pp 21-40
AIR FORCE	123 awards	pp 41-80
DARPA	26 awards	pp 81-90
DNA	9 awards	pp 91-94
SDIO	50 awards	pp 95-109

ARMY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

ADEZA BIOMEDICAL
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SYNNYVALE, CA 94089
Phone: (408) 745-0975

Topic#: 90-181 ID#: 90MED-105
Office: MEDICAL
Contract #: DAMD17-90-C-0076
PI: DAVID E. CHARLTON, PH.D.

Title: DIAGNOSIS OF NATURAL AND INDUCED DISEASES OF MILITARY IMPORTANCE

Abstract. This is a continuation of our Phase I proposal for the diagnosis of natural and induced diseases of military using a novel optical biosensor assay (OBA) technology. OBA is one of the most innovative and promising new diagnostic technologies currently available. The technology uses the principle of optical diffraction for direct detection of antigen-antibody binding on a silicon chip. It can also be applied to other binding assays such as DNA probes. Techniques for activation of the silicon surface and immobilization of protein on the silicon surface have been developed during the Phase I feasibility study. We also demonstrated the feasibility of the biosensor assay with Hantaan Virus as a model analyte. In addition, a research prototype reader was also developed. In the Phase II study, we propose to further develop the technology into a practical system by scaling up the water manufacturing, improving the reproducibility, purifying the Hantaan Virus antigen, optimizing the OBA Hantaan Virus IgM and IgG assay, designing a panel assay, adapting the technology to other new analytes, fabricating a OBA reader, and undertaking field trials to determine the applicability of this new test system for rapid diagnosis of various natural or induced diseases of military importance.

ALPHATECH, INC.
111 MIDDLESEX TNPK
BURLINGTON, MA 01803
Phone: (617) 273-3388

Topic#: 89-067 ID#: 89ARI-004
Office: ARI
Contract #: MDA903-91-C-0133
PI: MR. DANIEL SERFATY

Title: TACTICAL DECISION MAKING

Abstract. Expertise has long been one of the most difficult concepts to understand, capture, and quantify in the fields of decision making, planning, and problem solving. The challenge is even greater for those seeking to understand expertise in military command and control, where decision tasks reflect the high levels of complexity, time pressure, and uncertainty typical of tactical environments. In the initial phase we developed a theoretical framework and proposed a set of novel, testable hypotheses pertaining to tactical expertise. The theory is based on the key premise that expert commanders have a mental model of the tactical situation that differs in measurable ways from that of novices. We obtained the theoretical ideas and findings of the Phase I work through an extensive literature review and a set of interviews with tactical expert commanders. As part of the Phase II effort, we propose to validate and enhance our practical theory of tactical decision making expertise through a carefully designed empirical research program consisting of consultations and interviews with military tactical experts, realistic laboratory experiments, and direct observations and evaluation in exercises such as BCTP and NTC. Once empirically validated, the theory will specify how tactical expertise is developed, and the relative potential contributions of theoretical and practical training, field experience, and individual ability to expertise. As a result, we will propose a set of practical recommendations for the development of tactical decisionmaking expertise along the lines of commander's training, staff organization and procedures, and support systems

AMERICAN RESEARCH CORP. OF VA
P.O. BOX 3406
RADFORD, VA 24143
Phone: (703) 731-0655

Topic#: 90-193 ID#: 90SDC-102
Office: SDC
Contract #: DASG60-91-C-0153
PI: DR. USHA V. VASEASHTA

Title: LASER DEPOSITION OF MODULATED-STRUCTURE FERROELECTRIC THIN FILMS FOR NON-VOLATILE MEMORIES

Abstract. For use as computer memories ferroelectric thin film devices offer a number of advantages including high bit-density, non-volatility, low-voltage operation over a wide temperature range, high speed corresponding to short access and cycle times, and relatively high radiation hardness. There is a need for the design and development of lightweight, radiation hard, high performance electronic circuits for use in anti-satellite applications. Accordingly, American Research Corporation of Virginia has fabricated modulated-structure, ferroelectric thin films using low temperatures deposition, laser ablation techniques. The Phase I program has provided a basis for fabrication of modulated-structure, polycrystalline or heteroepitaxial, multilayer ferroelectric thin films to improve speed, performance and reliability of non-volatile random access memories. The principal finding of the Phase I program is that the laser ablation technique lowered the temperature deposition of crystalline, single phase

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PZT and PT, and modulated-structure ferroelectric thin films to 450 degrees C. This improvement in the current state-of-the-art makes this technology compatible with temperature-sensitive, semiconductor substrates such as silicon and gallium arsenide used in integrated circuit assemblies. The Phase II program will accomplish the technical feasibility demonstrated in Phase I by achieving the Phase II objectives which include design of a computer controlled laser ablation deposition system, optimization of process parameters, evaluation of modulation length, determination of device quality contacts, electrode materials, diffusion barriers and process technology, characterization, testing and analysis of modulated-structure ferroelectric thin films, and integration of ferroelectric thin films into silicon and gallium arsenide-based memory structures.

ANACAPA SCIENCES, INC.
P.O. DRAWER Q
SANTA BARBARA, CA 93102
Phone: (805) 966-6157

Topic#: 89-003 ID#: 89AVS-005
Office: AVSCOM
Contract #: NAS-213391
PI: STEVEN P. ROGERS

Title: EXPERT SYS. PILOTS ASSOC

Abstract The SBIR Phase I work clearly showed the technical merit and feasibility of an intelligent on-board mission management system (OMMS) for advanced rotorcraft. It is now apparent that the Army has elected to develop OMMS-like capabilities in the pilot-vehicle interface (PVI) for the Rotorcraft Pilot's Associate (RPA), and that the NASA Crew Station Research and Development Facility (CSRDF) will support the integration and demonstration of the RPAPVI. This proposal describes the specific objectives and approach for the construction of an expert system to support the development and demonstration of an advanced PVI for the RPA in the NASA CSRDF. The expert system will consist of a database summarizing the information requirements for mission management, a rulebase for the recommendation of display modalities, locations, and formats, based on the information attributes, and an inference engine to drive the display recommendation process. An associated set of guidelines will ensure a consistent, intuitive, and effective pilot-computer dialogue structure. The expert system will organize the extensive collections of analytical information, document the growth of the rules for information display, and manage the application of the rules to the database for selection of display methods in a methodical, consistent, and easily understood manner.

ANALYTICAL SOFTWARE, INC.
10939 MCCREE RD
DALLAS, TX 75238
Phone (214) 349-5977
Title: DECISION MAKING

Topic#: 89-086 ID#: 89AIR-001
Office: AIRMICS
Contract #: DAKF11-91-C-004
PI: MARK HALEY

Abstract The objective is to create Group Decision Support System (GDSS) software which permits Army personnel to quickly make decisions, even when the decision makers are located around the world. The software would operate on personal computer, such as the Zenith 248, and be compatible with the Army's word-processors and other software. Specific Phase II objectives would be to enhance the GDSS software developed in Phase I by adding the following features: (1) A calendar which could be faxed or shared, (2) Improved scheduling features, such as shared GANTT charts, (3) A screen capture utility which would permit any screen to be shared, (4) Other GDSS enhancements, such as group authoring features, (5) Integration into the Army's computer networks, such as DDN, and compatibility with X.400, the international standard for electronic mail and ASC X12, the U.S. standard for electronic data interchange (EDI), and finally (6) the software would run on a Local Area Network (LAN). This software would expedite Army decision making worldwide. The software would permit a computer novice to send electronic mail and FAXES directly from a PC, set up and coordinate meetings and schedules, and document any decision thereby streamlining communications in the Army.

ANTECH, INC.
788 MYRTLE ST
ROSWELL, GA 30075
Phone: (404) 993-7270

Topic#: 87-255 ID#: 87CER-003
Office: CERL
Contract #: DACA88-91-C-0006
PI: ASHOK K. NAGRANI

Title: AUTOMATED AS-BUILT CAD DRAW

Abstract In Phase I, it was successfully demonstrated that field measurements of as-built structures could be done electronically and fed directly into a program on a laptop computer. In Phase II, a complete prototype of a viable commercial device will be

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built such that field personnel with minimal training can use a surveying Electronic Total Station (ETS) to quickly measure dimensions of existing buildings, both interiors and exteriors, and create a drawing in real-time on a laptop computer system in the field. Software of commercial quality will be written to allow the surveyor to create CAD drawings in the field. An ergonomic stand/dolly which can house all the components needed will be designed and built such that the unit can be conveniently used and easily transported. All design and software engineering necessary to commercially produce the As-Built devices will be performed. Beta sites will be selected within the Army, other Government agencies such as the U.S. Post Office, GSA and commercial clients. Feedback from the beta sites will be used to debug the device and perfect the user interface.

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MCLEAN, VA 22101
Phone: (703) 356-0232

Topic#: 88-146 ID#: 88TEC-004
Office: TECOM
Contract #: DAA009-90-C-0021
PI: ROBERT S. BABINGTON

Title: MICROBIAL AEROSOL GENERATOR

Abstract: Babington Engineering was awarded a Phase I SBIR contract under project A88-146. This contract (DAAD09-88-0027) was granted to produce a high quality submicron aerosol using low force techniques. The Babington Atomization Principle was selected to achieve these objectives and several aerosol generators were developed. These units were delivered to Dugway for test and evaluation. The results of these tests proved that this new technology was well suited to the application, and the specific aerosol generators exhibited certain advantages over conventional equipment. These advantages related to liquid particle size, aerosol viability and aerosol output capacity. The Phase II work outlined in this proposal will build on the accomplishments that were demonstrated in Phase I. More sophisticated and varied aerosol generators will be developed in order to achieve the specific objectives as outlined by Dugway.

BIO-METRIC SYSTEMS, INC.
9924 W. SEVENTY FOURTH STREET
EDEN PRAIRIE, MN 55344
Phone: (612) 829-2700

Topic#: 90-181 ID#: 90MED-106
Office: MEDICAL
Contract #: 90-C-0002
PI: SHERYL L. GREGG

Title: TRI-ELISA FOR SIMULTANEOUS ANALYSIS OF THREE ANALYTES

Abstract. The enzyme-linked immunosorbent assay (ELISA) is a major tool for detecting infectious agents, proteins, and drugs in biological fluids, or contaminants in environmental samples. The majority of ELISA's are designed to detect a single analyte. We propose here to develop a three-enzyme ELISA system in which three analytes can be quantitated concurrently from a single sample. We have identified three enzymes/substrates that have minimal overlap at three separate wavelengths corresponding to their respective maximum absorbance. During Phase I, we will definitively identify the three enzymes and multiple substrate solutions that will work simultaneously, conjugate each enzyme to a separate antibody, develop individual ELISA's for each analyte, and test the three analyte systems concurrently. The ELISA's will be developed using a fungus (*Candida albicans*), a virus (herpes simplex virus, type 1), and bacteria (*Pseudomonas aeruginosa*). The expected results of this Phase I project will demonstrate feasibility and provide the basis for continuation into a Phase II project.

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Topic#: 88-196 ID#: 88CEC-015
Office: CECOM
Contract #: DAAB07-91-C-B017
PI: HERBERT DIXON

Title: INT DEMO SYS OF PROTOTYPE DECISION AIDS FOR ATCCS

Abstract. The proposed effort is to perform R&D in order to produce a communications and information transfer management workstation for the Prototype Decision Aids for ATCCS. Development will include a generic C4I library of software focused on communications and information transfer portions of the C4I mission and targeted for the desktop personal computer environment. The Integrated Demonstration System of Prototype Decision Aids implements and manages an Open Systems Architecture modeled after the ISO's OSI 7-Layer Model. It included Artificial Intelligence oriented onlines network planning and communications forecasting features. These AI features are designed to provide the workstation with a dynamic ability to model data communication operations from 7 layers of activity, ranging from applications software interaction to physical media topologies. The tool's utility is illustrated with a problem taken from the TRADOC common teaching scenario and the DARFA

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ALBM project in which the fictitious 10th U.S. Corps operates on the German frontier. The tool's possible uses are illustrated in its modelling of the communication's and information transfer characteristics of the problem.

CFD RESEARCH CORP.
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HUNTSVILLE, AL 35805
Phone: (205) 536-6576
Title: DILUTION HOLE CONCEPT

Topic#: 89-015 ID#: 89AVS-009
Office: AVSCOM
Contract #: DAAJ02-91-C-0050
PI: CLIFFORD E. SMITH

Abstract: Of critical importance in current and advanced technology small gas turbine combustors is the reduction of exit temperature non-uniformity, usually defined as pattern factor. This project proposes to develop a dilution hole concept capable of significantly reducing pattern factor. In Phase I, the overall feasibility of an advanced scheme to reduce pattern factor was shown through 3D numerical modeling of a generic combustor dilution zone. It was shown that closely-spaced, staggered dilution jets with high inlet jet turbulence had great potential of reducing pattern factor. In Phase II, the development and verification of proposed advance concepts will be accomplished through a combined numerical and experimental investigation. The combustor test vehicle will be the annular, reverse-flow F109 combustor of Garrett Engine Division (GED) of Allied-Signal Aerospace Company. At least ninety (90) dilution hole patterns will be numerically analyzed, and at least five (5) dilution hole patterns will be experimentally tested at GED facilities. A practical design correlation will be developed to optimize pattern factor of the best concept. The correlation will provide one means of transferring the technology to other small gas turbine engines.

DESE RESEARCH, INC.
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HUNTSVILLE, AL 35807
Phone: (205) 536-3396

Topic#: 90-195 ID#: 90SDC-103
Office: SDC
Contract #: DASG60-91-C-0134
PI: DR. ROBERT M. SMITH

Title: SENSOR SIGNAL AND DATA PROCESSING - IMAGE ENHANCEMENT

Abstract: Image processing algorithms for modern visual sensor guided engagements of complicated satellite targets are developed. These algorithms produce target shapes. The shapes provide the needed data from which accurate target and aimpoint selection can be accomplished in a variety of environment and background conditions, including star, earth limb, an albedo effects. The image processing methodology is based upon Sobel and Khan edge detection algorithms. Included are noise reduction algorithms and provisions for multiple target processing. Scan-to-scan target and background properties will be compiled to show target growth and preloaded image correlations. Then, engagement algorithms, for satellite class targets, are developed for aimpoints and distances based upon edge and shape definitions and include aberrant data point removal. The algorithms will be tested via simulation for single and multiple target scenarios.

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Topic#: 89-041 ID#: 89MIC-004
Office: MICOM
Contract #: DAAH01 1-C-R217
PI: ROBERT D. CICCARELLI

Title: PERFORMANCE MODES FOR MULTI-STAGE WARHEAD SYSTEMS

Abstract: In Phase I of the performance model program, the methodology was formulated for the construction of the predictive tool. An extensive literature review was performed to evaluate the models required to predict the performance of various penetrators against advanced armor threats. Modeling deficiencies were identified and will be addressed in Phase II. The primary objective of the phase II effort is the actual construction of the computer program. These proposal outlines the subtasks required for the development of the performance model.

DYNAGEN
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Phone: (617) 491-2527

Topic#: 89-081 ID#: 89MED-009
Office: MEDICAL
Contract #: 89-C-9141
PI: DR. JUDITH P. KITCHELL

ARMY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Development of a Controlled Release Delivery System for Immunogens

Abstract: The progress addresses the logistics of vaccination programs for effective military personnel. Such vaccination programs involve multiple encounters with trained medical personnel for administrations of injections and careful medical record maintenance. An approach for reducing the logistical problem is to modify immunization formulations for each vaccine so that a single dose confers complete immunity. As it is known that the human immune system frequently requires multiple experiences of exposure to immunogens in order to build lasting immunity, the formulation must reproduce this effect by presenting not one exposure, as is made with present dose forms, but multiple exposure events -such as are received with "booster" shots. The goal is to demonstrate the immunity comparable to that obtained with an initial vaccination plus one booster vaccination can be obtained by simultaneous injection of normal and "sleeper" vaccine formulations. The "sleeper" vaccine concept was demonstrated in Phase I of the program. Phase II will address a specific Army need: the preparation of a Hepatitis A Virus (HAV) vaccine "sleeper" formulation. General processing parameters suitable for use with this immunogen will be established. Several rounds of formulation and evaluation (in vitro an in vivo) will be carried out.

DYNAMET TECHNOLOGY, INC.
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Phone: (617) 272-5967

Topic#: 88-154 ID#: 88MTL-003
Office: MTL
Contract #: DAAL04-91-C-0046
PI: STANLEY ABKOWITX

Title: TITANIUM POWDER METALLURGY BEARING HOUSING

Abstract. Using an aircraft engine support bearing housing as a prototypical example, the Phase I program clearly demonstrated that near-net shape titanium alloy powder metal (P/M) fabrication of gas turbine engine components can result in substantial cost savings without compromising structural properties or performance level. The Phase II program proposed to refine this technology to optimize performance at lowest cost. Additionally, based on experimental data a mathematical model will be developed to quantify the relationship between the chloride level of P/M titanium alloys and the critical mechanical properties including fatigue and fracture toughness. The preform weight will be further reduced and metallurgical and engine testing of the optimal component will be completed while prototype development and testing of a second engine component is conducted.

DYNETICS, INC.
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Topic#: 88-019 ID#: 88ARD-012
Office: ARDEC
Contract #: DAAA21-91-C-0070
PI: WINDELL NEIL MOHON

Title: HYBRID OPTICAL ELEC SIG. PROC.

Abstract. Army FCS requirements for multiple target engagement, fire-on-the-move, NCTR, target orientation determination, and trajectory estimation lead to signal processing requirements in support of active ladar/MMW sensors that are beyond the capabilities of all-electronic processors. Dynetics proposes to design and assemble a breadboard model of a dual-channel hybrid optical/electronic signal processor. The breadboard will consist of three major subsystems: 1) signal generator producing target-like modulation, 2) the signal processor, and 3) a data acquisition, analysis, and display subsystem. Dynetics has selected a processor consisting of radiometer and spectrum analyzer channels that, when combined with a scanning, focused fan beam US Army ladar could provide crossrange resolved LCS and Doppler data to support NCTR, target orientation, and trajectory estimation functions. Dynetics further proposes to conduct feasibility demonstrations with this breadboard processor. It is anticipated that the breadboard system will allow data from both optical channels to be combined in the data analysis subsystem to demonstrate multichannel data fusion techniques. For the spectrum analyzer, Dynetics is proposing the use of a Fabry-Perot interferometer device that would provide the first demonstration of tactical Doppler spectrum analysis entirely in the optical domain.

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Topic#: 89-001 ID#: 89ARD-017
Office: ARDEC
Contract #: DAAA21-91-C-0069
PI: WILLIAM S. CHAN

Title: UNCOOLED INFRARED ARRAYS

Abstract. Advanced seekers used in munitions and missiles require detector arrays that are low weight, low power and that can

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operate at room temperatures with high sensitivity. Such requirements demand innovations in several technological areas. An innovative technique is proposed for fabricating large-area long wavelength infrared (LWIR) detector arrays that can operate at room temperatures with high sensitivity. This technique utilizes established technologies of micro-machining and microelectronic processing of silicon (Si) wafers for fabricating monolithic arrays of LWIR detectors containing a thin layer of pyroelectric elements for IR sensing and a special junction field effect transistor (JFET) readout circuit for amplification and multiplexing. The proposed effort is to develop the array configuration, the construction of the pyroelectric elements and the fabrication of the multiplexer circuit.

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Topic#: 90-206 ID#: 90SDC-105
Office: SDC
Contract #: DASG60-91-C-0160
PI: C.F. HUANG

Title: TWO-COLOR DETECTORS FOR SPACE-BASED INTERCEPTORS

Abstract. The molecular beam epitaxial (MBE) growth of photodiodes using the strained superlattice (SSL) of InSb/InAsSb can produce a medium wavelength infrared (MWIR) photodiode atop a long-wavelength infrared (LWIR) photodiode, forming a 2-color detector structure for space-based interceptor applications. Phase I investigated the growth of the 2-color structure on InSb, and made the following significant accomplishments. (1) all required modifications of an existing MBE system have been designed and reduced to practice, (2) the electronic model of the 2-color detector has been developed, and it showed high IR sensitivity, (3) the MBE processes for the photodiode growth have been delineated, (4) the feasibility of growing high quality epitaxial layers of InSb and InAsSb has been demonstrated by numerous growth runs, and therefore increased the probability of success of Phase II, and (4) a detailed plan for Phase II has been formulated for straightforward implementation. A Phase II is proposed to continue develop the MBE growth of multilayers, followed by the in-situ formation of the photodiodes. The low-defect multilayers will provide high detector performance, while the sequential multilayer growth will produce the two photodiodes in tandem as a straightforward single-step process. The first Phase II goal is to optimize the growth of the InSb/InAsSb SSL for a 12-micron wavelength cutoff, and the second goal is to grow the two photodiodes in tandem. Nine systematic tasks are scheduled in a 24-month program to accomplish these goals.

EMCORE CORP.
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Topic#: 90-112 ID#: 90ETD-115
Office: ETDL
Contract #: DAAL01-91-C-0143
PI: DR. PETER E. NORRIS

Title: GROWTH APPARATUS FOR MICROWAVE PLASMA DEPOSITION

Abstract. The technique of low temperature formation of diamond-like and refractory thin films using plasma-assisted chemical vapor deposition (PA-CVD) is crucial for many DoD applications. The development of such a process will permit deposition of high quality, low contamination, refractory films on a variety of substrates. The PA-CVD process offers the potential advantages of low cost large scale fabrication. The proposed system incorporates a resistance heated, high speed rotating-disk susceptor in a vertical, cylindrical cold-wall growth chamber. The specially designed resistance heater will decouple the temperature gradient caused by the plasma plume. The high speed rotating disc will largely improve the uniformity of the films. A downstream plasma design is adopted in the system to minimize contamination. The system is designed to have the capabilities of depositing with O(2) addition, depositing diamond in a microwave plasma pulsing mode, and the capability for controlled B-doping. In addition, provisions have been made for the future additions of oxide and/or nitride film deposition capability. Research into using the Atomic Layer Epitaxy (ALE) method for growth of diamond will also be possible. The design is based on successful results demonstrated at EMCORE by depositing thin films of the superconducting ceramic oxide, YBaCuO, using microwave PA-CVD. Both an advanced PA-CVD system and associated materials processing technologies will be developed in this program.

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Topic#: 87-254 ID#: 87CER-002
Office: CERL
Contract #: DACA88-90-C-0011
PI: DR. KARL BERNSTEIN

ARM / ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: MONITOR FOR AIRBORNE LEAD

Abstract The feasibility of an instrument for the measurement of airborne lead was demonstrated under Phase I and subsequent research. The objective of the phase II program described herein is to develop an adaptable optimum instrument head configuration for the airborne lead monitor. The objective will be met with a program that features a combination of simulation and verification, in an interactive process. The test components will be delivered at the end of the program, along with a copy of a proprietary analytical software package and operating manuals. The delivered hardware and software, plus a personal computer, will constitute a working system, with which the Government can perform field surveys of airborne lead concentration, and develop experience to guide future instrument development.

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Topic#: 90-192 **ID#:** 90MED-103
Office: MEDICAL
Contract #: 90-C-0083
PI: JOHN J. WALLS, JR.

Title: OCULAR PROTECTION FROM LASER HAZARDS

Abstract. Thin films are used in numerous applications including optics, electronics and surface protection. Physical vapor deposition (PVD) is the commonly used method to produce thin film coatings. Standard PVD techniques produce films with inherent weaknesses in optical and mechanical properties because of their typical columnar microstructure. This structure is a result of the low mobility of the condensed atoms or molecules on the substrate surface. This is particularly true for coating of plastics, where the substrate temperature needs to be kept low (around ambient). Reactive Ion Plating Deposition (RIPD) is an innovative technique which densifies the growing thin films by enhanced surface mobility as well as by continuous ion bombardment. This results in durable well adhering thin films at relatively low substrate temperatures. This technique and other hybrid ion enhancement processes will be investigated and directed toward production-oriented applications. Further refinement of the RIPD technique evaluated in the Phase I effort will be performed.

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Topic#: 89-017 **ID#:** 89AVS-010
Office: AVSCOM
Contract #: NAS-213489
PI: JOHN STEINHOFF

Title: AERODYN. ANAL OF HELICOPTERS

Abstract The development of a computer code to solve for aerodynamic flow over realistic modern high-speed helicopter rotor/body configurations is proposed. The code will treat the full aerodynamic problem including close blade/vortex interactions with impingement, transonic flow with shocks, fuselage effects and will do trim/blade dynamics calculations. The code, which will be based on technology that has been proven over the last several years and the code will represent a synthesis of existing code modules developed by the proposed investigators, both in the Phase I SBIR effort as well as parallel, DOD funded efforts. These modules have already been used, separately to: -Compute the entire rotorflow field with close blade-vortex interactions, but without impingement -Compute detailed blade-vortex impingement. -Compute effects due to fuselages. -Do a trim/blade dynamics computation as part of a comprehensive analysis. The method is based on the Vortex-Embedding technique which, as implemented in the HELIX I computer code, has been extensively validated by comparison with experiment for a wide range of cases.

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Topic#: 88-010 **ID#:** 88ARD-008
Office: ARDEC
Contract #: DAAA21-91-C-0065
PI: GERALD DOYLE

Title: PROPELLANT BINDERS

Abstract. A major drawback of the gun propellant binders currently in use is basic incompatibility with the energetic component. In addition, they are also nonenergetic and thus function as diluents in propellant formulations. The objective of this program is to develop new energetic binders which will form homogeneous mixtures with the substrate leading to powerful and relatively insensitive gun propellants. We plan to synthesize polymers incorporating RDX or HMX-like units for this purpose. These should show the required affinity for the substrate owing to similarity in structure and will also be energetic. Application of such

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energetic binders will enable a reduction in the volume of solids in a gun propellant for a given amount of energy and should also lead to lowered sensitivity. If successful, these polymers are expected to replace the binders currently used in formulation of gun propellants.

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Topic#: 89-060 ID#: 89CER-005
Office: CERL
Contract #: DACA88-91-C-0011
PI: I.J. WON

Title: ELECTROMAGNETIC SENSOR

Abstract: Under Phase I of this SBIR Program, Geopex designed, fabricated, and laboratory-tested a prototype electromagnetic sensor that is capable of locating metallic and nonmetallic underground storage tanks (USTs). The laboratory test data indicated that the sensor has a typical sensitivity of about 10 parts-per-million (ppm) or 0.01 parts-per-thousand (ppt). This demonstrated sensitivity is at least an order-of-magnitude better than any existing portable electromagnetic sensors that are commercially used for locating buried metallic objects. In addition to its superb sensitivity, the Geopex sensor is capable of simultaneously operating in multiple frequencies, which will aid interpreting the measured anomalies in terms of the geometry and physical properties of the target. The multi-frequency transmission and interpretation capabilities are unique to this Geopex electromagnetic sensor. With some additional electronic improvements, a set of real-time interpretation software, and rugged packaging, the sensor should be exceptionally useful for environmental investigation tasks involving USTs and leaking USTs. The sensor should also be useful for finding any buried objects such as utility pipes, land mines, burial trenches, and drums, as well as mapping groundwater levels, shallow geology, and possibly contaminant plumes. Based on the performance of our Phase I prototype, we formulated the scope of work for Phase II that would produce a field electromagnetic sensor and case histories.

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Topic#: 89-056 ID#: 89CEC-027
Office: CECOM
Contract #: DAAB10-89-C-0038
PI: FREDERICK H. RAAB

Title: EXPERIMENTAL INTEGRATED ANTENNA AMPLIFIER SYSTEM

Abstract: The integrated antenna/amplifier system (IAAS) integrates the power amplifier (PA), antenna, and matching network. The antenna is optimized to the extent possible given size constraint. The filter/matching network attenuates harmonics and brings the VSWR to a reasonable level within its band. A pin-diode network selects the filter/matching network. An overrated MA delivers the specified power into the approximately matched load. The FET PA achieves maximum efficiency by operating in class D at HF and class C at VHF. A switching regulator and control maintain the specified output power and maximum efficiency in spite of variations in load impedance. The Phase I feasibility study found the IAAS to be well suited for antennas of moderate Q such as the curtain. The proposed program includes antenna optimization, broadband matching, experimental hardware, and testing. Antenna optimization will determine how the antenna can be extended to lower frequencies through the use of multiple, broadband, center-loaded elements. The investigation of broadband matching will address variations of load resistance, providing high harmonic impedances, inherent design trade-offs, and synthesis of optimum networks. Experimental hardware will be designed and tested in a laboratory environment. System performance will be evaluated in ground, tower, and mobile installations.

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Topic#: 89-070 ID#: 89MED-006
Office: MEDICAL
Contract #: 89-C-9145
PI: DR. JOHN M. IVY

Title: DENGUE 2 ENVELOPE PROTEIN

Abstract: The four serotypes of dengue viruses are a leading cause of morbidity throughout the tropics and subtropics. For use in diagnostics and subunit vaccines, a reliable and inexpensive source of dengue antigens is required. During Phase I, we evaluated the ability of the yeast *Saccharomyces cerevisiae* to express antigenic dengue envelope (E) glycoprotein. We subcloned the E gene of dengue-2 strain PR15981 into six *S. cerevisiae* expression vectors having either a constitutive or a regulated

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promoter, with or without secretion signal peptide-encoding sequences. Western blots probed with anti-1 EN-2 hyperimmune mouse serum detected both intracellular and secreted antigenic proteins in yeast transformed with the recombinant yeast-dengue genes. During Phase II, we propose to extend our studies to include expression of E and NS1 of a virulent dengue-2 strain, to further characterize the dengue proteins expressed in yeast to enhance the levels of dengue protein expression in yeast, and to develop protocols for purification of yeast-expressed dengue proteins.

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Topic#: 90-169 ID#: 90ETL-101
Office: ETL
Contract #: DACA76-91-C-0021
PI: JOHN KOPECKY

Title: MISSION PLANNING WORKSTATION

Abstract: Advances in computer technology make feasible the use of Digital Topographic Data (DTD) to support terrain visualization, analysis, and electronic map display (EMD) in fieldable hardware for military operations. Their use will represent a fundamental breakthrough in mission planning and operations by shifting the basis of analysis from the interpretation of graphical planning aids (e.g. maps) to virtual battlefield visualization. Recognizing this, the Army has articulated requirements for these technologies. The U.S. Army Engineer Topographic Laboratories (USAETL) awarded a Phase I SBIR contract to Horizons Technology, Inc. (HTI) to evaluate existing and emerging DTD technologies and assess the feasibility for their near term fielding through the development of a terrain-based mission planning testbed. Based upon Phase I results, HTI proposes to develop and deliver a testbed fully compatible with the current and future ATCCS Common Hardware/Software (CHS) hardware to integrate and demonstrate these technologies. The testbed will provide a critical link in the transition of advanced technologies from the laboratory to the field and support the evaluation of other Army developed software. The Phase II effort will facilitate technology transfer, make provisions for testbed expansion to address future requirements, and include an evaluation of hardware upgrades to enhance the use of DTD technology in the field.

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Topic#: 89-085 ID#: 89AIR-002
Office: AIRMICS
Contract #: DAKF11-91-C-0008
PI: MOHSEN PAZIRANDEH

Title: AN ENVIRONMENT FOR SIMULATION MODELING OF DISTRIBUTED SYSTEMS

Abstract: The purpose of Phase I of this research was to study the feasibility of developing and Environment for the Simulation of Distributed Systems (ESDS). The research showed that such an environment can be developed and must contain a number of libraries including hardware components, operating systems, DBMS, algorithms, performance measures, and three knowledge bases. The capabilities of such an environment was demonstrated via the implementation and assessment of the performance of a distributed database operating under the distributed operating system Cronus. The purpose of Phase II research is to develop a working version of ESDS with the following capabilities: The detailed definition and updating of a number of libraries, including operating systems, performance measures, DBMSs and databases. Easy assignment and reassignment of system elements (operating systems, DBMSs etc.). The development of a detailed model of the distributed operating system Cronus which will be used in the full scale version of environment. A library of algorithms for developing simulation, analyzing the performance, and optimizing the system operation. Three knowledge bases for the isolation of performance failures to a device, optimal assignment of application functions to processors, and checking the integrity of input data. Workload and application functions can be defined, assigned to various processors, and analyzed. They can be reassigned to different processors or workstations to evaluate the impact on performance.

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Topic#: 88-198 ID#: 88CEC-017
Office: CECOM
Contract #: DAA804-91-C-B017
PI: DR. MICHAEL G. SAMET

Title: INT DEMO SYS OF PROTOTYPE DECISION AIDS FOR ATCCS

Abstract: The objective of this program is to enhance the state-of-the-art of tactical scenario generation methods and technology for Army C3 systems. Focus is placed on the relationship between scenario generation and tactical planning, especially in light

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of common data and knowledge base requirements and inputs available from on-line wargame simulations. The proposed scenario generation module and related components are to be implemented within an integrated demonstration system of prototype decision aids for ATCCS—an object-oriented suite of interacting, cooperative functional prototypes for Army tactical command and control. The role of scenario generation, and supporting common database requirements, is established vis a vis current Army doctrine and information-requirement priorities. A technical approach is proposed that includes the design, development, and demonstration of: (a) a common man-machine interface for supporting scenario generation and decision aiding prototypes, (b) innovative "action" symbology to portray critical aspects of operational orders, and, (c) scenario generation software that portrays battlefield situations and provides dynamic updates through communication with a common tactical database, common setup process, and wargame simulation models.

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Topic#: 88-199 ID#: 88CEC-018
Office: CECOM
Contract #: DAAB09-91-C-B029
PI: ALLEN D. DAYTON

Title: TACTICAL DIGITAL CELLULAR COMMUNICATIONS

Abstract. The purpose of this program is to demonstrate to the U.S. Army that Digital Cellular Telephone technology can be used to enhance the war fighting capability of Tactical Communications Systems such as MSF. Currently, the ability to provide rapid and effective communications to mobile subscribers on the tactical battlefield is limited by the lack of full automatic hand-off between cells and by the lack of capacity of radio systems that are not spectrum efficient. Additionally, current tactical communications systems require that a large amount of wire be laid to support users that are not mobile. The end product of this phase of the program will provide a demonstration of a digital cellular system at a U.S. Army Test Bed selected by CECOM. This demonstration system, based on the new North American Digital Cellular Standard, and fully compatible with the U.S. Army's MSE system, will demonstrate full automatic hand-off between cells and will demonstrate two simultaneous calls per frequency pair. The system will also demonstrate that current fixed users in command posts can be served by wireless digital telephone systems, resulting in significant savings for the U.S. Army in manpower and material.

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Topic#: 89-010 ID#: 89AVS-007
Office: AVSCOM
Contract #: DAAJ02-91-C-0038
PI: JAMES R. TREGGIO

Title: CERAMIC COATINGS

Abstract: ISM Technologies has successfully completed Phase I of an SBIR program by depositing hard ceramic coatings on organic matrix composite materials, including low temperature epoxy resin/carbon fiber composites. Hardnesses were achieved that are 10 to 20 times that of the composite materials. The success of this effort has led to this proposal to increase deposition rate, coating thickness, and coating quality and to subject the coatings to erosion tests. Successful erosion tests will provide a basis for additional work. This option part of the proposal would culminate in the deposition of ceramic coatings on actual turbine components. The work will include an analysis of the economics of the process for actual production deposition of turbine components, such as turbine rotor assemblies.

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Topic#: 89-028 ID#: 89HEL-007
Office: HEL
Contract #: DAAA15-91-C-0058
PI: GARY A. KLEIN

Title: SPEECH INTELLIGIBILITY

Abstract. Communication is vital to performance on the battlefield. The effects of speech intelligibility on performance in military exercises will be assessed. We will conduct two studies. First, we will measure armored crew performance in a simulator facility. Speech intelligibility will be the independent variable and resulting crew performance will be measured. The demands on communication necessary to accomplish mission success will be varied across scenarios at each speech intelligibility level. In the second study, MOS-qualified armored crews will participate in simulated force-on-force exercises under varying levels of speech intelligibility. For each engagement, the speech intelligibility will be set at a fixed level for each force,

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however, the speech intelligibility will be better for one force than for the other. We will measure the point at which the quality of the communication is the decisive factor in determining the outcome of the military engagement. Military equipment designers and specification writers will use these results as recommendations to establish guidelines for speech intelligibility standards. Design decisions based on these performance data will improve communication within military vehicles. In addition, these recommendations can be used by military command-and-control planners, allowing these planners to predict the consequences in military engagements conducted at a given level of speech intelligibility. Furthermore, these given guidelines can set standards for Military communication systems by measuring performance at fixed levels of speech intelligibility.

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Topic#: 87-136
Office: BRDEC
Contract #: 89-C-0013
PI: IAN LEWIN

ID#: 87BRD-003

Title: Realistic Decoy Specifications

Abstract. The project will extend the phase I effort, with the objective of producing a complete specification system for design of decoys and their quality control during manufacturing. This will cover detailed theoretical and mathematical investigations to develop advanced algorithms which provide a measure of decoy realism. Instrumentation will be produced to allow collection of bidirectional reflectance distribution data on real objects and decoys, and forms of data reduction will be provided. Experimental work will collect such data which then will be related to subjective judgements of decoy realism. Factors considered will include types of decoys, both two and three dimensional, angles of incident light, battlefield illumination conditions and enemy viewer geometries. Test equipment factors include development of a fully automated gonireflectometer under microcomputer control for measurement of surface reflectance characteristics. Experimentation will analyze typical Army materials, and development of mathematical descriptions of ideal decoys. The result will be a system which provides decoys with enhanced realism, along with a technical and purchasing specification for the Army.

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Topic#: 88-A91
Office: BRDEC
Contract #: 91-C-0071
PI: DR. R. I. BRASIER

ID#: 88BRD-005

Title: ELECTROLYTIC WATER DISINFECTION UNIT (EWDU) FOR THE REVERSE OSMOSIS WATER PURIFICATION UNIT (ROWPU) A REPLACEMENT FOR GRANULAR CALCIUM HYPOCHLORITE

Abstract Previous LATA work in Electrolytic Disinfection of Water. An electrolytic cell capable of producing an oxidizing solution from a weak electrolyte had been previously developed and tested by Los Alamos Technical Associates, Inc., (LATA). The cell produced an oxidant solution that sterilized water contaminated with coliform bacteria. Because of its low power requirement and small size, the cell appeared to be highly suitable for treating potable water supplies on ships or for military units in the Field. The primary objective in Phase I was to demonstrate the feasibility of electrolytic disinfection of shipboard potable water supplies.

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Topic#: 89-050
Office: TECOM
Contract #: DAAD01-91-C-0066
PI: C DAVID NEWLANDER

ID#: 89TEC-010

Title IN-BORE MOTION DETECTION

Abstract The analytical and test results from the MRC Phase I program indicate that the development of an accurate in-bore detection and trigger system is feasible for standard Army 105 and 155 mm artillery barrels. The system is based upon X-ray transmission and beam interrupt by the high mass density projectile as it travels up the barrel. The proposed Phase II effort will take the system from the Phase I conceptual feasibility stage through development such that a working prototype system will be delivered to the Yuma Proving Ground at the end of the Phase II effort. This will be accomplished by defining the specific performance requirements with the Yuma personnel, performing trade studies and developing a conceptual design, conducting laboratory tests to support the design optimization, and conducting field tests of a bread-board system at the Yuma test site. These activities will support Prototype and Critical design Reviews which will allow the Yuma personnel to study and approve

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the design. Finally, MRC will fabricate and deliver a prototype system to Yuma for their testing and assessment. MRC will deliver system specifications and conduct training and safety classes. The effort will be documented with a Final Report and Phase III plans to commercialize the system.

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Topic#: 88-140 ID#: 88NAT-005
Office: NATICK
Contract #: 91-C-0087
PI: MR. ROBERT D. EISLER

Title: FAILURE MECHANICS - POLYCARBONS

Abstract. Based on phenomenology demonstrated during Phase I of the proposed effort, Phase II will develop detailed analytical models and a supporting experimental database that can be employed to determine the effect of analytical models and a supporting experimental database that can be employed to determine the effect of parameter excursions on ballistic performance. Parameter excursions will be determined in consonance with the government but will emphasize the effects of coatings and processing on transparent ballistic protective materials. Results will be rendered in terms of design nomographs and software. The software will optimize material properties and the geometric configuration of individual layers in a multilayer assembly in terms of ballistic performance subject to user prescribed constraints with respect to layer geometry and properties. The software will also be designed to assess a range of ballistic threats which will be prescribed at the beginning of the Phase II effort in consonance with the government. Hardening strategies designed to mitigate the ductile to brittle transition in faul restudied during Phase I will also be tested and prototype designs rendered. Alternative vendor specifications that may be prescribed by the government for transparent ballistic protective materials will also be developed to insure performance under field conditions.

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Topic#: 89-071 ID#: 89MED-007
Office: MEDICAL
Contract #: 89-C-9137
PI: MARC S. COLLETT

Title: SYNTHETIC VACCINES

Abstract. Use of synthetic peptides, comprising both B and T cell determinants, is being considered a viable approach to vaccine development. Our Phase I work initiated investigations of this strategy employing Rift Valley fever virus (RVFV) as the study model. Results indicated potent antibody responses to important B cell antigenic determinants of RVFV could be elicited with synthetic peptides. Also, sequences from RVFV glycoprotein G2 were identified as putative T helper (Th) cell determinants. This Phase II work proposes to build on the foundation of these Phase I results and exploit them for the development of an efficacious synthetic peptide vaccine for RVF. Toward this end, several areas will be pursued. The form and presentation of synthetic peptides, including means for combining multiple peptide epitopes in a single immunogen preparation, will be investigated and correlated with ability to induce specific, biologically relevant antibody responses in mice. The activity of the putative RVFV glycoprotein Th epitopes will be identified. Finally, an antibody-directed strategy for peptide vaccine design and development involving peptide structure determinations, in vitro antigenicity, and in vivo specific immunogenicity, will be established. The technologies developed through the conduct of this work will significantly advance development of synthetic vaccines for other disease agents for which epitope-specific immunity is protective.

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Topic#: 90-196 ID#: 90SDC-101
Office: SDC
Contract #: DASG60-91-C-0114
PI: M. K. KILCOYNE

Title: MODULATORS FOR OPTICAL S.P

Abstract: The proposed effort is for the development of linear and two dimensional GaAs based asymmetric fabry-perot modulators (ASFP) which have shown the largest changes in optical modulation per volt (45% @ 2V) of any devices developed to date. Since the devices operate essentially as reverse biased diodes, they consume very little power and have an estimated frequency response up to 30 GHz. Two devices can be connected in series to form a symmetric self electro-optic effect device (S-Seed). The S-Seed has bistable characteristics which allow the devices to be optically latched for memory capability or switch programmability. The S-Seed devices can be configured to be programmed either optically or electronically and can be used

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in linear arrays as multi-channel optical interconnects or in 2-D arrays as optical signal processors, filters and multipath data switching systems.

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Topic#: 89-046 ID#: 89TAC-009
Office: TACOM
Contract #: DAAE07-91-C-R031
PI: DR. GAJENDRA SAVANT

Title: PASSIVE AGILE LASER FILTERS

Abstract: With the advent of both ground and space-based lasers in modern warfare, the percentage of casualties due to eye injuries may climb dramatically. In order to protect soldiers' eyes from diverse types of lasers, Physical Optics Corporation (POC) proposes the fabrication of highly efficient self-induced Bragg reflection shields (SIBARS) based on a hybrid agile laser filter composed of X3 nonlinear polymer and birefringent broadband reflectors. These SIBARS are extremely fast (on the order of picoseconds). In addition, they are low cost, planar, have a high laser damage threshold an high photopic/scotopic efficiency. After the successful demonstration of experimental proof-of-concept SIBARS filters in Army tanks. There are three issues basic to the Phase II project: (i) full-scale engineering an development of SIBARS, (ii) refining the mass fabrication techniques for various wavelength protection in the 400 to 700 nm range, an (iii) optimizing response time and photopic/scotopic performance in relation to the structure property aspect of X3 and birefringent polymers. These novel, ultra fast agile laser filters will prevent injury by lasers in military exercises involving tanks, lasers and pathfinders.

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Topic#: 90-192 ID#: 90MED-104
Office: MEDICAL
Contract #: 90-C-0086
PI: GAJENDRA SAVANT, PH.D.

Title: BROADBAND NEAR IR LASER HAZARD FILTERS

Abstract: Physical Optics Corporation (POC) proposes the continued development of holographic broadband laser eye protection (BLEP) filters as a new approach to protecting ground troops from eye damage by near infrared (IR) lasers. The infrared broadband filters investigated during the Phase I research program combined high optical density ($OD > 4$), high photopic visual transmission efficiency (60 to 75%) and large angular protection (> 40 Degrees) for the 694 nm wavelengths and with the environmental stability necessary for battlefield conditions. During its Phase I research, POC successfully fabricated broadband IR filters with excellent optical qualities. In addition, BLEP filters are comparable with flat and curved polycarbonate substrates and can be contained with absorption dye technology to yield cost effective hybrid technology for laser-eyewear. This technology should be able to supply complete wavelength and angular laser protection for the near IR portion of the spectrum from 690 to 1100 nm for the Army's spectacle, goggle or visor configurations with appropriate OD and photopic efficiency. In Phase II, eyewear will be fabricated in both all-holographic and hybrid scenarios on the various substrates noted above. These samples will be subjected to appropriate MIL-SPEC environmental and optical tests and delivered to Fort Detrick for evaluation.

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Topic#: 87-251 ID#: 87CER-001
Office: CERL
Contract #: DACA88-91-C-0008
PI: DR. HECTOR SIERRAALCAZAR

Title: MICRO-ELECTROCHEM PROBE

Abstract: A micro-electrochemical probe with segmented electrodes (MEPSE) will be developed to monitor localized corrosion and scaling in potable water distribution lines. The MEPSE consists of a metallic (Cu) tube with a number of fine wires running along its length and supported very close to its inner walls. The tube, carrying the water of electrolyte to be tested is, itself, segmented in rings which are separated from each other by thin insulators that also serve as seals. Each separate wire and segment is electrically connected through a switching device to measuring instruments. The electrochemical activity of micro-areas located at the intersection of a wire-segment combination is thus scanned under computer control. Ionic currents (with or without cathodicprotection) to individual segments can also be determined by appropriate switching. A statistical approach will be used for evaluation of localized voltametric, amperometric AC and DC transient measurements. scaling can be assessed from throwing power and from capacitance measurements, while localized corrosion can be assessed from voltage

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gradients in the electrolyte, or polarization resistance and Tafel slopes. About 70% of water utilities in the United States provide moderately to highly corrosive water causing approximately 12 billion dollars in costs from corrosion and scaling in public and private water systems. About 20 % of this cost could be saved by implementation of control measures using MEPSE sensors to monitor water quality at critical points in the distribution networks, and ultimately to applied erect feed back to control water chemistry. With MEPSE's linked to a central CPU, the Army or utilities could improve reliability and reduce maintenance costs. problems can be detected instantly, before damage occurs. MEPSE can be extended to test corrosion and scaling in cooling water systems and in any system involving electronically conductive tubes and liquid electrolytes in a range of pressures and temperatures only constrained by sealing effectiveness.

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Topic#: 90-187 ID#: 90MED-101
Office: MEDICAL
Contract #: 90-C-0075
PI: DAVID W. BLAIR

Title: A STANDARD INSTRUMENT TO MEASURE THE OXYGEN EQUILIBRIUM CURVE

Abstract. This is a Phase II proposal to continue work on developing a standard instrument to measure the oxygen equilibrium curve of blood, hemoglobin, hemoglobin solutions and artificial bloods or blood oxygen capacity enhancers. It will use the knowledge and experience gained in developing a prototype breadboard instrument in Phase I to develop and produce a compact laboratory instrument for this purpose that is reliable, precise, portable and cost effective. The instrument will be fully automated. It will be able to communicate with desktop computers through a standard interface (RS232 or IEEE-488) to provide for experimental control data acquisition and data reduction and presentation. It will be readily portable and it will be capable of moving among laboratories and being put into operation without extensive preparations. It will need only a convenient source of power. It will enhance progress in blood chemistry research even as it lowers its cost, and it will promote comparability of results among laboratories.

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Topic#: 90-113 ID#: 90ETD-114
Office: ETDL
Contract #: DAAL01-91-C-0142
PI: DR. MILTON PALMER

Title: INFLUENCE OF TEMPERATURE ON IC FAILURE MECHANISMS

Abstract. Reliability improvement of electronic equipment has focused to a large portion on the reduction in temperature, treating temperature as a harmful failure causing stress. To assess the impact of temperature on IC failure, a extensive literature research was conducted on the temperature related failure mechanisms found in microelectronic devices, in phase I of this project. Only a few of the failure mechanisms were found to be dependent on temperature, and it is not clear how strongly dependent they are in the range of temperature between -55 degrees C to 125 degrees C (average device junction temperature). It is concluded that the use of the Arrhenius temperature relationship as the dominant acceleration model is probably misleading in this temperature range. The goal of the Phase II effort is to address accurate formulation of the temperature dependence in the -55 degree C to 125 degree C range.

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Topic#: 89-020 ID#: 89AVS-012
Office: AVSCOM
Contract #: DAAJ02-92-C-0003
PI: JAMES R. DOWNER

Title: ELECTRIC TAIL ROTOR DRIVE

Abstract. During Phase I, the Direct Electric Tail Rotor Integrated Drive (DETRID) concept was shown to be not only feasible, but competitive on a per-unit-weight basis with the existing hardware. DETRID is a concept identified by the Army to eliminate current difficulties with the tail rotor drive train of many helicopters. DETRID replaces a system of gearboxes, couplings, shafts, and bearings with an electric motor which directly drives the tail rotor blades. The promising results of Phase I suggest that the program proceed into the next Phase, which is to demonstrate the DETRID concept both in the laboratory and on an actual tail section in a wind tunnel. SatCon Technology Corporation proposes to continue to develop a DETRID system for the UH60A by designing, fabricating, and testing a prototype of the baseline motor identified in Phase I. By use of

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Government-furnished equipment and rental of a specialty test facility, SatCon will be able to demonstrate the DETRID motor at full scale both on a dynamometer an integrated into an actual UH60A tail section.

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Topic#: 89-055 ID#: 89CEC-026
Office: CECOM
Contract #: DAAB07-91-C-J004
PI: DR. ROBERT J. FONTANA

Title: MODULAR NEURAL EW SYSTEMS (MNEWS)

Abstract. Objective 1. Architecture--Develop a detailed system architecture design which incorporates the dual neural network approach from Phase I into a ground-based brassboard ESM workstation; Objective 2: Software--incorporate algorithm enhancements from Phase I recommendations, implement, test and evaluate modifications using Phase I software simulator Design, implement and test additional algorithms required for ANSP functionality (e.g., simple PRI and scan analysis). Objective 3 Firmware--Design, implement and test a transputer-based firmware implementation of MNEWS. The workstation will have the capability of directly interfacing to an available ESM receiver Provide detailed software and hardware performance specifications. Objective 4. Test and Evaluation--Evaluate the performance of the MNEWS brassboard via Monte Carlo simulation using actual emitter data. Laboratory tests will first be conducted using intercept data obtained from magnetic tapes collected during previous tests. Actual field testing of the MNEWS brassboard will be accomplished by connecting the brassboard to an intercept receiver providing raw pulse descriptor words. The ultimate goal is a side-by-side comparison of MNEWS with the existing MASS and VMAS architectures.

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Phone (602) 893-7533

Topic#: 89-021 ID#: 89AVS-013
Office: AVSCOM
Contract #: DAAJ02-92-C-0006
PI: JOSEPH W COLTMAN

Title HELICOPTER AIR-BAG

Abstract The latest U S. Army production helicopters include crewseats that significantly reduce the probability of spinal injury in a crash by limiting the vertical impact forces. However, the risk of injury to the upper torso and head due to secondary impacts is still high because the standard five-point restraint system allows some lateral motion, and impacts with high vertical loads result in compression of the upper torso and extensive head and torso motion within the restraint. Research and development in the automotive industry with air bag systems has produced the technology needed to reduce the hazards of secondary impact The objective of this Phase II effort is to develop a retrofit air bag system for an existing Army helicopter The effort includes evaluation of the cockpit, development of a lightweight and effective air bag system (including computer modeling of the occupant, seat, cockpit, and air bag system), fabrication of prototype units, and dynamic testing of the system under various impact conditions.

SPRINGBORN MATERIALS SCIENCE, INC.
10 SPRINGBORN CENTER
ENFIELD, CT 06082
Phone. (203) 749-8371

Topic#: 88-116 ID#: 88BRD-003
Office: BRDEC
Contract #:
PI: DR. BERNARD BAUM

Title CURING FOR THERMOSETTING POLYMERS AND ADHESIVES

Abstract. The objective of Phase II is to further develop the radio frequency, induction, resistance, infrared and ultraviolet methods shown to be feasible in Phase I for accelerating the cure of thermosetting epoxy adhesives The program will address adhesive selection and process optimization to the extent that an adhesive and rapid curing technique is proven suitable for tactical bridge manufacture or field repair

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Topic#: 90-192 ID#: 90MED-102
Office: MEDICAL
Contract #: 90-C-0078
PI: F. DONALD ROBERTS

ARMY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: DEVELOPMENT OF NEW LASER-PROTECTIVE DYES

Abstract A program of synthesizing and stabilizing new laser protective dyes, especially for the near-infrared region is proposed. Two families of dyes and methods of thermal and photochemical stabilization will be developed. Sets of lenses for field trials from at least five sets of dyes will be produced. In addition, technical reports will be generated which will describe the technology. It is expected that several dyes will be available for commercial use by the end of the Phase II program.

STRUCTURAL INTEGRITY ASSOC.
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Topic#: 89-004 ID#: 89AVS-006
Office: AVSCOM
Contract #: DAAJ02-92-C-0005
PI: SHU (STAN) TANG

Title: FATIGUE LIFE MONITOR

Abstract A methodology for on-line fatigue monitoring of non-airframes components of rotorcraft has been developed under Phase I of this project. It is a semi-empirical method, using a combination of pattern recognition, load-cycle spectrum classification, and correlated load ranges. It was demonstrated to efficiently predict the fatigue usage of a rotating component based only on quasi-static, flight recorder type data. This method significantly reduces required data handling and processing compared to conventional techniques. It thus provides a viable method for on-board fatigue usage monitoring of production rotorcraft using a relatively small microprocessor, and with no new instrumentation of data acquisition requirements. A prototype hardware/software system will be developed under Phase II to demonstrate the functionality and operability of the methodology.

SUPERCONDUCTOR TECHNOLOGIES, INC.
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SANTA BARBARA, CA 93111
Phone: (805) 683-7646

Topic#: 89-026 ID#: 89ETD-013
Office: ETDL
Contract #: DAAL01-91-C-0104
PI: DR. ROBERT B. HAMMOND

Title: SUPERCONDUCTING MMW FILTER

Abstract We have successfully produced superior HTSC thin films and designed, fabricated, packaged, and tested HTSC microwave delay lines and resonators. These devices show 10 to 30 times better performance than identical thin film Ag devices at 3 GHz and 77K. Based on surface resistance (R_s) measurements at 9.55 GHz, 77K, performed on our current HTSC films, we expect $R_s = Z$ mohm at 35 GHz, 77K (ten times better than thin film Cu or Ag). This is a factor of 30 better than room temperature Au films at 35 GHz. Our power dependent microwave loss measurements on these films indicate that these very low losses can be achieved at microwave current densities in excess of 100,000 amps per square centimeter. Using these films, we propose to develop a practical low loss bandpass filter with center frequency at 35 GHz with a 1 GHz pass band operating at 77K. This filter will demonstrate the enormous potential for high temperature superconductors to improve performance in high frequency systems. The filter could be used directly to improve range in a 35 GHz missile seekers.

SUSQUEHANNA RESOURCES & ENVIRONMENT
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Topic#: 88-022 ID#: 88ARD-020
Office: ARDEC
Contract #: DAAA21-91-C-0063
PI: TIMOTHY D. MASTERS

Title: ADVANCED WEAPON STATION AUTOMATION/INTEGRATION

Abstract In the SBIR Phase I effort on Advanced Weapon Station development, we examined three related topics: (1) automation, (2) embedded expert systems, and (3) automated target recognition (ATR) system integration. The tasks were accomplished by using FLIR imagery from the PAIRSTECH program. On automation, we examined the factors influencing the hit-rates when classification is performed using Fourier descriptors. On embedded expert systems, we demonstrated how a classification process can be controlled using system parameters such as our Auto-start and Auto-stop. On integration, we examined the ATR components including sensors, trackers, segmentors, classifiers and interface modules, and discussed how an integrated ATR system can be achieved. Based on these Phase I results, we propose a Phase II effort centering on the delivery of a prototype weapon station system to ARDEC via these major tasks. (1) development of system modules. tracker, segmentor and classifier, (2) development of interface modules. tracker to segmentor, classifier to classifier and classifier to wire frame models (3) acquiring image data and conducting demonstrations, and (4) delivery of a prototype system. In addition,

ARMY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

we will conduct a number of field tests with the developed system at ARDEC and possible at the Aberdeen test site where the PAIRSTECH imagery was acquired.

TAU CORP.
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Topic#: 89-048 ID#: 89TEC-009
Office: TECOM
Contract #: DAAD07-91-C-0157
PI: DR. FRED SMITH

Title: DIGITAL FOCUS/OBJECT TRACKER

Abstract. TAU Corporation proposes to complete the design and implement an image processing workstation for the development and evaluation of real-time video mount control trackers. Both the range tracker using the digital focus techniques developed in Phase I as well as conventional angle trackers will be developed. The proposed prototype will use the proprietary TAU EAGLE data Reduction Video Tracker as its core component in order to take advantage of TAU's existing tracker software. The EAGLE will be modified for tracker development by creating a Tracker Development Environment for real-time video trackers. This Tracker Development Environment will include general interactive image processing commands as well as more specialized tracker functions, such as adaptive thresholds. The digital focus algorithms and software developed during Phase I will also be added to EAGLE. This software will measure the defocus of an image in real time and generate control signals for a theodolite focus control. The proposed effort will also develop a prototype stand-alone real-time tracker with hardware and software that is compatible with EAGLE. This real-time tracker at the minimum will have the functionality of the current "White Sands" mount control tracker. It also will be able to implement the digital focus range tracker from Phase I. The proposed effort also integrates the TAU Attitude Estimation software with EAGLE.

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Topic#: 89-039 ID#: 89MIC-003
Office: MICOM
Contract #: DAAH01-91-C-R283
PI: VERN E. BROOKS

Title: SMALL LOW COST EXPENDABLE TURBOJET DEMONSTRATION

Abstract. A low-cost, small turbojet engine has been designed using currently available high-production turbocharger core components, and two complete engine assemblies will be delivered. The turbocharger components have near state-of-the-art performance, and the turbojet engine will also have near state-of-the-art performance at truly expendable engine cost. The use of fully developed and proven turbocharger components will also reduce the development cost and time. Turbocharger-based test fixture engines provide a low-cost method to qualify newly designed engine components in the early development stages. The engine is a small, light-weight package with an integral ignition and compressed air starting capability to eliminate the need for expensive pyrotechnic starting and ignition devices. No lubricating oil is required to support engine operation. This engine will have a low initial cost and also will be cost effective in its application to an air vehicle.

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Topic#: 88-022 ID#: 88ARD-014
Office: ARDEC
Contract #: DAAA21-91-C-0068
PI: DR. ALTON GILBERT

Title: WPN STATION AUTOMATION

Abstract. Research projects directed at segments of the required capability to effect an intelligent artillery platform have been sponsored or performed by ARDEC. A requirement exists for an integrating effort that moves the emerging technology toward a non-laboratory demonstration. This proposal is directed at performing these integrating tasks around a realistic hardware and display technology. One component of crew reduction efforts is the information presentation technology employed. As processes are automated the need for means of communicating to the reduced crew the conclusions, recommendations and decisions of the automated functions is critical. As flat panel displays and other display technologies achieve resolutions compatible with quality graphics systems and become increasingly available for use in weapons systems, a need exists for graphics engines and display software integrated into the intelligent weapons platform. The development of graphics engine hardware, sufficiently compact and in the proposer form factor for VETRONICS compatibility, is proposed in this effort to provide menus, terrain displays, situation assessment, and control of the functionality developed.

ARMY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 87-330 ID#: 87HEL-002
Office: HEL
Contract #: DAAA15-91-C-0009
PI: ALTON L. GILBERT

Title: SIMULATION/MODELING OF ROBOTIC VEHICLES IN THE BATTLEFIELD

Abstract A need exists for an analysis tool to properly evaluate various aspects of robotic vehicle deployment in the battlefield. The purpose of the Phase II effort will be to develop a ground combat model for the analysis of missions, capabilities, limitations, requirements, system specifications, and concepts feasibility of robotic vehicle systems in a battlefield environment. This model will be a two-sided, stochastic, computer-based system simulation model which will provide the user with a capability for evaluating a wide variety of robotic vehicle (and related) issues. The model will have limited interactive capability to address teleoperated and robotic controlled issues, however, the major functions will operate closed form. It will allow the integration of mixes of various weapons systems, both robotic and conventional, in a realistically simulated combat environment. The architecture design (hardware and software) will use a distributed open system concept developed from technology in the SIMNET program, the open system architecture project at ARDEC, and the results of the Phase I effort.

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Topic#: 89-019 ID#: 89AVS-011
Office: AVSCOM
Contract #: DAAJ02-92-C-0002
PI: R.A. THOMAS

Title: COMPOSITE FLOW CASTING

Abstract Thompson Aluminum Casting Company proposes to use an Integrated Composite Flow Squeeze Casting System (developed under a previous U.S. Army SBIR Program) to cast near net shape production items made of metal matrix composites. Our proposal is to demonstrate squeeze casting as a viable manufacturing process for metal matrix composites in the manufacture of turbine engine blades. Our plans are to employ techniques which will break clusters, improve distribution of SiC composite reinforcements and eliminate porosity. Phase I consisted of squeeze casting tensile bars of aluminum metal matrix-SiC particulate. This Phase yielded test bars which characterized the solidification, micro-structure and permitted measurement of tensile properties of the test bars demonstrating improved qualities of the squeeze cast metal matrix composite aluminum. Initial Phase I test bar samples also demonstrate that Squeeze Casting as a manufacturing methodology for production items is a viable concept. Phase II will primarily consist of proving squeeze casting as a manufacturing process capable of full scale production. Phase II will utilize Al-SiC particle composite to manufacture actual turbine engine blades using the Integrated Flow Squeeze Casting System.

TRIFID CORP.
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Topic#: 89-062 ID#: 89ETL-002
Office: ETL
Contract #: DACA76-91-C-0001
PI: MARSHALL FAINTICH

Title: DIGITAL IMAGE DATABASE

Abstract A concept is developed to perform rigorous, analytical, multi-sensor triangulation for the absolute control of digital images within a larger data base environment. In Phase II, TRIFID proposes to progress from the operational concept design and engineering demonstration completed in Phase I to an operation testbed installed at a government facility by accomplishing the following three objectives. 1. Perform detailed systems requirements studies, 2. Develop CDIDB engineering software modules at TRIFID, 3. Provide ETL with a testbed capability. These three objectives will result in a working prototype CDIDB on an ETL testbed system. The prototype is to be used by government personnel in creating controlled digital imagery from a variety of sources for a variety of applications and exploitation systems.

VULN/EVAL ASSOC
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Title: EW VULN EVAL METHOD FOR COM SYSTEMS

Topic#: 90-137 ID#: 90VAL-104
Office: VAL
Contract #: DAAL01-91-C-0129
PI: JAMES E. BARTOW

ARMY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Abstract. The goal of this program is to devise a methodology for the evaluation of the EW Vulnerability of complex communication systems imbedded in a network. In order to develop this methodology the parameters of the communication system must be identified and defined, the interrelationships among these parameters must be identified, the interference waveforms must be assessed, the network structure and composition must be determined, measures of performance must be established and defined, and algorithms relating the measures of performance to the parameters, interrelationships, interference waveforms, and network structure must be derived. Included in the assessment task is the invention of simple meaningful methods of presenting the results. The benefits of this program include the establishment of a standardized methodology for evaluating the performance of netted communication systems in a stressed environment. Commercial applications include the evaluation of radio telephone systems in local area networks which are stressed by self interference, background noise, and fading signals. The use of a well defined consistent methodology in assessing performance of competing systems and evaluating changes and improvements in systems will benefit both industry and the Government.

WINDROCK ASSOC.
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Title: PROGNOSTIC/DIAG EQUIP

Topic#: 88-115
Office: BRDEC
Contract #: 91-C0037
PI: JAMES F. KIRKPATRICK

ID#: 88BRD-002

Abstract. A program is proposed to design fabricate, test, and deliver 10 prototype, on-line, prognostic and diagnostic monitors to the U.S. Army. The on-board, microprocessor-based monitors will be able to detect incipient engine diagnosis of the detected faults. The monitors will additionally be able to monitor lubricating oil quality (including detection of ferric wear debris) as well as measure real-time generator set efficiency. The Phase I effort went well beyond the necessary demonstration of "proof-of-principle" via successful daily use of a working prototype in the severe "real-world" service environment of a working automotive diesel engine.

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-008
Office: ONR
Contract #: N00014
PI: ROBERT M PAP

ID#: 40823

Title: Neural Networks for Autonomous Motor Control

Abstract: Planning, coordination and control of multiple joints on a robot require considerable algorithmic and computational effort. Accurate Automation has developed a concept for decentralized adaptive controller using neural networks that can be applied to autonomous motor control for a real-time robot controller. This neurocontroller will learn and maintain its own calibration, generate accurate and stable multi-joint motion control and move a payload from any starting point to any ending point without end point oscillations. Our neurocontroller is basically composed of these four components: joint controllers, adaptation networks, inverse kinematics networks and optimization networks. Based upon this innovative neurocontroller system, we propose to build a prototype neurocontroller and show that it is able to perform better than current adaptive control techniques. Our neurocontroller will demonstrate the flexibility of the concept, fast computational capability, stability, adaptability and ease of hardware implementation. A major goal of this project is to simulate the concept, realize as much as possible of the decentralized adaptive neurocontroller in off-the-shelf hardware, and then test the controller on an actual undersea robotic arm.

ADCOM SYSTEMS, INC.
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Phone: (617) 899-5905

Topic#: 89-207
Office: NOSC
Contract #: N66001-92-C-7000
PI: DR. ELIE J. BAGHDADY

ID#: 37919

Title: Accurate Passive Ranging System

Abstract: A Phase II program is proposed for developing, implementing and operating a bench model of an innovative Induced Doppler Emitter Locator (IDEL) system to provide a conclusive demonstration that proves the system concepts. The IDEL technique has been shown in Phase I to be superior to all other techniques for accurate passive ranging onboard a platform with very limited available physical space for passive ranging sensor aperture/baselines, and to be readily combinable with incremental ranging based on one-way range-rate Doppler and other passive ranging techniques. Detailed functional block diagram design of the bench model IDEL has been planned for operating frequencies in the S-band range of 2 to 3 GHz, which range is reserved for aerospace test range telemetry and is therefore presumed available for outdoor experimentation with and demonstration of IDEL. Moreover, proven components/modules are available, which reduces the need to develop new modules to those unique to IDEL.

ADROIT SYSTEMS, INC.
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Phone: (602) 571-1191

Topic#: 90-012
Office: ONT
Contract #: N66001-92-C-7005
PI: Robert K. Bowden

ID#: 54253

Title: Tactical Data Quality Metric

Abstract: The objective of the project is to develop an engineering prototype system for determining the quality of Tactical Data in the context of its usefulness to Naval decision makers. The project will employ real/exercise formatted Naval Tactical Data traffic to: (1) enhance the data importance determination capability of the Tactical Data Quality Metric System (TDQMS) developed in Phase I; (2) extend this capability to the Strike Warfare Area, and (3) develop the requirements definitions that will facilitate extension to the Electronic Warfare Area. The enhancement/extension will include the understanding gained through discussions with developers of other systems supporting Tactical Data Quality. The project will first produce the philosophy for formulation of the mathematical models used in quantifying the importance of data relative to six message features. The mathematical models will be verified prior to merging them into a metric for global determination of message importance. Users will evaluate system capabilities in order to ensure the effectiveness of the TDQMS for its intended purpose and its "user friendliness." Prior to delivery, necessary refinements of the TDQMS will be tested to ensure that its Output correlates well with its intended purposes.

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

ADVANCED DECISION SYSTEMS

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Topic#: 89-009
Office: ONT
Contract #: N00014-91-C-
PI: Gregory J. Courand

ID#: 37583

Title: Counter-Deception Support for Expert Systems

Abstract The data, knowledge, inference, and reflective capabilities of expert systems are limited. We describe a collection of tools that address the problem that deception poses for expert systems and for organizations that employ them to reason about observations, plan, or make decisions. We have completed a Phase I SBIR in which we explore the ways that deception, of deceiving, and of the components of expert system. For Phase II we proposed to build a deception planner and use the deceptive plans to detect the weaknesses of particular expert systems and determine how they can be mitigated or eliminated. Specifically, our objective is to develop a collection of tools to support counter-deception reasoning in support of the situation assessment task for the Navy's Outer Air Battle mission. Our deception planning methodology calls for the deceiver to behave in a way that manipulates the beliefs that the target forms based on his (the deceiver's) emissions and actions. Our deception planner integrates case-based reasoning, sophisticated planning technology, and belief formation and revision technologies.

ADVANCED TECHNOLOGY & RESEARCH CORP.

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Topic#: 88-070
Office: NAVAIR
Contract #: N00019-90-C-0302
PI: DR NABIH E BEDEWI

ID#: 24484

Title: NON-DESTRUCTIVE EVALUATION OF CERAMICS USING SYSTEM IDENTIFICATION

Abstract. The overall technical objective of Phase II is to perform the engineering development of non-destructive testing of ceramics. Phase I studies indicated the feasibility of these developments, provided the implementation of more sophisticated experimental hardware including specimen fixture, excitation device, pick-up device, and data acquisition system. The culmination of the effort would be a proven technique utilizing the Randomdec process that could accurately describe the state of degradation present in a ceramic specimen. The end item would be the development of an in-situ monitoring system. Assuming that we are successful in measuring damping, natural frequencies and system parameters of structures in the laboratory, it would be very desirable to have a compact system which could be hand carried to the field or installed in a pre-existing assembly line. It is proposed to investigate the possibility of developing an Random Decrement System Identification measurement unit with the capability of processing the dynamic response data from the transducer to obtain the free vibration signature and hence the modal parameters. The design goal for the monitoring system is that it should be man-portable and easy to use by individuals not intimately familiar with the Randomdec technique.

AEROCHEM RESEARCH LABS, INC.

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Topic#: 90-020
Office: ONT
Contract #: N60921-92-C-0036
PI: William Felder

ID#: 40836

Title: Reactivity of Coated Boron Particles in Combustion Environments

Abstract. Thin coatings of reactive metal have been shown to enhance the reactivity of boron particles in a combustion environment. Phase I research indicated that Mg-coated, 3 µm diameter amorphous boron particles ignited at earlier times and lower temperatures and burned more quickly than identical, uncoated boron particles in a set of atmospheric pressure hydrogen/oxygen/nitrogen flames. This is the first experimental demonstration that thin reactive metal coatings enhance the reactivity of boron particles in combustion environments. With this demonstration, the concept of coating boron particles for use as practical fuels has been made credible and the need for further work has been emphasized. The proposed Phase II work will provide quantitative validation of this enhancement in a variety of combustion environments, extending the measurements on the system studied in Phase I, and additionally exploring carbon monoxide/oxygen, nitrogen, hydrocarbon/oxygen/nitrogen and nitrous oxide/oxygen/nitrogen flames. The effects of coating material (Mg, Al), coating thickness, boron particle purity and phase, and particle size on reactivity will be determined. In addition, the pyrolysis and ignition of boron loaded solid fuel pellets will be compared using coated and uncoated boron particles. Physical and chemical mechanisms for the enhancement effect will be developed and tested using the data.

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 88-013 ID#: 30304
Office: ONT
Contract #: N60921-92-C-A371
PI: DR RUSSELL J CHURCHILL

Title: LASER ALLOYING OF PLASMA-DEPOSITED COATINGS FOR OXIDATION PROTECTION OF CARBON-CARBON COMPOSITE MATERIALS

Abstract. C-C composites are attractive materials for use in energy conversion and hot structural applications as a result of the strength retention at elevated temperatures. Phase I of the program produced oxidation-resistant coatings on C-C composite materials using plasma spray techniques followed by laser surface alloying and laser annealing. Significant industrial interest has been generated in such coatings for gas turbine nozzles, turbine blades and high temperature structure applications. The Phase II of this program will realize the feasibility demonstrated in Phase I and refine parameters.

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Topic#: 87-233 ID#: 16945
Office: NOSC
Contract #: N66001-92-C-7001
PI: ROBERT G DAVENPORT

Title: Noise Suppressor Development Rotary Control Valves

Abstract: Phase II will continue the development of trims in a broader range of sizes but will focus on solving specific flow problems in each size. These flow requirements will be defined by NOSC/DTRC. A goal of an additional 10 db of noise suppression is desired.

APPLIED TECHNOLOGY ASSOC., INC.
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Topic#: 90-030 ID#: 40856
Office: MCRDAC
Contract #: N00167-90-C-0051
PI: DR. ROBERT CAVALLERI

Title: Light Weight Rotary Compressor Evaluation for Advanced Marine Propulsion Applications

Abstract. Rotary compressors are capable of providing larger volumes of compressed gas than reciprocating compressors. This is due to the fact rotary devices can rotate at higher speeds than reciprocating devices. A high efficiency, large displacement rotary compressor offers versatility and features that existing reciprocating do not possess. An advanced marine propulsion concept that is currently under consideration requires the combustion of high pressure air in conjunction with a column of water to produce a high momentum water jet propulsion system. The proposed rotary compressor, which will be considered in this effort, has features incorporated into its design that minimize the amount of internal leakage and decrease the internal friction. A working prototype of the proposed compressor has been fabricated and tested on a smaller scale than that required for the water jet propulsor. The proposed effort will design, fabricate and test a subscale and full scale compressor to meet the needs of the water jet propulsor.

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Topic#: 89-119 ID#: 36888
Office: NAVSEA
Contract #: N00024-92-C-4013
PI: JOSEPH R. JAHODA

Title: Advanced Direction of Arrival Pulse Sorting Array

Abstract. An innovative single antenna array is proposed which can achieve extremely high direction of arrival accuracy for pulse sorting applications. The maximum diameter is less than 4 inches and can be made flush mounting.

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Topic#: 90-063 ID#: 41139
Office: NAVAIR
Contract #: N62269-92-C-0009
PI: Dr. Michael S. Wengrovitz

Title: ADAPTIVE NULLING SUBSYSTEM FOR SONOBUOY RF RECEIVER

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Abstract: Protecting sonobuoy data RF uplinks against disruption by jammers is critical to maintaining an effective anti-submarine warfare capability. Atlantic Aerospace's SBIR Phase I work assessed the feasibility of incorporating a fully-automatic all digital antenna nulling subsystem within an Advanced ASW Receiver for sonobuoy signals. Our Phase I work identified a class of nulling algorithms that have excellent potential for suppressing sonobuoy RF jammers in a robust and computationally-efficient manner. The SBIR Phase II work proposed herein is aimed at demonstrating that all necessary technology is in-place for constructing an effective jammer-suppression subsystem suitable for incorporation into the Advanced ASW Receiver. The Phase II program elements consist of: selection of the preferred nulling algorithm, construction of a real-time data acquisition system to facilitate collection of flight/field data, implementation of the preferred nulling algorithm in high-level software, performing sizing/timing estimates of the preferred algorithm, performing sizing/timing estimates of the preferred algorithm, performing sizing/timing of related signal demodulation techniques, and validation of the preferred algorithm on synthetic and real flight/field data.

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Topic#: 90-185 ID#: 40959
Office: NSWCWO
Contract #: N60291-92-C-0020
PI: JOLANTA I SOOS

Title: MULTI-DIMENSIONAL OPTICAL PROCESSOR FOR PHASED ARRAY ANTENNA PROCESSING

Abstract. A laboratory system will be constructed to test the effectiveness of a frequency bearing/range-bearing optical processor. The processor will incorporate an eight channel, TeO₂, slow shear mode Bragg cell which will be fabricated at Brimrose. The impedance matching and phase correction of the Bearing cell's channels will be a major portion of this effort. The system will be completely under computer control permitting the testing of an unlimited variety of signals and post-processing algorithms. These algorithms may include triangulation for range and velocity, or algorithms for SAR (synthetic aperture radar) processing. The system will also permit the test of digitally encoded range data. This hardware and algorithms developed may be of use in next generation radar systems.

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Topic#: 90-267 ID#: 41205
Office: NCEL
Contract #: N47408-91-C-1232
PI: DR SEAN WISE

Title: Heat Resistant Concrete Pavements of Naval Airfields

Abstract: Given the present state of knowledge, shrinkage is the major player in creating and growing microcracks. Attempts to design a heat resistant (thermal cycling) pavement have to concentrate to reduce or eliminate shrinkage. There are several ways to approach this problem. This Phase II will concentrate on developing a cement type pad for Navy use.

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Topic#: 90-172 ID#: 40944
Office: NSWCWO
Contract #: N60291-92-C-0036
PI: DR. GARY KNOTT

Title: STATICAL MODELING OF FAILURE DATA

Abstract. Special optimization algorithms and software are to be developed during this project to allow stochastic functions to be fit to observed data, i.e. to estimate relevant parameters within functions to evaluate weapons system effectiveness, sensitivity and reliability of munitions and vulnerability of complex structures to severe loading including attack. Random number-generation tools are to be provided for use in evaluating stochastic functions, including a method for use in evaluating stochastic functions, including a method for generating random vectors with specified correlation structures. Research in goodness-of-fit tests is to be done to provide a means of addressing certain models. Meddonald's Chi-square test is to be extended to two dimensions, and a binary-storage-rec-based test is to be developed. Estimation of survival curves for failure data is to be done together with a set of statical tests to compare two or several such survival curves.

CORPORATION FOR STUDIES AND ANALYSIS

Topic#: 88-235 ID#: 25221

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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INGLEWOOD, CA 90304
Phone: (213) 649-2046
Title: REMOTELY PILOTED

Office: NAPC
Contract #: N00140-91-C-0940
PI: DR PETER JENKINS

Abstract: CSA proposes to build a fully operational prototype of the roto-compound rotary engine (RCRE) designed in Phase I. The prototype will utilize existing rotary technology: a Norton 294cc engine, Norton 208cc engine and connecting manifold constitute the basic components of the RCRE as designed. After modifications to the engine, compressor etc., testing of the prototype, we will deliver it with a final report to Naval Air Propulsion Center.

CORTICON, INC.
3401 MARKET STREET
PHILADELPHIA, PA 19104
Phone: (215) 898-3553

Topic#: 90-001 ID#: 41149
Office: ONR
Contract #: N00014-
PI: PETER CHANCE

Title: ASSEMBLY OF A PROTOTYPE NEURAL ANALOG COMPUTER
Abstract: Phase II will demonstrate a prototype analog neural computer.

DAVIS TECH., INTER., INC.
5025 ARAPAHO ROAD
DALLAS, TX 75248
Phone: (214) 385-9428

Topic#: 90-026 ID#: 40848
Office: MCRDAC
Contract #: N00167-91-C-0067
PI: LEO W. DAVIS

Title: Compressible Fluid Strut for Wheeled Vehicles

Abstract: The final development and prototype manufacture of the DTI system design utilizing compressible fluid is proposed to enhance the utility of USMC-LAV 25. DTI will apply direct experience and proprietary knowledge gained in other successful applications of its compressible fluid suspensions technology to other military vehicles and heavy duty mining trucks. DTI will use silicone as the compressive media to integrate spring and suspension damping functions into 8 individual wheel units, providing a lighter, simplified system through elimination of torsion bars, bulky single rate springs, separately mounted shock absorbers and other ancillary mounting places. The DTI system will feature independent, adjustable fluid suspension for the widest range of vehicle-carrying capacity possible while improving the ride characteristics and overall mission capability. Phase II activity begins with the reduction of the approved preliminary design to practice. This includes completion of detail design, calculation and finally, a production drawing package. Then DTI will manage the prototype manufacturing phase by providing assistance in the following: manufacturing, quality control, schedule compliance, and final assembly.

DELFIN SYSTEMS
1349 MOFFETT PARK DRIVE
SUNNYVALE, CA 90489
Phone: (408) 734-2400

Topic#: 90-179 ID#: 40955
Office: NSWCWO
Contract #: N60291-91-C-A378
PI: KENNETH W CUMMINGS

Title: CRYPTOGRAPHIC ESM EXPERT SYSTEM MAN-MACHINE INTERFACE PROTOTYPE

Abstract: Cryptologic operations today are much more complex than those of just a few short years ago. The RE environment and target environment complexity has increased. To meet this increased complexity, an array of fielded cryptologic ESI.I equipments, subsystems, and automated analytical tools have been, or are being, developed. However, using collocated subsystems in a coordinated manner onboard a platform remains difficult due to disparities in programming environments, subsystem specialization, the extensive and different man-machine-interfaces (MMI). Since modern MMI design should reflect how the operator actually uses and interacts with the machine, Delfin proposes development of the Basic Real-time Interface & Display Genre Expert (BRIDGE) system which we designed during the Phase I SBIR program. BRIDGE is targeted for implementation on a Desktop Terminal Computer Version 3 (DTCC) in the Unix environment, using C++ for procedural software and Mexpert Object for expert system development. During Phase I Delfin investigated current cryptologic systems, technical operator procedures, identified and organized the set of universal operator and system functionalities, then developed an HMI interface requirements matrix. Delfin also investigated potentially useful A1 MNI support technologies, and chose to use Delfin's proprietary expert slice technology. Our slice technology enables real-time parallelism in a high density and diverse MNI environment. BRIDGE display design provide a consistent and easily understood user interface that can be efficiently

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modified over time to match changing environmental, system and MMI requirements. The BRIDGE prototype will accurately reflect and enhance operator use.

DIGITAL SYSTEMS RESEARCH, INC.
2000 NORTH 14th STREET
ARLINGTON, VA 22201
Phone: (703) 522-6067

Topic#: 90-052 ID#: 41135
Office: NAVSUP
Contract #: N00600-91-C-3791
PI: BRIAN BARRY

Title: INTEGRATED USERS SUPPORT SYSTEM FOR SHIPBOARD UNIFORM AUTOMATED DATA PROCESSING RESYSTEMIZATION

Abstract: During Phase I DSR investigated methods by which sailors could be provided better access to reference material, and be better able to perform assigned duties on resystemized SUADPS software. For Phase II DSR proposes: 1) Developing models of five sample SUADPS processes that will change during resystemization for evaluation, 2) Evaluate the results of the PACFLT and SURFPAC sponsored SUADPS Beta Test, 3) Collect and evaluate comments relating to the PQS User Manual, and 4) Restructure and computerize a portion of the contents of publication NAVSUP F-485. A sufficient portion of F-485 will be modeled to permit demonstration of the functionality of all program features and to make cost predictions of complete implementation of F-485 data practicable, should NAVSUP decide to proceed from a prototype to a production program.

DONNELL AND ASSOC., INC.
P.O. BOX 10161
MCLEAN, VA 22102
Phone: (703) 476-6854

Topic#: 90-049 ID#: 40881
Office: SPAWAR
Contract #: N00039-91-C-0196
PI: Michael L. Donnell, Ph.D.

Title: NAVAL WARFARE SYSTEMS ARCHITECTURES: INNOVATIVE SYSTEM ARCHITECTURE TOOLS FOR AUTOMATION OF THE DEVELOPMENT PROCESS

Abstract. This proposal for the development of innovative systems architectures through automation of the warfare systems development process focuses primarily on the CVBF force structure implementation of the mission area but has general applicability well beyond that particular force and mission area. The total Phase II system would be comprised of several databases and an analytical module. The databases would include functional, physical, threat, and technological. The modules would include operational cautious automation, architecture creation and modification, assessment, option development, and database integrator. The assessment modules would include bus-modules for database installation, performance evaluation, explanation, user interface, discrimination analysis, sensitivity analysis, and shortfall/overlap analysis. Primary analytical tools brought to bear include decision analysis, object oriented programming, expert systems and semantic networks, and relational and hierarchical database management. The Phase II implementation would include the following features: modularity, user-friendliness, explanation capabilities, flexibility, robustness and maintainability handling. The system will be capable of residing a number of different hardware systems including Navy standard and workstations. The system addresses two critical naval needs. 1) innovative concepts for future Naval warfare systems, and 2) architecture automation tools for multi-warfare, multi-platform warfare.

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

Topic#: 89-151 ID#: 36038
Office: NSWCWO
Contract #: N60291-92-C-0057
PI: DR. K. M. ABRAHAM

Title: Metallo-Macrocycles as Catalysts for Li/SOC12 Cells

Abstract. A program to develop advanced cathode catalysts for the Li/SOC12 cell is proposed. Research to elucidate the mechanism of catalysis by transition metal macrocyclic complexes will be complemented by the construction and testing of high rate AA cells. The program will involve the following tasks: Task I. Factors affecting the Catalytic Activity of Transition Metal Phthalocyanines. Task II: Catalytic Activity of Transition Metal Porphyrins. Task III. Catalysts Derived from Ni Macrocycles. Task IV: Alternative Precursors for Highly Active Catalysts. Task V. Analytical Studies. Task VI: Construction and Testing of High Rate Li/SOC12 AA Cells.

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ELECTRONIC WARFARE ASSOC., INC.
2071 CHAIN BRIDGE ROAD
VIENNA, VA 22182
Phone: (703) 893-4820

Topic#: 90-178 ID#: 40954
Office: NSWCWO
Contract #: N60921-92-C-A306
PI: ROBERT K. BASSETT

Title: Embedded Training Capability for Afloat Cryptologic Systems

Abstract: The objective of this project is to produce an Advanced Development Model (ADM) of an Embedded Trainer for afloat cryptologic systems. The design technique will follow the recommendations identified in the Phase I SBIR Report generated by Electronic Warfare Associates, Inc. (EWA). This concept will make use of software modules, existing hardware, and documentation that are currently a part of Device 784.

ENVIRONMENTAL DIAGNOSTICS, INC.
1238 ANTHONY ROAD
BURLINGTON, NC 27215
Phone: (919) 226-6311

Topic#: 90-037 ID#: 53910
Office: MCRDAC
Contract #: N60921-91-C-A387
PI: CAROLE GOLDEN, PHD

Title: EZ-SCREEN Test Kit Development for Agents of Biological Origin

Abstract: This project involves the development of membrane-based enzyme immunoassays for up to 15 different agents of biological origin. The tests will be presented in the EZ-SCREEN assay format and will be suitable for use by nontechnical personnel in a combat setting. The tests will be totally self-contained, require no instrumentation and yield results in 10 minutes or less. Performance characteristics of the test including sensitivity, crossreactivity and effect of interfering substances will be determined. Up to 1000 test kits for each agent will be provided. In addition, a device suitable for delivery of these assays in a more simple, "one-step" format will be developed and feasibility of test delivery on the device demonstrated by transition of three of the Ez-SCREEN tests to this format and 100 of each of the prototype devices will be supplied.

EOS TECHNOLOGIES, INC.
10116 36TH AVE CT SW
TACOMA, WA 98499
Phone: (206) 581-7444

Topic#: 90-023 ID#: 40842
Office: MCRDAC
Contract #: N67854-92-C-0019
PI: BLAIR B. DILLAWAY

Title: Multilevel Security Systems for Amphibious Operation Command and Control

Abstract. The modern battlefield demands rapid access to information to support the effective application of tactical forces. A key element in this process is the collection, analysis, and dissemination of all source intelligence information. To meet these needs, there is increasing use of automation systems supporting the intelligence staff. Such systems require application of COMPUSEC technology to allow flexible and efficient processing of multilevel data while supporting automated interfaces to external systems. The USMC has an urgent requirement to support the processing of multilevel data within the tactical C2 system, particularly in the intelligence mission area. The proposed effort will develop a prototype system which demonstrates the required COMPUSEC technology through the integration of NDI hardware, COTS software, and developmental mission oriented applications. It will also demonstrate the feasibility of implementing near term multilevel operation within the existing IAS system at relatively low cost and risk. The system design will be compatible with the evolving MTACCS architectural requirements.

EPOCH ENGINEERING, INC.
806 WEST DIAMOND AVENUE
GAITHERSBURG, MD 20878
Phone: (301) 670-6600

Topic#: 88-020 ID#: 26320
Office: ONT
Contract #: N62269-91-C-0517
PI: JOHN M. WACK

Title: SELF-DEPLOYING LARGE ARRAY STRUCTURES

Abstract. This effort extends the technology of self erecting arrays developed under a SBIR Phase I contract. Eight and 16 arm arrays will be designed and analyzed and actual components fabricated. Many arm arrays (up to 24) will also be studied. In addition, a long (140') horizontal array will be analyzed for feasibility. The second phase of the effort will encompass design and fabrication of one of the studied systems. After fabrication, the systems (equipped with sensors) will be subjected to full scale testing.

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WALTHAM, MA 02254
Phone: (617) 890-3200

Topic#: 89-110 ID#: 36810
Office: NAVSEA
Contract #: N60291-92-C-0016
PI: JACK A. WOODS

Title: Using Interleaf Layers to Improve Strength and Acoustics of Composites Underwater Pressure Hulls

Abstract: The ongoing Phase I program is investigating the use of thermo-plastic interleaf materials as a means of further improving the acoustic damping of composite hull structure while deriving a synergistic improvement in hydrostatic compressive properties. Results of acoustic testing have been very positive and structural testing is scheduled to begin soon. Foster-Miller is requesting project continuity by submitting this Phase II proposal at this time. Because of the high degree of relevance to ongoing Navy projects at NSWC, NUSC, NOSC, DTRC, and DARPA (ASTP), we believe it is important to continue this without the usual 9 to 12 month delay between phases. We are also proposing an accelerated Phase II program of 15 instead of 24 months. Phase II will involve the design, fabrication and testing of inter-leaf composite cylindrical structure to establish a data base for design of thickwalled and torpedohull structure. Design analysis methods will be further established, building upon the Phase I effort. As a part of this analysis, joint and penetration requirements for interleaf hull structure will be made. Interleaf and standard cylinders having an ID of 21 in. by a 48 in. length will be tested acoustically. Thickwall cylinders will be tested under simulated hydrostatic loading. Procedures for the proper manufacture of interleaf cylinders will be established and documented.

GLOBE RUBBER WORKS
254 BEECH STREET
ROCKLAND, MA 02370
Phone: (617) 871-3700

Topic#: 89-109 ID#: 36792
Office: NAVSEA
Contract #: N609_1-92-C-0011
PI: RICHARD C SOMERVILLE

Title: Development of Closed Cell Foam to Attenuate Shock Waves

Abstract: The Phase I study demonstrated that lightweight foam materials with air void content up to 80% could be fabricated using flexible Expanse I macrospheres and a variety of polyethylene matrix materials. These materials possessed acoustic impedance properties which would theoretically attenuate underwater shock waves and hull plating response by approximately a factor of 10. However, the static stiffness of these materials as measured by compression testing indicated that the materials are too flexible to sustain submergence pressures for deep diving submarines. The Phase II effort will initially concentrate on increasing the static stiffness of the high void materials by means of introducing chopped Kevlar into the matrix material, use of high molecular weight polyethylene and epoxy while maintaining the low acoustic impedance which is required for high shock attenuation. The fabrication process will be improved with specially designed low shear mixing head and dispensing nozzles. After verification of adequate static stiffness, high strain dynamic tests will be performed to measure the shock wave transmission properties in a laboratory environment. The measured properties will be used to describe the foam layer in an underwater shock analysis of a representative submarine/equipment configuration. The final task will be to conduct an underwater shock experiment to verify the shock attenuating performance of the material for components which are external to the hull and components which are directly attached to the inside of the pressure hull. Test data will also be used to validate the shock design computer model. A design guidance document will be prepared which will enable survivability engineers to design and implement foam shock attenuation materials in combatant ships and submarines.

HNC, INC.
5501 Oberlin Drive
San Diego, CA 92121
Phone: (619) 546-8877

Topic#: 90-011 ID#: 40826
Office: ONT
Contract #: N00167-91-C-0060
PI: Robert Hecht-Nielsen

Title: Noise Reduction System for Shipboard Spaces

Abstract: In Phase I of this project HNC, Inc. and its teaming partner, Cooper and Bauck, designed and provided (via a mathematical simulation) a successful preliminary demonstration of a new integrated hearing protection and communication system for use by personnel operating in noisy shipboard spaces. This system is based upon the use of an ear plug, a noise monitoring microphone, and a noise canceling speaker for each ear. The noise cancellation signal is the sum of an anti-servo version of the microphone signal as well as the output of a recurrent back propagation neural network that uses the microphone signal as its input. Noise cancellation of 41 dB at the eardrum was demonstrated by computer simulation of the system using digitized sounds from a simulated 5 meter by 10 meter engine room with three engine sound sources. An audio tape

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demonstrating this reduction was made. The system design will allow crewmembers to communicate with other crewmembers and with the bridge, as well as to hear alarms. In Phase II, the Cooper and Bauck team will build and iteratively refine prototypes of this system and demonstrate them on Navy ships.

HOLTGREN, INC.
PO BOX 262
KENILWORTH, NJ 07033
Phone: (201) 686-2323

Topic#: 87-232 ID#: 20050
Office: NAPC
Contract #: N00140-91-C-3188
PI: DR EDWARD R BUCHANAN

Title: J-52 BOLT HOLE REPAIR USING A "SHAPE MEMORY" ALLOY EXPANSION BUSHING
Abstract: THE OVERALL GOAL OF THE PHASE II PROGRAM IS TO DEMONSTRATE THE EFFICACY OF THE SHAPE MEMORY ALLOY BUSHING AS A TOOL FOR EXTENDING THE LIFE OF J-52 COMPRESSOR DISCS. THE PROGRAM WILL CONSIST OF IDENTIFYING PARAMETERS TO OPTIMIZE PROPERTIES, DEFINE THE PROPERTIES, AND EVALUATE THE BUSHINGS IN ENGINE DISCS IN A SIMULATED ENGINE ENVIRONMENT.

IRI CORP.
4544 TOTANA DRIVE
TARZANA, CA 91356
Phone: (818) 996-1698

Topic#: 90-292 ID#: 41028
Office: NOSC
Contract #: N66001-92-C-7003
PI: DR. IZHAK RUBIN

Title: Safenet Performance Evaluation

Abstract: Under Phase II IRI will develop a software based program to serve as a tool for performance evaluation of SAFENET and FDDI networks. This prototype incorporates uniquely developed innovative analytical models that provide for time effective performance calculations, parameter selection, network planning and tradeoff studies involving the system configuration, performance requirements and traffic/service loading.

KVH INDUSTRIES, INC.
110 ENTERPRISE CENTER
MIDDLETOWN, RI 02840
Phone: (401) 847-3327

Topic#: 89-078 ID#: 36412
Office: NAVAIR
Contract #: N00018-91-C-0066
PI: A. KITS VAN HEYNINGIN

Title: AUTOMATIC CALIBRATION ELECTROMAGNETIC FLUXGATE AIRCRAFT SENSOR SYSTEM

Abstract: KVH Industries proposes to design, fabricate and deliver one brass-board electromagnetic fluxgate aircraft sensor which will demonstrate automatic calibration. The compass will be capable of interfacing with current families of U S Navy and Air Force magnetic heading sensors and will be compatible with joint services C/AHRS.

LRA LABORATORIES, INC.
18195 A EAST MCDURMOTT
IRVINE, CA 92714
Phone: (714) 474-7727

Topic#: 88-084 ID#: 24535
Office: NAVSEA
Contract #: N00024-91-C-4036
PI: DR LOUIS RAYMOND, PHD

Title: Accelerated Stress Corrosion Cracking Screening Test Method

Abstract: Phase II is directed at accomplishing the technical feasibility demonstrated in Phase I. Since both the 0.4 inch thick (0.4T) and 1.0 inch thick (1.0T) Rising Step Load (RSL) bend SCC test machine were demonstrated in Phase I to offer unique advantages, it is proposed to develop an accelerated SCC system testing system that covers the complete spectrum of testing requirements. The RSL-0.4T machine is best suited for welded HY-130 ships with cathodic protection using an impressed potential. This proposal deals with resolving technical issues identified in Phase I, automation of the RSL-0.4T, and improved instrumentation of the RSL-0.4T, in addition to expanding the capabilities of the RSL-0.4T to measure crack growth rates and test actual hardware. The transition to Phase III is clearly identified.

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METRATEK, INC.
5205 LEESBURG PIKE
FALLS CHURCH, VA 22041
Phone: (703) 671-6500

Topic#: 89-213 ID#: 37976
Office: NATC
Contract #: N00421-91-C-0051
PI: RAYMOND L. HARRIS

Title: Multi-Mode Multifrequency Instrumentation Radar System

Abstract. The technical objective of Phase II is to demonstrate an initial implementation of the slaved multimode multifrequency radar system defined in the Phase I effort. This will provide new capabilities that will allow ranges like the Chesapeake Test Range (CTR) at the Naval Air TestCenter (NATC) to add advanced coherent waveforms and signal processing capabilities, additional frequency bands, and greatly expanded threat simulation capabilities at a modest cost, while retaining their existing tracking radar systems. The approach will be to implement the unique portions of the system, to the extent permitted by available funding, and to combine these elements with existing commercially-available subsystems (such as the transmitter and frequency synthesizer) in order to provide a demonstration and evaluation of the full-up system concept in the realistic environment at the Chesapeake Test Range. This approach can provide an effective solution to the need for economical addition of capabilities for threat radar simulation for EW purposes and multiband coherent measurement of target and chaff backscatter.

MICROSENSOR SYSTEMS, INC.
6800 VERSAR CENTER
SPRINGFIELD, VA 22151
Phone: (703) 250-5336

Topic#: 88-085 ID#: 24545
Office: NAVSEA
Contract #: N00024-91-C-4027
PI: HENRY WOHLTJEN

Title: SAW Array Detector for Hazardous Vapors

Abstract. Based on the results of the Phase I study, Microsensor systems Inc. will optimize the SAW chemical microsensor array for the shipboard detection of fire and selected hazardous gasses, including chemical warfare agents. The goal will meet Navy requirements for performance, size, weight, and cost, and will be compatible with shipboard damage controlsystems. This effort will require a major redesign to improve system producibility, reliability, and performance. This will include the use of surface mount electronics, a greatly simplified pneumatic system, expanded software capability, optical fiber communications interface, and future sensor expansion port. New processes will be developed for the coating of the SAW devices, and automatically testing the sensor arrays. Ten demonstration units will be built and programmed for the detection of smoke (fire), flammable/explosive vapors and chemical warfare agents. The unit will be submitted to an extensive test and evaluation.

MRV TECHNOLOGIES, INC.
8917 FULLBRIGHT AVE
CHATSWORTH, CA 91311
Phone: (818) 773-9044

Topic#: 90-205 ID#: 40986
Office: NSWCWO
Contract #: N60291-92-C-A305
PI: DR SHLOMO MARGALIT

Title: HIGH-POWER FIBER OPTIC SOURCES

Abstract. This proposal describes an effort towards developing an optical source that will be capable of launching -12db to single mode fiber at the widest temperature range. This is to be done, through continuation of our initial effort in Phase I. The structure proposed is a P-substrate wide V-groove E-LED. The parameters to be optimized are the active region volume, gain area length and A.R coating. In addition MRV's current effort in the area of packaging will be extended based on our results of Phase I. The confidence level as to the ability to achieve the above mentioned characteristics, is very high.

NETROLOGIC, INC.
5080 Shoreham Place, Suite 201
San Diego, CA 92122
Phone: (619) 587-0970

Topic#: 90-002 ID#: 41152
Office: ONR
Contract #: N00014-
PI: Dan Greenwood

Title: Fractal Image Encoding

Abstract. NETROLOGIC developed and implemented a "fractal based" image compression scheme during our Phase I study. The Scheme encodes images as a collection of affine transformations in the plane, leading to a loss but highly compressive algorithm which yields good results. For Phase II we propose to implement this algorithm in hardware, to demonstrate the feasibility of utilizing the algorithm for a variety of applications. Although the Phase I research resulted in good results, we feel that further concurrent mathematical research will lead even better results.

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NEUROGEN LABORATORIES, INC.
325 Harvard Street
Brookline, MA 02146
Phone: (617) 232-8266

Topic#: 90-008 ID#: 40822
Office: ONR
Contract #: N00014-
PI: Michael Kuperstein, Ph.D.

Title: Autonomous Neural Network Controller for Adaptive Material Handling

Abstract: Current methods in motor control have problems dealing effectively with highly variable inertial and dynamic interactions between novel payloads and robots. The proposed neural controller overcomes some of these difficulties by learning to anticipate inertial interactions from its own experience. The objective of the proposed Phase II work is to implement a multi-jointed arm and controller for handling unforeseen payloads with accurate and stable movements. The proposed development will be based on a working implementation from the Phase I effort that has been shown to achieve autonomous adaptive control. The feedforward nature of control will allow parallel implementation in real time across multiple joints. It will tolerate internal noise, partial system damage and changes in the mechanical and sensory parameters of the robot as they occur over time. This adaptability eliminates the need for operator calibration and maintenance. In phase III of this project, this neural controller will be brought to market as a product. It will unload the burden of control details from human operators in telerobotic operations and can be used to accomplish repetitive or dangerous tasks in uncertain environments such as underwater, on the battlefield and in space.

NUCLEAR & AEROSPACE MATERIALS CORP.
16716 MARTINCOIT ROAD
POWAY, CA 92064
Phone: (619) 487-0325

Topic#: 88-096 ID#: 24765
Office: NAVSEA
Contract #: N60921-92-C-A371
PI: GLEN B. ENGLE

Title: Carbon-Carbon Composites for Thermal Management

Abstract. The results of the Phase I study showed the feasibility of fabricating carbon-carbon composites using high thermal conductivity fibers. Thermal conductivity values of up to 400 W/m.K in the composites were achieved along with excellent mechanical properties. The specific thermal conductivity of these composites was significantly higher than metal and organic matrix composites of similar architecture. The research in Phase II will be aimed at maximizing the in-plane thermal conductivity and to control the in-plane thermal expansivity of the carbon-carbon composites. High modulus pitch fibers will be used as reinforcements in pitch/PyC matrices. Mesophase pitch liquid crystals will be elongated parallel to the "2" direction of 2D high thermal conductivity preforms to enhance the "2" direction thermal conductivity and mechanical properties. Metal carbide particles will be added to the matrices to increase and control the in-plane thermal expansivity. The composites will be processed to promote a high degree of crystallinity, high thermal conductivity and good mechanical properties. The composites will be characterized by SEM and light microscopy and by measuring physical, thermal, electrical and mechanical properties. A system component such as a SEM E thermal plane will be fabricated and tested during the latter part of the program.

OPTIMIZATION TECHNOLOGY, INC.
175 E MAGNOLIA AVE
AUBURN, AL 36830
Phone: (205) 826-6700

Topic#: 88-071 ID#: 24506
Office: NAVAIR
Contract #: N00019-91-C-0092
PI: HOWARD O WELCH

Title: A Feasibility and Cost/Benefit Model for Assembler Conversion to Ada - Phase II

Abstract. OTI proposes to apply the Ads conversion methodology developed and demonstrated during Phase I to generate a Technology Insertion Plan for replacing the E-2C Airborne Tactical Data System (ATDS) Litton L-304 computer with either the VHSIC AN/AJK-14 or the Control Data Corporation and to generate an executable Ada PDL design for the ATDS software. This methodology features a top down verification of requirements as explicitly contained in existing ATDS documentation and implicitly contained in the existing L-304 code. The objective of Phase II is to produce a verified executable Ada code skeleton ready for final code conversion and a plan for installing the selected replacement computer system in the E-2C which maximizes cost-effectiveness.

ORINCON CORP.
9363 TOWNE CENTRE DRIVE
SAN DIEGO, CA 92121

Topic#: 90-154 ID#: 53144
Office: NAVSEA
Contract #: N00024-92-C-4014

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Phone: (619) 455-5530

PI: SAMANT

Title: NEURAL NETWORKS FOR TORPEDO DETECTION

Abstract: Evolving neural network technology has the potential to provide rapid and reliable detection and classification of torpedoes. In comparison with other types of detection and classification algorithms, neural networks are robust and do not depend on any assumptions about noise original distribution. As a result, there is less difficulty in modifying neural network processing to accommodate specific signal types. This type of processing can perform both detection and classification functions. Consequently, the system false alarm rate may be reduced by rejecting energetic events that are part of the normal operational background as well as maintaining appropriate false alarm rates in a "quiet" background. The expected availability of hardware neural net implementations will allow processing to be performed on a large number of sensor inputs simultaneously. Work in Phase I of this program and in parallel programs has demonstrated the potential for detecting and classifying a wide range of signatures in general, and torpedo signatures in particular. The objectives of the Phase II effort are to fully demonstrate the applicability of this approach in the laboratory with a variety of realistic Navy-supplied and contractor-generated real and simulated test data cases, to integrate newly available line tracking technology into the system, and to plan the transition of the technology to the Navy SLR-24 system.

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Topic#: 88-223 ID#: 23128
Office: NUSC
Contract #: N66604-91-C-0572
PI: DALE KLAMER

Title: Real-Time Display for Multiple Hypothesis Contact Management

Abstract: The development of a real-time display for a Multiple Hypothesis Correlation (MHC) algorithm is described. The design addresses the fundamental operator interface issues unique to the real-time display of MHC information: 1. Real-time multiple scene display, 2. Operator understanding, and 3. Operator interaction and control. The Operator-Machine Interface (OMI) design provides monitoring, analysis, and control of real-time contact management problems while enhancing the operator's understanding of the complex relationships carried by the MHC algorithm. Graphical representation of clusters allows easy identification of tracks involved in ambiguities and aids the operator in focusing on problems. Operator commands allow manual correlation decisions to override the automated correlation decisions made by the MHC algorithm. Distributed processing separates the display and correlation functions into a synchronous processes with dedicated CPU's.

PACIFIC SIERRA RESEARCH
12340 SANTA MONICA BLVD
LOS ANGELES, CA 90025
Phone: (213) 820-2200

Topic#: 90-101 ID#: 40926
Office: NAVAIR
Contract #: N00019-91-C-0272
PI: CHARLES S KAUFMAN

Title: Multispectral Electro-Optical/Infrared Real Time Sensor

Abstract: PSR will design, fabricate and test a flyable, imaging Common Aperture Multispectral Sensor (CAMS) hardware demonstrator and will specify the characteristics of a production version of CAMS. CAMS, which consists of receiver, sensor electronics and data conditioning subsystems, will operate simultaneously in the visible and IR spectral bands through a single aperture. The digital data output will be comparable with Advanced Tactical Air Reconnaissance System (ATARS) requirements.

PAGE AUTOMATED TEL. SYSTEMS, INC.
Rt.2, Box188
La Honda, CA 94020
Phone: (415) 941-7260

Topic#: 89-082 ID#: 36466
Office: NAVAIR
Contract #: N00019-91-C-0191
PI: Patricia Wiener

Title: New Packaging Technologies for Sensor Based (Fiber Optic) Computer Systems

Abstract: A new sensor configuration which could enable real-time response in adaptive system has been successfully implemented. This smart skin array technology holds promise of significantly impacting the interconnectivity crisis as it relates to parallel systems. The need for an adequate sensing and translation capability pattern recognition (any automated detection technique which could enable responses in real-time system operation) is apparent. It is anticipated that increased numbers of sensory elements able to interact with processing elements would enable a solution to enhancing pattern recognition and real-time system operation. In the Phase I portion of this project, a fabrication methodology for developing a multisensor system has been

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tested. This smart skin array technology is an innovation which would enable the physical realization of complex, sensor-based, real-time systems.

PERFECT VIEW, INC.
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RALEIGH, NC 27607
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Topic#: 88-085 ID#: 24547
Office: NAVSEA
Contract #: N00024-91-C-4026
PI: DR. A J ATTAR

Title: Fiber Optic Arrays Sensors for Toxic Gases and Fire

Abstract: Rapid and reliable detection of toxic gasses and fire can save lives and material. It is even more critical in military installations where the presence of explosives, fuels, and possibly chemical warfare materials may be imminent and the safety systems have to continue operating in stressed conditions including military confrontation, magnetic fields, etc. A fiber-optics based system can be advantageous for these purposes because of its high reliability even in magnetic fields. In Phase I we developed different coatings that change their color when exposed to NH₃, CO₂, CO, NO₂, 602, NH₃, and H₂O and quantified some of their properties. We used these coatings with low-cost optical detectors to determine the concentration of and the dynamics of concentration changes in controlled environments. In Phase II we shall continue to develop gas-sensitive chemical coatings and build a fiber-optic based integrated gas and fire detection system. The system will consist of multiple gas-sensitive probes, each containing fiber-optics coated with chromophores that are sensitive to many different gases, fiber optics as light and attenuated-light guides, and the proper electronics, computer, and software. When the system is developed, it can control many gas-sensitive probes. Each probe can be placed in a different location in an installation and be attached to the central control room via fiber optics. Such a system has the potential of being low-cost and very reliable even under demanding conditions.

PLANNING SYSTEMS, INC.
7925 Westpark Drive
McLean, VA 22102
Phone: (703) 734-3400

Topic#: 89-077 ID#: 36399
Office: NAVAIR
Contract #: N00019-91-C-0010
PI: David Woolen

Title: Chaos/Fractal Processing and Display Methods

Abstract: This program provides an innovative approach of millimeter wave (MMW) utilizing the most advanced active end game homing sensor in an augmented shared aperture mode with anti-radiation homing weapon systems. This dual mode sensor system approach will be able to penetrate the countermeasure technique such as radiation source shut down near the target area. The active MMW terminal sensor employs a common aperture two plane linear antenna array for both transmitting and receiving. The MMW antenna array is collocated with ARH spirals, mounted in an X configuration between spirals, and is compatible with either gimbed or fixed body configuration. The array provides a wide acquisition field for ARH hand-over and generates directional gain. The MMW processor utilizes smart target recognition and classification algorithms for enhanced terminal accuracy and Probability of kill. This phase of the program will provide design, development and fabrication, systems engineering and test and evaluation of a self protect weapon conceptual design utilizing a MMW seeker as a secondary seeker for an ARM.

Q-DOT, INC.
1069 ELKTON DRIVE
COLORADO SPRINGS, CO 80907
Phone: (719) 590-1112

Topic#: 90-188 ID#: 40962
Office: NSWCWO
Contract #: N60291-92-C-
PI: DAVID W GARDNER

Title: HIGH SPEED GATED DETECTOR

Abstract: There has been a growing desire to develop non-acoustic methods of performing underwater tasks which have been previously been the exclusive domain of active sonar systems. One concept of interest involves the use of a pulsed laser as the energy source in an active system. The laser is pointed at the target, and the time required for the light pulse to travel from the laser to the target and back is measured to determine the range. Light detection and ranging (LIDAR) systems based on this concept have been used for almost 20 years in atmospheric applications, but their use in underwater applications has been very limited due to their vulnerability to near-field backscatter. Q-DOT proposes a solid-state, gated-detector to be used in place of a conventional photomultiplier tube (PMT) for underwater LIDAR. In contrast to the PMT, the detector can reject huge (1,000

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to 100,00 times full scale) backscatter overloads and recover to full sensitivity as quickly as a few nanoseconds. Sharp range-gate resolution is afforded by range gates as narrow as 2 vs. initial Phase I experimentation has successfully demonstrated a simplified model of the proposed LIDAR system.

QUADRANT ENGINEERING, INC.
55 Cherry Lane
Amherst, MA 01002
Phone: (413) 549-4966

Topic#: 90-003 ID#: 41145
Office: ONR
Contract #: N00014-
PI: James B. Head

Title: Fine-Scale Measurements of Microwave Backscatter from the Ocean Surface

Abstract: Quadrant Engineering designed a unique phased array radar system during phase I of this SBIR project capable of making fine scale microwave backscatter measurements of the ocean surface. Here we propose to build and test the resulting Focussed Phased Array Imaging Radar (FOPAIR) system during Phase II. FOPAIR will be able to rapidly (less than 1 ms) image surface areas as large as 3200m with 1m pixel resolution. Such images can be obtained .100 times each second for periods as long as 4 minutes. FOPAIR can also measure backscatter from smaller areas at more frequent intervals. Consequently, FOPAIR can be applied to. (1) studying sources of ocean surface clutter, (2) understanding the processing of SAR images of the ocean and (3) scientific studies of microwave backscatter from breaking waves at near-grazing incidence angles. In this proposal we describe the radar design, its capabilities and our plans to build and test a prototype. FOPAIR data can be used by the research community for basic studies of the ocean surface.

RADIX SYSTEMS, INC.
2 Taft Court
Rockville, MD 20850
Phone: (301) 424-7410

Topic#: 89-077 ID#: 36402
Office: NAVAIR
Contract #: N00019-91-C-0020
PI: Dr. Ronald G. Hughes

Title: Multiple Dimensional Analysis of Broadband Submarine Signatures for Airborne Systems

Abstract. The major thrust of the studies proposed herein will be to develop and demonstrate an analysis system for chaotic time series that distinguishes between noise and real Soviet submarine signatures. The resulting demonstration software will be integrated into a computer architecture which is optimized for speed to compute chaotic parameters and to display results. An additional product of these studies will be a set of specifications with which to define a "real time" chaotic data analysis system for use by maritime patrol aircraft. The studies will identify characteristics in broadband submarine signatures by employing techniques developed for chaotic analyses of time series signals. In particular, additional measures of signal properties, beyond those identified in Phase I, e.g., dimension, will be exploited using algorithms to calculate the mutual information, topological entropy, and quantities related to the correlation dimension. Newly developed techniques will be used to filter data based upon chaotic properties. Measures identified in Phase I -- Grassberger-Procaccia correlation dimension, local intrinsic dimension (LID), and measures related to information quantities -- will be applied to real signatures. These measures will be tested for robustness to preprocessing, signal-to-noise ratio, signal length, sampling rate and other key parameters found during this study.

S.T. RESEARCH CORP.
8419 Terminal Road
Newington, VA 22122
Phone: (703) 550-7000

Topic#: 90-111 ID#: 40935
Office: NAVAIR
Contract #: N00019-91-C-0186
PI: DAVID RICH

Title: SIDEARM I Seeker Enhancement

Abstract. Design and build an enhanced SIDEARM I Seeker. Provide enhanced antenna system, receiver system, and digital guidance controller with +35 degree field-of-view (FOV), 3.1 frequency coverage, and guidance accuracy equivalent to current SIDEARM I.

SANDIA RESEARCH ASSOC., INC.
P.O. BOX 1545
CORRALES, NM 87048
Phone: (505) 897-4100

Topic#: 89-112 ID#: 36853
Office: NAVSEA
Contract #: N60291-92-C-0041
PI: DR. STEVEN M. SHOPE

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Prelaunch Torpedo Communications Using Electromagnetic Induction

Abstract. A wireless communications link for torpedoes or similarly-launched weapons is described in this Phase II SBIR proposal. The link is based on an innovative electromagnetic induction technique. Phase I of this project was extremely successful. A breadboard system was built and evaluated. The results showed that the induction technique is very robust and can operate at high data rates in spite of alignment errors and large link separations. Foreign objects in the path, including sheet metal and seawater, do not affect operation. The goal of Phase II is to obtain a better theoretical understanding of the link operation along with advanced prototype design and development. A set of objectives has been defined to meet this goal. Specifically, computer modeling and analysis will be used to characterize the physics of the induction link. Actual measurements will be used to validate these models. Core materials, shapes and sizes will also be investigated. The result will be a solid understanding of induction device design. The mechanical aspects will also be studied. Pressure and shock resistant designs will be developed and tested. The half-duplex mode of link communications will be further developed. This will include high-level error detection and error correction algorithms. Board-level hardware will be designed. An advanced prototype system will be constructed. A torpedo-tube and torpedo mock-up will be used to test and characterize the induction communications link. Complete system analysis and characterization will be conducted. The results of this research will be documented in monthly reports, periodic briefings, and a final report.

SAVI TECHNOLOGY, INC.

260 Sheridan Avenue
Palo Alto, CA 94306
Phone: (415) 328-4323

Topic#: 89-064

ID#: 36229

Office: NAVSUP

Contract #: N00600-91-C-1551

PI: Robert S. Reis

Title: DFTag - A Material Tracking Tool

Abstract: A system that quickly locates items and guides personnel to their exact location is proposed. This system uses an innovative radio/acoustic identification tag, called DFTag that communicates with stationary interrogator modules in order to automate the tracking of items. The result is a substantial improvement in both asset utilization and individual productivity. Assets within an instrumented environment will no longer get lost or misplaced and personnel will no longer need to search extensively to locate inventory. Previous identification technology such as barcode cannot compare to DFTag because they operate at short ranges and are read-only. Such technologies require direct human involvement in the process of finding an asset (commonly referred to as exhaustive search). A person must physically locate an item and its identification mark before the mark can be read. DFTag, in contrast, provides a means to find an asset, read its identification code and retrieve information about it from a remote computer console. No manual labor and no exhaustive search are required.

SCIENCE AND APPLIED TECHNOLOGY, INC.

8380 MIRAMAR MALL
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Topic#: 90-074

ID#: 40903

Office: NAVAIR

Contract #: N00019-91-C-0212

PI: C F BUMAN/K SHERMAN

Title: Secondary Sensor for Anti-Radiation Missiles

Abstract: Build and demonstrate secondary sensor using millimeter wave (MMW) as defined under phase I.

SEA TECH, INC.

PO BOX 779
CORVALLIS, OR 97331
Phone: (503) 757-9716

Topic#: 90-005

ID#: 41147

Office: ONR

Contract #: N00014-91-C-

PI: J RONALD ZANEEVELD

Title: DEVELOPMENT OF AN EXPENDABLE PARTICLE SENSOR

Abstract. The purpose of this research is to develop an expendable sensor that allows the rapid determination of suspended particle concentrations in natural marine environments. At present there exists no method for near-synoptic measurement of particle distributions, yet the three-dimensional particle distribution and its temporal development are of major significance to every oceanographic discipline. During Phase I we built and tested forward scattering sensor at 880 nm wavelength. In Phase II we propose to miniaturize the electronics and to integrate the sensor into an expandable delivery device and multifunction processor to be developed by Sparton. We propose to field test the first 24 expendable particle-temperature sensors within one year after initiation of the contract. After two years, we will have completely tested the sensor design, sensitivity, and accuracy

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as well as the communication electronics and software.

SIERRA MONOLITHICS, INC.
107 W. TORRANCE BLVD.,
REDONDO BEACH, CA 90277
Phone: (213) 379-2005

Topic#: 89-183
Office: PMTC
Contract #: N00123-91-C-0396
PI: DR. B. Y. LAO

ID#: 37699

Title: Octave Bandwidth Digital Phase Shifter and Doppler Module

Abstract: A compact Doppler simulator module is proposed for the phase II effort using digital frequency synthesis techniques providing frequency and phase shift capabilities with an octave bandwidth from 5.3 to 10.5 GHz. Several alternate approaches have been studied in Phase I. The proposed approach provides the best frequency ability and performance. A breadboard module has been successfully built and tested to demonstrate the feasibility of the approach. Excellent test results have been obtained. The breadboard shows better than 40 dB rejection of carrier and close in spurs. The frequency resolution for Doppler shift is .007 Hz with a dynamic range of +/- 2 MHz. In addition, phase shift with 3-bit resolution is also possible at a 20 KHz rate. For the Phase II effort, the Doppler module will be redesigned to satisfy system performance specifications in terms of temperature and frequency stabilities, power, volume, and size requirements, Doppler bandwidth, Doppler techniques, and system control interfaces for application in airborne systems requiring self protection techniques.

SPARTA, INC.
9455 TOWNE CENTRE DRIVE
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Topic#: 90-174
Office: NSWCWO
Contract #: N60921-92-C-0033
PI: R. DANIEL STEVENSON

ID#: 39802

Title: Particulate Reinforced Magnesium for Missile Components

Abstract: Present and future generation Navy missiles and other structures require metal matrix composite (MAG) materials with properties tailored for uses which require low density, low (MMC), and high isotropic thermal conductivity. During the Phase I program the feasibility of fabricating a particulate reinforced magnesium alloy that meets these property requirements was demonstrated. Test results included an increased thermal conductivity of 53%, and a decrease in CTE of CTE31% below the matrix alloy. The density of the MAG material was 18% less than aluminum. The Phase I composite properties were obtained with 25% volume loading. Substantial thermal property improvements are expected at higher loadings. During the proposed Phase II program the material and processes will be further developed and optimized. Both magnesium and aluminum matrices will be developed and demonstrated. A selected Naval component will be fabricated from this innovative MMC material and tested to demonstrate its advantages over presently utilized materials. A variety of tests including CTE, thermal conductivity, tensile strength, shear strength, and flexural strength will be conducted to generate preliminary properties for design. Different grades of the particulate will be investigated as well as particulate coatings to improve the material producibility and the reproducibility of the resulting thermal and mechanical properties.

SPRINGBORN LABORATORIES, INC.
10 SPRINGBORN CENTER
ENFIELD, CT 06082
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Topic#: 89-191
Office: NCEL
Contract #:
PI: ROY A. WHITE

ID#: 37775

Title: Further Development on Joint Sealants for Concrete Airfield Pavements

Abstract: Effective sealing or resealing of joints in PCC runways for military aircraft is an old and on-going problem. Many of the presently used materials are deficient due to attack by fuel and hydraulic fluid, melting/trailing on exposure to jet engine blast, loss of adhesion to pavement, especially at low temperatures, etc. During Phase I of the proposed program, Springborn demonstrated the feasibility of an epoxy-cured nitrile rubber-based sealant. This material shows good resistance to JP-5 and other chemicals, as well as jet engine blast, and has good adhesion and flexibility at temperatures as low as -20 degrees F. The Phase II effort will concentrate on refining the base formulation for wet adhesion and UV resistance, identifying/ developing meter/mix/dispense equipment for field installation of seals, field testing, analyzing the manufacturing costs, and modifying test specifications for use in Q.A.

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STRUCTURAL COMPOSITES, INC.
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Topic#: 88-073
Office: NAVSEA
Contract #: N61533-91-C-0017
PI: ERIC GREENE

ID#: 24635

Title: Fire Performance of Composites Materials in a Submarine Environment

Abstract: The Performance benefits of Composite Materials aboard Naval Submarines have been recognized by the Navy. The potential for weight and signature reduction, coupled with Advantageous Structural, Electromagnetic and Corrosion Resistance Properties, have been a driving factor in the composites development effort. Additionally, production and life cycle costs for many systems potentially can be reduced. Physical performance characteristics are beginning to be understood quite well, even in a marine environment. Along with the extensive test programs that have occurred in the Aerospace Industry, much empirical data is available from the use of composites on naval vehicles over the past three decades. Composites have traditionally been used for external components. However, the introduction of composites to the numerous applications within the submarine will require the investigation of performance criteria. The impact of composites upon their operating environment has been the subject of structural Composites, Inc.'s phase I effort. This not only includes offgassing properties under normal operating conditions, but also performance at elevated temperatures and in fires. Phase I investigations determined that the performance of composites in a fire scenario presents the greatest composite material risk to the submarine and its crew and thus represents the area where future research should be concentrated. Organic matrix composite materials burn when exposed to intense fires, such as those fed by pools of highly flammable liquids. A need exists to assess the fuel load.

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

Topic#: 90-153
Office: NAVSEA
Contract #: N00024-92-C-4012
PI: DR. GREGORY D. GIBBONS

ID#: 41250

Title: THE USE OF ARTIFICIAL INTELLIGENCE IN SURFACE SHIP TORPEDO DEFENSE

Abstract: Surface Ship Torpedo Defense (SSTD) requires timely detection, classification and localization of threat torpedo acoustic signatures. The AN/SLR-24 system currently under development using VME hardware architecture, will collect acoustic data from the towed array, do beamforming, FFTing, and filtering to alert the operator to possible torpedo signatures. Phase I of SCT's SBIR program, SBIR N-90-153: The Use of Artificial Intelligence to Torpedo Defense, successfully demonstrated that spectral data produced in the AN/SLR-24 system could be used to produce high quality detection, classification and contact management. In addition, the Phase I work produced a software system, TES (Torpedo Expert System), which implements a number of these functions. The Proposed Phase II will result in a complete implementation, TES II. TES II will provide reliable classification of threat torpedoes earlier in the data stream than will the AN/SLR-24. In addition, TES II will offer improved false alarm performance, reduced operator workload, and other benefits of automation. This will be the first system to be able to operate on real data, in real time, in conjunction with a deployed sonar system. And it will be implemented in a deployable hardware configuration, already integrated with the SLR-24.

TECHNO-SCIENCE, INC.
7833 Walker Drive, Suite 620
Greenbelt, MD 20770
Phone: (301) 345-0375

Topic#: 89-014
Office: ONT
Contract #: N66001-91-C-7017
PI: Lee M Garth

ID#: 37335

Title: Detection Techniques for Acoustic Non-Gaussian Signals

Abstract: Recent developments in submarine design have greatly reduced the level of narrowband acoustic signals that have traditionally been exploited by passive sonar system. This emerging scenario mandates the development of increasingly sensitive detection techniques to allow for the exploitation of these signals, as well as new techniques to allow for the exploitation of different types of signals (transient, broadband, etc) to a degree that was not necessary in the previous generation of system. This development will require the application of the most sophisticated detection-theoretic principles applicable within the framework allowed by the specific detection scenario of interest. The objective of this study is to develop and evaluate innovative algorithms for array detection to meet this need. This development will be based on the use of multidimensional linear-process models for non-Gaussian acoustic signals in hydrophone arrays. Specific products of this Phase II study will be a set of tractable non-Gaussian multidimensional statistical models for the signals of interest in underwater hydrophone arrays, a group of optimum, near-optimum, and polyspectral-based algorithms for non-Gaussian signal detection based on these models; and a

NAVY ABSTRACTS OF FY91 SBIR PHASE II AWARDS

performance evaluation of the proposed algorithms on both simulated and sanitized operational data.

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SALT LAKE CITY, UT 84108
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Topic#: 88-250 ID#: 24103
Office: NATC
Contract #: N00421-91-C-0199
PI: JIAN-JUEI WANG

Title: Fully Three-Dimensional Modeling of Fatigue Failure of the Helicopter Gearboxes

Abstract: An accurate fatigue life prediction for helicopter gearboxes requires a dependable method or methods for defect detection and measurement, an understanding of the cause and character of propagation mechanisms, and appropriate modeling of applicable fatigue failure mechanisms. Under the SBIR Program Phase I, the feasibility of an approach to the problem was evaluated. The work successfully detailed the construction of a computer software package to perform fatigue life prediction, knowing defect size, type and location. To meet the overall program objectives the Phase II effort needs to build on the Phase I results. Specific objectives of Phase II are to model spalling fatigue for a fully three-dimensional stress field due to contact loading of an elliptical shape. The von Mises failure criterion will be adopted and coupled with fatigue life prediction in modeling the spalling process. The deliverable product will be a "user friendly" FORTRAN software package which will allow input of defect information at various stages of fatigue, ranging from micro-defects to small spalling, leading to prediction of the remaining fatigue life.

TEXTILE TECHNOLOGIES, INC.
2800 TURNPIKE DRIVE
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Topic#: 88-096 ID#: 24768
Office: NAVSEA
Contract #: N00164-92-C-0020
PI: T. EBERSOLE

Title: Passive Thermal Management Through the Use of Ultra-High Thermal Conductivity Fibers

Abstract. The key to the success of existing and proposed future electronic systems is the effective management of thermal loads. Future electronics will have greatly increased gate densities and correspondingly increased thermal loads. Industry guidelines indicated that for current systems technology operated over military temperature ranges, an increase in electronics system reliability of up to 40% can be achieved with a 10 degree C reduction in junction temperature. This Phase II effort is directed towards the further development advanced organic matrix composites for use as thermal frames and constraining cores. In the Phase I effort, TTI successfully produced and tested organic matrix heatsink materials using Amoco's ultra-high thermal conductivity graphite fibers with both thermoplastic and thermoset matrices. Thermal conductivities in excess of 470 Watts/Meter degree K were measured. Having shown the feasibility of producing such high performance, light-weight, low CTE materials in Phase I, the Phase II effort will exploit these materials by working closely with leading electronics firms to design, fabricate and test advanced thermal frame and constraining core materials based upon the success of Phase I.

THE IMAGINATION WORKS
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Topic#: 89-155 ID#: 36065
Office: NSWCWO
Contract #: N60291-91-C-A330
PI: STEVEN M. CASSELMAN

Title: Nanocoded Hardware as a Means to Solve Hierarchical Decomposition Problems

Abstract. Chameleon uses nanocoded instruction sets to completely reconfigure a matrix of Xilinx Logic Cell Array (LCA) gate array devices using custom routing ASICs. This enables the user to completely reconfigure the hardware at the gate level to match the needs of the innermost software loops, which account for all the software performance. In an instant, the hardware becomes the algorithm that needs implementing, since software no longer has to fetch an instruction for each execution, some phenomenal throughput gains are indicated. A prototype machine housed on ribbon-connected IBM-PC/386 boards will prove the concept. Logic synthesis began with microcoding and with Chameleon the work can continue down into the realm of nanocoding reconfigurable hardware.

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400 RIVER RIDGE DRIVE
ELGIN, IL 60123
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Topic#: 89-172 ID#: 37604
Office: NADC
Contract #: N62269-92-0517
PI: RICHARD BUCK

Title: LONG FOCAL LENGTH SURVEILLANCE SYSTEM DEVELOPMENT

Abstract: A need exists for a long focal length, small, low cost sensor that can be operated beyond threat or visual detection range. A Phase I SBIR effort was conducted to determine the feasibility of a sensor capable of operating from a helicopter or unmanned vehicle. The study concluded that such a system was feasible based on vendor supplied data. The program described in the proposal offers a cautious approach to the development of the system. A three phase effort is proposed that provides check points along the development path. The first phase addresses the high technical risk critical components. The second phase provides detailed design alternatives that weigh size, weight and cost against performance. The final phase fabricates a flyable system and tests the system through flight test. Key to the success of the program is a unique low cost three level stabilization system which will be evaluated in the first phase of the effort.

UES, INC.
4401 Dayton-Xenia Road
Dayton, OH 45432
Phone: (513) 426-6900

Topic#: 90-010 ID#: 40825
Office: ONR
Contract #: N00014-
PI: Peter P. Pronko

Title: Monolithic Integration of DBR Lasers by Focused Ion Beam and High Energy Ion Implantation

Abstract: The objective of this research proposal is to fabricate Distributed Bragg Reflector (DBR) gratings in an AlGaAs/GaAs superlattice by Focused Ion Beam (FIB) processing and to use this technology to monolithically integrate a DBR quantum well laser with a passive waveguide. The FIB technique involves the selective mixing of the superlattice by silicon ions in such a manner that the grating consists of alternating lines of superlattice and homogeneous AlGaAs. This technique requires an annealing cycle to enhance mixing and to remove radiation damage. The selectively processed layer consists of alternating indices of refraction with a period which determines the lasing wavelength. Investigations will be carried out to determine the optimum FIB and annealing parameters for processing well resolved, laser compatible gratings. Selective partial mixing of the quantum well by high energy silicon implantation will be developed so that the quantum well can be used for both the active region of the laser and the passive waveguide. High energy oxygen implantation will be used to electrically isolate and optically confine the stripe geometry laser and integrated waveguide. The planarity of the proposed laser structure makes it attractive for Integrated Optoelectronic Circuit (IOEC) applications.

UFA, INC.
335 BOYLSTON STREET
NEWTON, MA 02159
Phone: (617) 964-5172

Topic#: 88-053 ID#: 22277
Office: NAVSUP
Contract #: N00600-91-C-2537
PI: ARTHUR GERSTENFELD, PhD

Title: PREPROCUREMENT AUTOMATION PROCESS

Abstract: A program will be written to tap into current data banks and to automate the information retrieved. Specifically it will help to categorization item for which a stock number does not exist, call attention to inconsistent or incomplete data concerning an item, and will combine available sources of information to provide a comprehensive report on a data item. The program will be installed at a Navy-specified stock point and inventory control point.

VIASAT, INC.
6120 PASEO DEL NORTE
CARLSBAD, CA 92009
Phone: (619) 438-8099

Topic#: 91-025 ID#: 14357
Office: NAVAIR
Contract #: F19628-91-C-0150
PI: MARK DANKBERG

Title: Command, Control, and Communication (C3) Systems/Subsystems

Abstract: This proposal describes an SBIR Phase II program to design, build, and demonstrate a prototype multi-function UHF DAMA Stacom modem for airborne and other weight/volume sensitive applications. We propose to add extended 25 khz TDMA/DAMA capabilities to the VM-100 (previous Phase II program), in addition to adding an embedded secure voice capability. We also propose to work to produce a viable solution to the TDMA-I ranging problem for dynamic platforms. The

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overall goal of this program is to develop a miniature modem that provides compatibility with DoD TDMA/DAMA waveform standard for 25 khz UHF satellite channels, and to embed critical functions for users of this waveform. The goal of the ranging work is to formulate and also prove and demonstrate the effectiveness of our solution to the problem.

XINOTECH RESEARCH, INC.
1313 FIFTH STREET S.E.
MINNEAPOLIS, MN 55414
Phone: (612) 379-3844

Topic#: 90-274 ID#: 41020
Office: NOSC
Contract #: N66001-92-C-7004
PI: ROMEL RIVERA

Title: Tools to Assist in Modification and Reuse of Ada Software

Abstract: Xinotech has researched and developed commercial technology for a language-based, language-independent, grammar-generated interactive programming environment instantiated for Ada, CMS-2 and other languages. The objective of the proposed research is to use this technology as a framework to maximize the reuse of Ada software. The new environment will 1) assist in the understanding of Ada programs, 2) provide an object-oriented methodology conducive to reuse, 3) predict the reusability effort, and 4) automate aspects of the reorganization, modularization and modification of Ada software. This (1) will produce the Graph Analyzer to display Ada object relationships, a Semantic Browser, an Outliner, and an Ada PDL Abstractor, (2) will combine these tools with others to produce multi-platform APSE's supporting the leading methodologies, (3) will produce the Guideline and Metrics Analyzer to predict reusability and automate conversion of Ada software to standards, and (4) will produce the Object Abstractor to automatically reorganize Ada code to reflect object structures. These tools will be open systems with immediate commercial availability.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

ACCURATE AUTOMATION CORP.
1548 RIVERSIDE DR - STE B
CHATTANOOGA, TN 37406
Phone: (615) 622-4642

Title: EMERGING TECHNOLOGIES RESULTING IN LIGHTER AIRCRAFT WEIGHT INCREASED ENGINE PERFORMANCE (ISP) AND IMPROVED DESIGN TOOLS
Abstract: Not available for publication

Topic#: 90-192 ID#: 39813
Office: AFSC/NAS
Contract #: F33657-92-C-2008
PI: ROBERT M PAP

ADVANCED DECISION SYSTEMS
1500 Plymouth Street
Mountain View, CA 94043
Phone: (415) 960-7300

Title: Evidence Accrual ADS

Abstract: Successfully applying model-based reasoning to real world vision problems (e.g., Automatic Target Recognition (ATR) requires accurate representation of complex relationships among things in the world and observable image features. Evidence accrual techniques must be able to operate over these relationships with little loss in information. Current techniques such as Bayesian Networks promise, but have some limitations in the nature of the relationships they can easily represent. Binary Constraint Systems to be a strong candidate for supplementing this or other evidence accrual schemes. The proposed effort will investigate and develop techniques for parameter estimation and evidence accrual using binary constraint systems. This development will take place on the SARES testbed.

Topic#: 90-083 ID#: 39839
Office: WL
Contract #: F33615-91C-1794
PI: DR. ROBERT FUNG

ADVANCED RESEARCH & APPLICATION CORP.
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Phone: (408) 733-7780

Title: RADIATION-HARD ANALOG INTEGRATED CIRCUIT DEVELOPMENT

Abstract: ARACOR proposes to develop for the United States Air Force a new microelectronics design and fabrication process that will support the manufacture of radiation-hard analog devices and circuits. The basis for this development will be an innovative isolated-substrate technology known as bond-and-etchback silicon-on-insulator (BESOI), complemented by a new technique for fabrication of lateral bipolar analog circuit components. The results of a successful Phase I project support a presumption that the manufacture of high-performance, radiation-resistant analog circuits by these complementary technologies is feasible. The proposed Phase II project will develop and experimentally evaluate the two key design tools used in the manufacture of high-performance analog integrated circuits: a "process architecture" which specifies the means by which individual circuit components are fabricated, and a "design rule set" which specifies the manner in which components are integrated to form a functional circuit. Phase II experimental evaluation of the besoi/lateral bipolar device technologies will confirm the accuracy with which the process architecture and design rule set simulate electronic device performance at the component and circuit levels, and will substantiate our claims of improved radiation hardness for analog circuits fabricated by the innovative technologies.

Topic#: 89-219 ID#: 32625
Office: PL/BMO
Contract #: F04704-91-C-0011
PI: DR ALVIN A MILGRAM

ADVANCED RESEARCH & APPLICATION CORP.
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SUNNYVALE, CA 94086
Phone: (408) 733-7780

Title: AUTOMATED IMAGE ANALYSIS OF SOLID ROCKET MOTORS

Abstract: Modern Air Force CT systems are capable of generating more than a gigabyte of inspection data per day and seriously overloading the review and evaluation process of critical weapons systems. Phase I established the validity of two important observations: 3D display and analysis of CT solid rocket motors (SRM) images is far more efficient than 2D viewing; and some SRM defects can only be detected and understood with 3D methods. The Phase II effort proposed to develop a strategic motor aging and reliability tomographic (SMART) workstation expressly for the purpose of monitoring the U.S.'s Minuteman force. The SMART workstation will permit Minuteman CT data to be presented in 3D format to facilitate the study and assessment

Topic#: 89-227 ID#: 32706
Office: PL/BMO
Contract #: F04704-90-C-0074
PI: J W COPELAND

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of aging defects. In particular, a unique set of SRM-specific modules will be developed for inspecting the insulation/liner/bond interface, the bore surface, and the bulk propellant. With the aid of powerful 3D and stereo display techniques, the SMART workstation will be able to communicate quickly-and quantitatively--to the reliability engineer complex as-built information, greatly accelerating the understanding of aging phenomena. The proposed workstation also provides an elegant platform for the development of an SRM aging data base, an important step in achieving "digital logs" for all SRMs.

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Topic#: 90-173 ID#: 39781
Office: PL
Contract #:
PI: HARVEY E. PECK

Title: Kissing Debond Detection in SRMs

Abstract. The objective of this program is to establish the theoretical and experimental image processing basis for determining the integrity of solid rocket motor propellant systems from CT images of applicable propellant systems. Applicable propellant system will be those solid state propellant system that contain aluminum (A1) and ammonium perchlorate (AP) particles and exhibit measurable dilatation, i.e., the formation of small vacuoles adjacent to the A1 or AP particles in the composite propellant under an imposed strain. The magnitude and direction of dilatation will be characterized by image processing techniques and the strain level will be inferred from this measure. Determining bond integrity and propellant grain integrity will be accomplished by monitoring the strain near the bonds and near the bore fins. ARACOR shall develop and evaluate an inspection technique as a useful tool to detect and quantify strain level in MINUTEMAN propellant from CT image. The deliverables will be a written final report that will detail the theory, approach, and capability of this advanced inspection technique

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Topic#: 89-125 ID#: 33249
Office: WL
Contract #: F33615-91C-5622
PI: DR. JEREL A. SMITH

Title: Improved High-Resolution X-Ray NDE

Abstract: All of the goals set for the Phase I program were achieved. The PH I effort established three important results: (1) the optimal X-ray converter for an advanced high-resolution detector is currently an improved scintillator-loaded fiber-optic material not previously available, (2) charge-coupled devices (CCDs) offer major performance advantages over current Reticon technology; and (3) CCD 2D-array geometries permit important performance serendipities, including dual-energy and enhanced-contrast-sensitivity scan modes. The PH II program proposes to develop and install on the existing high-resolution CT system at Wright Research and Development Center (WRDC) an advanced X-ray detector incorporating improved scintillator material and CCD-array technology. The result will be faster scan, improved image quality, and increased inspection flexibility. The proposed innovations will yield major cost savings during Ph III manufacture and are more suitable for use with high-energy X-rays than present technology. They also support the future inclusion of two new scan modalities, variable dual energy and adjustable contrast sensitivity. Together, these improvements will make high-energy, high resolution CT imaging a highly attractive--and practical--NDE option.

AIREX CORP.
Route 16
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Phone: (603) 742-3703

Topic#: 90-172 ID#: 39779
Office: PL
Contract #: F04704-91-0041
PI JAMES C. SEDGEWICK

Title: Automated Manufacture of Small Electric Motors

Abstract: This Phase II proposal provides for three distinct efforts. Task A provides final documentation of the prototype winding machine developed in Phase I and adapts that machine to the SFIR/TGG Magnetic Suspension components. This effort will determine the adaptability of this machine to additional components and to alternative future applications. Task B provides for modification of a second Airex winding machine to achieve automation of the SFIR Torque Motor Stator. A successful program to develop this capability is very likely to result in implementation of automated techniques to the production floor. Task C is an effort to design and build a new machine for super small components such as the SFIR Motor Stator. No alternative mechanized means is currently available to wind super small components of this type. The further development of

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technology to wind complex components would serve many current and future production needs for high reliability systems. SFIR, the Navy 10 PIGA guidance system and the Minuteman MOD G system have immediate applications for such technology.

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Topic#: 89-034 ID#: 31681
Office: ESD
Contract #: F19628-91-C-0005
PI: DR THOMAS KURIEN

Title: E-3 SENSOR DATA FUSION ALGORITHM

Abstract: The goal of this SBIR program is to design and develop an advanced fusion algorithm which is capable of satisfying current and future surveillance mission requirements of the E-3 Airborne Warning and Control System (AWACS). During the Phase I effort, we developed a prototype model-based fusion algorithm capable of tracking and identifying multiple targets using radar, IFF, and ESM sensor measurements. The model-based approach enables the fusion algorithm to combine all relevant sensor information to develop a unified surveillance picture. It also parameterizes sensor characteristics so that either changes in existing E-3 sensor characteristics or the addition of new sensors to the E-3 sensor suite can be accounted for by changes in the parameter database rather than changes in the algorithm. Heuristic parameters in the fusion algorithm control the tradeoff between performance and warred requirements and, consequently, these parameters can be set to fully utilize the available capabilities of either the current 4TT/CC-2E computer or an enhanced computer on board the E-3. The goal of the proposed Phase 2 effort is to demonstrate the fusion algorithm with real E-3 sensor data and deliver the prototype fusion system to the Air Force. During this effort, we also will interface the fusion algorithm with the testbed developed by the Air Force and refine the man-machine interface in the prototype fusion system to satisfy the requirement of E-3 1 surveillance operators.

AMERICAN GNC CORP
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Topic#: 90-001 ID#: 39674
Office: WL/EGLIN
Contract #: F0863091C0055
PI: DR CHING-FANG LIN

Title: High Performance, Adaptive, Robust Missile Autopilot Design

Abstract: An innovative, synergistic autopilot procedure is developed in this high performance, adaptive, robust bank-to-turn autopilot contract. Evolved from the GSLQ approach of Phase I study, this synergistic design procedure addresses parametric insensitivity (GSLQ), noise reduction (H2), and robust stability (H ∞) simultaneously. The autopilot of the advanced missile is designed using this synergistic procedure together with design insights observed through other tangible methods such as quadratic stabilization, robust eigenstructure assignment, (n) synthesis, and quantitative feedback theory and design limitations derived via nonlinear analysis. The resulting autopilot is robust against parasitic effects, adaptive with respect to flight condition changes, compatible with other subsystems, and deadbeat in its command responses. Parallel to the development of the synergistic procedure and the design of missile autopilot, a missile application-specific computer-aided control system design (ASCACSD) package is developed. This user-friendly, menu-driven ASCACSD package incorporates a missile design knowledge base and features a set of missile design algorithms. A comprehensive missile simulation program is also developed to verify the autopilot design. The simulation program is generic, modularized, and compatible with the ASCACSD package. The performance of the designed autopilot is then quantified by extensive simulations.

AMHERST SYSTEMS, INC.
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Topic#: 88-146 ID#: 26993
Office: WL
Contract #: F33657-90C-2120
PI: Mr Cesar Bandera

Title: New Concepts and Innovations for Aeronautical Systems/Subsystems Suppressor Environment Characterizer

Abstract: This 18 month, Phase II project will implement the SUPPRESSOR Environment Characterizer. The system will cover all facets of RF environment characterization, from scenario generation to report production. A three step approach will be used, consisting of scenario generation, environment generation, and environment characterization. The project will make extensive use of off-the-shelf software, minimizing cost and associated risk. The end result will be a software product that is efficient and easy to use, and will meet current and anticipated Air Force requirements for environment characterization.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-111 ID#: 39866
Office: WL
Contract #: F33615-91C-5654
PI: DR. B. LASKOWSKI

Title: Theoretical Chemistry Studies of Conducting and Nonlinear Optical Polymer Systems

Abstract: Theoretical chemistry techniques are used to provide fundamental understanding of the molecular requirements for achieving non linear optical or intrinsically conductive properties in organic and semi-organic polymer systems. The theory employs time evolution of a many particle wave function determined from the time dependent variational principle. The key difference with previous treatments is that we consider the full electron-nuclear dynamics without ad hoc use of the Born-Oppenheimer approximation. Linear response of a molecular system is used to obtain a direct expression for the conductivity tensor. The conduction mechanism is deduced by calculating the conductivity tensor directly and analyzing the different contributions to the quantity. Novel approaches to calculating propagators make possible a direct consideration of the conductivity tensor. Non-linear response theory (quadratic, cubic, ...) allows for the calculation of the second hyperpolarizabilities. The methods used can yield these properties for all frequencies. Post processing software gives a graphic visualization of the results in order to clarify structure property relationships. Phase II extends the software-extended systems using chemical oriented semi-empirical models based on the Ph I theoretically validated code for small molecules and ab initio integrals. Ph I also showed that it will be feasible to perform semi-empirical calculations over time spans comparable to the duration of experiments. Thin films using Langmuir-Blodgett techniques will be made based on resulting software design rules and vice versa allow for further experimental validation of the software for its use in Phase III efforts.

ANALYSIS CONSULTANTS
21831 Zuni Dr
El Toro, CA 92630
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Topic#: 90-134 ID#: 39742
Office: PL
Contract #: F29601-91-C-0073
PI: DR. B. G. MARTIN

Title: Radiation Discriminating, Impurity-Band-Conduction LWIR Photodetectors

Abstract: The innovation proposed here is the development of a new type of radiation-discriminating, long-wavelength infrared (LWIR) detector based on impurity-band-conduction (IBC). This new configuration shows promise for discriminating between gamma-ray and LWIR radiation. Conventional IBC photodetectors have the problem of injected dark current which greatly limits their use for radiation discrimination. For the device design proposed here, the use of a double-barrier quantum well (DBQW) structure is proposed as the means for blocking unwanted electron injection, but allowing for electron readout via resonant tunneling. The storage and subsequent readout of ionized donors enables one to discriminate between gamma and LWIR events. Phase I results have shown the theoretical feasibility of the proposed design. The objective of Phase II would be to demonstrate experimental feasibility by successful device fabrication and testing.

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Topic#: 89-111 ID#: 33630
Office: WL
Contract #: F33615-91C-3408
PI: DR. NISAR SHAIKH

Title: Ultrasonic Nondestructive Techniques and Instrumentation for Transparent Enclosures of High Perform A/C

Abstract: The feasibility of the Ultrasonic Surface Wave technique for transparent enclosures was successfully demonstrated in the Phase I effort. These results can be considered as the needed breakthrough and strongly motivate the next phase of extensive research and development, leading to the commercial availability of products and techniques for nondestructive evaluation needed by the USAF, the DOD and civilian industries at large. Though the Phase I efforts were concentrated for the specific problems of stress measurements and detection of crazes in the top sheet, the Phase II research would have much broader scope. It would be applicable to many other aspects of transparency durability, for example, Coating Degradation, Delaminations and Stress Concentration (round cracks). The surface wave transducers devised in Phase I would be improved, reduced in size and would be modified to generate Lamb waves. In addition surface acoustic microscopy made possible by phase I results would be pursued by developing novel dry contact acoustic lenses (transducers). The application of this research to structural composites should be of great benefits to the USAF. The second major component of research would be to develop portable instruments for field of use. These instruments would use state-of-the-art digitizing and computer components to create a new class of low cost ultrasonic instruments. A complete portable Nondestructive Evaluation System would be constructed

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and made available to the USAF for field demonstration and testing. The commercial potential is high since there is a lack of viable nondestructive stress measurement technique.

ANAMET LABORATORIES, INC.
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Topic#: 89-102 ID#: 33549
Office: WL
Contract #: F33615-91C-3200
PI:

Title: Prediction of Flutter in Panels Made from Advanced Composite Materials

Abstract: The objective of the proposed Ph II research is to develop computational programs for the prediction of nonlinear flutter (aeroelasticity) in panels made from low-temperature polymer matrix materials such as graphite/epoxy in Kevlar/polyester used in aircraft primary and secondary structures, and radomes and high-temperature capability materials for use on supersonic/hypersonic vehicles (NASP). The structural and material models, defined during Ph I research, effectively model complex phenomena including nonlinear geometry (large deformations), nonlinear material behavior (in plane and in the matrix), transverse shear, curvature in two directions of the structure, damping, and thermal heating. The aerodynamic models include extended nonlinear piston theory for supersonic/hypersonic flow with subsonic/transonic flow treated by allowing the structural/material modules to interact with full-fledged CFD codes, thus permitting state-of-the-art aerodynamic modeling to be used with high fidelity structural/material models. Of extreme importance to the Air Force is Anamet's intention to implement these numerical models on a low-cost transputer-based personal computer (TPC) system capable of performing at the rate of 20 Mips. At the option of the Air Force, the TPC can be a deliverable item as a part of Phase II effort. This would give the Air Force the capability to perform advanced state-of-the-art nonlinear flutter calculations without reliance on a mainframe computer system.

APPLIED ANALYSIS, INC.
45 Manning Road
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Phone: (508) 663-6828
Title: Target Detection

Topic#: 91-025 ID#: 91ESD-560
Office: ESD
Contract #: F19628-91-C-0005
PI: Dr. Robert L. Huguenin

Abstract: Applied Analysis Inc has developed a new data processing technology that when used in conjunction with multispectral sensors can provide much higher target acquisition performance than current implementations can achieve. The characteristics and demonstrated performance of the Applied Analysis Spectral Analytical Process (AASAP) appear to be ideally suited for providing the level of object discrimination performance needed for signature extraction of targets from multispectral imagery and then detecting multiple occurrences of the materials of interest. It promises to provide higher levels of detection than prior art capabilities due to the ability to detect targets that are sub-pixel in size. It should provide stronger discrimination against clutter, based on its stronger clutter discrimination capability than those of prior art technologies. The demonstrated robustness of AASAP against variation in background conditions may also prove essential for handling battlefield as well as area surveillance scenarios.

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Topic#: 90-001 ID#: 39684
Office: WL/EGLIN
Contract #: FY7621-91-C-0048
PI: WILLIAM L HACKER

Title: Simply-Coupled Penetration Analysis System Research and Development

Abstract: The objective of this effort is to assemble a software system which will perform cost-effective weapon response calculations for concrete penetration events. Phase I showed that the approach of using PENCO-3D loading equations as boundary conditions for a finite element model of a weapon to calculate the response was feasible. Phase I also pointed out that the loading equations required refinement in certain areas and that various portions of the analysis can be automated. Therefore, this effort will produce the necessary loading refinements and incorporate them into an automated software system which weapon and fuze designers can use for design trade studies and preliminary design verification. Also, test cases for the various applications of the software will be run to determine its suitability to those areas.

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Topic#: 90-001 ID#: 39780
Office: WL/EGLIN
Contract #: F08630-91-C-0052
PI: DR LEONARD E SCHWER

Title: A Rapid Aero-shape Generator (RAGE)

Abstract. This Phase II work proposed herein will develop and deliver a completely tested "Rapid Aero-shape Generator" (RAGE) software package that will help determine and display 3-D, optimal, geometric aero-shape designs and analysis results. This work will include capabilities to: generate a family of aero-shapes that have identical aerodynamic coefficients to include wings and control fins, uniformly shrink geometries to automatically create shell geometry definition and solid rocket motor burn surfaces, plot 3-D missile trajectories and related data, find the intersection of surfaces, translate data between the ASD/XRHI database and the MOVIESTAR database, develop an F-16 model in the MOVIESTAR database format, and provide computer hardware and RAGE software compatibility. Two optimal tasks are proposed that will provide the capabilities to: 1. allow shape optimization capabilities to handle subsonic (and possibly transonic) aerodynamic bodies, and 2. use improved MOVIESTAR, CALIPER, PACKER software to complete physical fit compatibility studies of weapons on aircraft.

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Topic#: 89-137 ID#: 33770
Office: WL
Contract #: F33615-91C-5703
PI: DR. FRANK M. BROWN

Title: Epistemic Planning for Management and Manufactures

Abstract. The long term objective of this project is to develop and implement a general self-extensible knowledge based reasoning technology specifically targeted for use in comprehensive manufacturing and management operations systems. This technology should provide manufacturing and management operations systems with an automated reasoning mechanism for inferring the potential consequence of actions and for planning sequences of manufacturing and management operations to achieve specific organizational goals.

ASTRON CORP.
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Topic#: 88-030 ID#: 28541
Office: ESD
Contract #: F19628-91-C-0085
PI. JOSEPH R JAHODA

Title: CONFORMAL HF BROADBAND AIRCRAFT ANTENNA

Abstract: Presently, HF communications for the C-130, C-141, KC-135, C-5, C-17, and P-3 aircraft are, for the most part, maintained by a "Long Wire" antenna that is connected to the fuselage behind the cockpit and the leading edge of the vertical stabilizer. This wire, over 60 feet long, represents a threat to flight safety, despite numerous precautions that have been taken. The HF communications system moreover, consists of the long wire, a transmitter and a coupler/tuner, the latter of which is used to "match" the antenna characteristics to the frequency being broadcast or received. Older couplers/tuners tended to be slow and somewhat prone to failure. Newer compilers/tuners have decreased tuning time dramatically but still represent an additional component that decreases overall system reliability and availability. Were methods available to change frequencies without a coupler/tuner and without degrading system performance, reliability, performance and life cycle costs would all be improved. The Astron proposed aircraft antenna system is an easily added, conformal antenna which obviates the above disadvantages by eliminating the coupler and the Long Wire antenna. Very significant improvement in reliability and maintainability will result in a large reduction of the life cycle cost due to the elimination of the antenna high power coupler. During Phase I, a Broadband Conformal Antenna/Matching Network was constructed and tested on the Astron Aircraft Simulator with excellent results. During Phase II, a prototype will be constructed and tested.

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Topic#: 89-213 ID#: 32582
Office: PL/BMO
Contract #: F04704-91-C-0005
PI: T CRAIG DERBIDGE

Title: BOOSTER ACCELERATION OF INSULATOR EROSION

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Abstract: Data from recovered solid propellant rocket motors have convincingly shown that more charring/erosion occurs on forward-dome insulation during flight than in static firing. This flight amplification problem increases the complexity of the rocket motor design process, especially for future systems with high acceleration. Phase I successfully demonstrated a laboratory test approach enabling independent variation of each parameter affecting insulation charring/erosion, and direct observation of the material response. Phase II will extend this test method by using a laser to provide higher heat transfer levels and a centrifuge for constant acceleration loading. Material response will be recorded with a video camera and optical pyrometer. Tests using this method will result in improved quantitative understanding of the insulation ablation process in general and flight amplification effects in particular. Silica-filled EPDM test data will be generated and applied to validate and/or refine computer codes developed by the Air Force for insulation analysis. Tests using EPDM with various levels of Kevlar reinforcement will be analyzed to define the important tradeoff between insulation strain capability (enabling practical insulation application) and char strength (affecting flight amplification of erosion).

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Topic#: 89-159 ID#: 32515
Office: WL
Contract #: F33657-90C-2240
PI: KENNETH WILKINSON

Title. Automatic Test Equipment (ATE) Requirements Specification Authoring Tool

Abstract. This proposal applies expert system technology to aid in the complex and time consuming task of creating a request for proposal (RFP) for the development of automatic test equipment (ATE) in accordance with Modular Automatic Test Equipment (MATE) Handbooks, specifications and applicable Military Standards (MIL-STD). The problem of creating the automatic testing (AT) requirements specification is made larger by the nature of the acquisition process, the lack of knowledge regarding application of the MATE Handbooks, MIL-STDs, and the complexity of writing an RFP. The technical and user feasibility of the expert tailoring assistant for automatic testing requirements specification (ETAARS) was demonstrated during Phase I. Also demonstrated was an innovative computer aided authoring capability which allows updating ETAARS without writing a single line of program code. ETAARS will be used by program management personnel to create the RFP, SOW, Contract Data Requirements List (CDRL), Data Item Descriptions (DID) and source selection criteria. The resulting AT requirements specification adheres to MATE Handbook requirements and is tailored to the end user's prime system and automatic testing mission requirements. During an authoring session the RFP author responds to questions posed by ETAARS. Based on the author's responses, ETAARS automatically generates the SOW text, CDRL's, DIDs and source selection criteria.

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Topic#: 89-160 ID#: 32494
Office: WL
Contract #: F33657-90C-2241
PI: DAVID W. GILLESPIE

Title. MATE Guide Expert Presentation System

Abstract. This proposal applies expert system and hypertext technology to enhance the usability and maintainability of the MATE Handbooks. The central theme of this proposal is the idea of representing the technical information contained in the MATE Handbooks in a way that corresponds to the needs of every user level. The structure of the information is geared toward the needs of the user and not based on the structure of the paper form the Handbooks currently take. The Phase I technical feasibility demonstration of the MATE Automated Guide and Interface Expert (MAGIE) system demonstrated alternative paths through the Handbook content in graphic and textual format, with the user deciding the path to take. MAGIE enables the user to move easily between introductory and advanced material, or between text explanation and graphic representations. The user interface is automatically tailored to the user's experience level and technical perspective. A novice user will have a computer aided instruction interface the experienced user will have a graphical interface and the expert will have a query interface. Acquisition managers can select acquisition oriented material with paths available to the detailed design functions related to each acquisition task. Design engineers can jump directly to the detailed design tasks with paths available to the related acquisition references. Each of these interfaces is interlinked with the others, thus making all data rapidly available to each user without the intimidating bulk of the Guides. An innovative computer aided authoring interface will make it easy for AF personnel to make changes to MAGIE and expand applications.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-140 ID#: 39747
Office: PL
Contract #: F04701-91-C-0086
PI: JEFFREY BLUEN

Title: Direct Optical Viewing Element (DOVE)

Abstract: The objective of the Direct Optical Viewing Element (DOVE) effort is the development of a compact and flexible two-axes stabilized sensor platform for manned observations of the Earth or sky from space utilizing Aura System's unique electromagnetic levitation technology. DOVE represents the first application of electromagnetic levitation to a stabilized platform specifically designed for manned optical observations. As a result of this innovative application of state-of-the-art technology which Aura Systems is pioneering, the stability characteristics of DOVE would significantly exceed those of the best stabilized platforms currently available. Active, electromagnetically levitated bearings are used to provide friction-free operation necessary to implement a two-axes stabilized platform without vibrational coupling mechanisms (bearing friction and stiction) which otherwise allow the host vehicle's angular motions to disturb the sensor's line-of-sight.

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Topic#: 90-077 ID#: 39833
Office: WL
Contract #: F33615-91C-1786
PI: DR. I.C. CHANG

Title: Instantaneous Frequency Measurement (IFM) Correlator Using Optical Approach

Abstract: The IFM is almost an ideal receiver for the intercept of radar signals. A major deficiency of the conventional IFM is its incapability of handling multiple simultaneous signals. Recent work done at WRDC has developed a new approach that appears promising for overcoming the critical limitation. In the implementation of this approach, a large number of phase correlators with long delay lines are required. Thus, the conventional implementation using microwave hardware would be too bulky and complicated. The objective of this program is to develop a simultaneous signal IFM correlator using an optical approach. Theoretical studies in the Phase I has shown the feasibility of the optical correlator. In Phase II a hardware effort will be pursued. The proposed approach includes a coherent acousto-optic correlator configuration using optic fibers as the delay lines. In phase and quadrature components of the autocorrelations are measured. Performance goals of the proposed optical IFM correlator include 1 GHz bandwidth, 1 MHz resolution, 100 nsec pulse width and capability of handling two simultaneous signals.

BURGE & ASSOC
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Topic#: 90-058 ID#: 39731
Office: AL
Contract #:
PI: DR. SCOTT R. BURGE

Title: Integrated Real-Time Ground-water/Soil-Gas Monitoring System for Analysis of Volatile Organic Chemicals

Abstract: The primary objective of this proposal is to develop a real-time ground-water/soil-gas sampling system with an integrated chemical sensor for the collection and analysis of select volatile organic compounds in groundwater and soil-gas. The system will be capable of being installed in existing 2-inch and 4-inch diameter ground-water monitoring wells. The system will be capable of collecting the sample, preparing the sample for analysis, analyzing the sample and relaying the data to the user by telemetry. Upon completion of the analysis, the system will discard the analyzed sample and rinse the analytical chamber. The system will calibrate the sensor in preparation of the subsequent analysis. The system will be self-contained and will reside totally within the well casing. It will be capable of operation off batteries and will be able to operate 8 to 12 months without maintenance. The system will be true "remote field laboratory" capable of many of the operations encountered in laboratories including calibration and quality control checks. The sensor technology to be used can analyze trichloroethene, tetrachloroethene, carbon tetrachloride and chloroform at the parts per billion range without interference from other compounds.

CLEVELAND CRYSTALS, INC.
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Topic#: 89-126 ID#: 33294
Office: WL
Contract #: F33615-91C-5605
PI: GRETCHEN KENNEDY

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Nonlinear Optical Materials - Zinc Tris (Thiourea) and Related Derivatives

Abstract: The feasibility of producing optical quality zinc tris thiourea sulfate crystals (ZTS) was established during Phase I. Cleveland Crystals successfully grew ZTS crystals measuring 1.3 x 6.2 x 1.3 cm³. Results of this Phase I program also indicated that ZTS exhibits low power threshold (due to near 90° phase matching) and may be successfully deuterated, thus making it an excellent candidate for 1064nm, Type II SHG, possibly as a replacement for more expensive crystals such as KTP and LBO. Because of its exceptionally large angular acceptance, ZTS may also be a replacement for CD*A. The Phase II program goal would be the consistent production of optical quality crystals of ZTS and deuterated ZTS (d-ZTS), from which laser components could be fabricated for commercial applications. The Phase II program would study the solution growth of these crystals, with an emphasis on scaling parameters and morphology control, and should result in the growth of 5 x 5 x 5 cm³ optical quality ZTS and d-ZTS crystals. Also being proposed for this program is the evaluation of nonlinear optical materials belonging to the same class of semi-organic compounds as ZTS. ZTS and, more particularly, d-ZTS may open up an entirely new category of nonlinear optical materials to the commercial market. This Phase II development would lay the foundation for the commercial development of these crystals.

COMPUTER SCIENCE AND APPLICATIONS, INC.

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Topic#: 90-001

ID#: 39675

Office: WL/EGLIN

Contract #: F08630-91-C-

PI: FREELAND D CRUMLY

Title: Airborne Antenna Pattern Prediction Program

Abstract: The overall objective of the Airborne Antenna Pattern Prediction Program (A2P3) is to develop a general purpose, user-oriented analytical tool to provide a fast and cost effective means for the analysis of the electromagnetic radiation from antennas in the presence of complex structures such as aircraft. The free-space radiation patterns of antenna elements are highly distorted by reflection and diffraction on complex airborne vehicles. Cut-and-try antenna element design and location on such structures followed by tests are time consuming and costly. The proposed Phase II effort will adapt state-of-the-art antenna radiation pattern computer prediction techniques for complex structures to the requirements of computer simulation testing of airborne instrumentation systems, such as the multiple antenna vector scoring systems, radar warning receivers, missile attack warning systems, and telemetry/data link systems. The Phase II effort will provide this capability in a user-friendly workstation environment.

CREARE, INC.

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Phone: (603) 643-3800

Topic#: 90-032

ID#: 39706

Office: ROMELABS

Contract #: F30602-91-C-0123

PI: Dr. James J. Barry

Title: PC-Based Expert System for Thermal Analysis of Electronic Equipment

Abstract: Thermal analysis of electronic equipment for reliability in the early stages of design would provide cost and time savings by avoiding redesign or modification of completed designs. System and reliability engineers need a thermal analysis tool that does not require heat transfer expertise or detailed input data so that evaluation can take place early in the design process. In Phase I of this project, the feasibility of a PC-based expert system thermal analyzer was shown, and the preliminary design of the software was completed. The software will estimate component temperatures and deratings using a simple input description of the design and assuming no heat transfer expertise on the part of the user. Missing or incomplete input information is inferred from other input. Uncertainty in the predictions can be assessed and the knowledge base of the expert system is extensible by the user. In this Phase II project we propose to develop, document, test, and validate the thermal analyzer software. A complete, supported, and ready-to-use software package will be available upon completion of Phase II.

CREW SYSTEMS CONSULTANTS

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Topic#: 89-112

ID#: 33646

Office: WL

Contract #: F33615-90C-3808

PI: RICHARD L. NEWMAN

Title: Cockpit Situational Awareness: Flight experiment design

Abstract: Reports on accidents to modern military fighters increasingly implicate pilot spatial disorientation (SDO) as a factor.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

While SDO of pilots has been a problem in aviation since the beginnings of instrument flight, it is becoming a more serious problem in high performance jet fighter cockpits. The head-up display (HUD) has been cited as a contributor to SDO. Recent research has developed several HUD symbologies and control laws which hold promise for minimizing susceptibility to SDO. A program to conduct flight tests of a programmable HUD in an Air Force T-38 has been proposed. This program will conduct an inflight evaluation of candidate symbologies under both visual and simulated instrument conditions. At the same time these inflight evaluations are being conducted, HUD-specific instrument flight techniques will be tested and evaluated.

CSA ENGINEERING INC
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Topic#: 90-164 ID#: 39770
Office: PL
Contract #: F29601-91-C-0079
PI: DR. DAVID A. KIENHOLZ

Title: Advanced Suspension System For Simulating On-Orbit Conditions

Abstract Simulating the weightless, unconstrained conditions of orbit in ground-based beam pointing and tracking experiments requires a means for offloading the weight of the beam director from the servo system that controls its position and orientation. The suspension must support the beam director with only modest static deflection under its weight and with minimal constraint forces due to suspension stiffness. It must allow virtually frictionless, unconstrained motion in all six degrees of freedom, including slewing over angles of several degrees. Phase II will design, build, test, and deliver such a system to the Air Force Space Integrated Controls Experiment. It will be a floor-standing system using three identical support devices and will be scaled for a large beam director having a 6-meter primary mirror and total weight of 7000 lb. The development will be based on the single, half-scale pneumatic/electric suspension device and scalable, frictionless air piston that were demonstrated in Phase I.

DEFENSE SYSTEMS, INC.
1521 Westbranch Dr
McLean, VA 22108
Phone: (703) 442-9636

Topic#: 90-146 ID#: 39751
Office: PL
Contract #: F04703-91-C-0109
PI: LEONARD A. ATKINSON

Title: High Power Microwave (HPM) Detector

Abstract. Ground radars and other spacecraft support systems which transmit microwave radiation may produce electric field strengths in excess of those specified in MIL-STD-461. These high electric field strengths can damage or reduce the reliability of spacecraft and electronic systems before and during launch. A High Power Microwave Detector (HPMD) has been developed to detect electric fields over the 1 to 10 GHz frequency range with strengths from 1V/m to 50V/m, using an innovative antenna/detector design. In the Phase I SBIR effort, a proof of principle prototype was developed which has +/-3dB of accuracy within a 90 degree conical angle. In Phase II, the target accuracy will be +/-3dB over a hemispherical region by making an array of the single channel HPMDs. The HPMD measures the amplitude of incident microwave pulse or CW radiation, and stores the field intensity and time of occurrence. The HPMD is built into a small enclosure that can be located close to the spacecraft and is simply programmed through a "digital watch" type interface. The HPMD displays the greatest electric field strength measured and has an alarm mode with flashing light and audible alarm if a preset electric field threshold is exceeded. It operates on batteries, or may use an external calculator type power supply run from line voltage. It records data for several hours on a set of batteries. The HPMD sensors will be configured in a network developed under Phase II which will monitor through a network Master computer the electric field strength over an entire complex.

DONMAR LTD
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Topic#: 90-056 ID#: 39724
Office: AFCESA
Contract # F0863591C0217
PI: DR. A. DONALD GOEDEKE

Title: Machine Vision Fire Detection System

Abstract. This Phase II proposal is directed at developing a commercially producible Machine Vision Fire Detector System (MVGDS) that would, in essence, significantly advance the state-of-the-art of fire protection and provide the Department of Defense, as well as other users, with the ability to identify very small fires at large distances in less than 1 second, and to discriminate fire events from all false alarms and false activations of suppressant that has been a continuing major problem in fire protection. The MVFDS utilized machine vision, pattern recognition, artificial intelligence and image processing techniques

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

to process real time information obtained by a CCD Color Video Camera to identify fire-specific properties and to discriminate them from nonfire specific properties. The hardware involves a rugged color CCDE camera with high resolution, frame grabber and storage electronics, a small computer mother board, I/O devices, power supply, and other related electronics. The techniques as well as the hardware configuration and design were demonstrated and proven in the Phase I effort, it was proven that the approach is feasible and that no technical risk exists, as all the software and hardware technology exists in commercial form. Not only will the MVFDS provide major increases over current "old" technology detectors in performance and reliability, but it will also provide for the first time the capability to measure the size of the fire event and to determine its exact location, therefore allowing application of suppressant in zonal regions or directly on the fire thus limiting unnecessary use of suppressant and reducing environmental impacts and costs. Also, for the first time, the MVFDS will know by direct means when the fire reaches the exact specified size requiring a dump, not by the uncertain indirect technique of UV/IR detectors today that do not know where the fire is located or what is its size, only that appropriate UV/IR radiations are present (which could emanate from any one or combination of nonfire sources)

EIC LABORATORIES, INC.

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Topic#: 90-123 ID#: 39879
Office: WL
Contract #: F33615-91C-2164
PI: DR. GERHARD L. HOLLECK

Title: Bipolar Lead Fluoroboric Acid Battery for Pulse Power

Abstract. The U.S. Air Force requires standard pulse power sources for airborne/spaceborne applications with power densities greater than 50 kW/kg. To meet these requirements, we propose to develop a rechargeable highpower bipolar battery based on the Pb/HBF₄/PbO₂ system. This battery is unique in that the discharge product of both electrodes is a highly soluble salt, Pb(BF₄)₂. The active materials, Pb and PbO₂, are regenerated from the salt on charge. Specific advantages of the battery include high rate capability, complete use of active materials, invariant electrodes, and simple and inexpensive battery construction and assembly. In Phase I we demonstrated feasibility of the approach and showed pulse power densities of 1.6 W/cm² in bipolar prototype batteries. In Phase II we will develop a comprehensive technology base for rechargeable bipolar Pb/HBF₄/PbO₂ batteries. This effort will culminate in fabrication and performance demonstration of practical 1.5 to 3 kW, 60 Wh bipolar battery modules.

EIDETICS INTERNATIONAL, INC.

3415 Lomita Blvd.
Torrance, CA 90505
Phone: (213) 373-9316

Topic#: 89-162 ID#: 32418
Office: WL
Contract #: F33615-90-C-3615
PI: ROBERT C. ETTINGER

Title: Innovative Display Concepts for Field of View Expansion in Air Combat Simulators

Abstract. Recent acquisitions of a domed simulation with visual terrain, laser and high resolution target displays and graphics workstations for manned interactive crew stations by WRDC/FIGD are aimed at increasing their capability to evaluate new technologies and refine design requirements for future tactical aircraft. The recent emphasis for this equipment is in beyond-visual-range (BVR) air combat to support the Integrated Cockpit Avionics for Air Superiority (ICASS) program. The manned, interactive crew stations will allow evaluations to consider the effects of multiple targets in a BVR environment. Innovative display concepts for field-of-view expansion developed by Eidetics International during an SBIR Phase I study can be used to make these manned interactive BVR crew stations capable of credible close-in, within-visual-range (WVR) combat. The objective of this SBIR Ph II effort is to continue the development and evaluation of enhanced field-of-view (FOV) display concepts developed in Ph I. The two most promising of three display expansion techniques will be refined into a single enhanced FOV visual display capable of conducting credible close-in visual air-to-air combat from a single CRT screen. This SBIR effort will lead to fully capable visual displays for low cost, manned interactive crew stations to supplement existing WRDC/FIGD and industry simulations with credible multiple participants. These low-cost interactive crew stations would allow true MvN air battle simulations from BVR to WVR close-in maneuvering to properly evaluate new technology concepts at an affordable cost.

EIDETICS INTERNATIONAL, INC.
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Topic#: 89-162 ID#: 32419
Office: WL
Contract #: F33657-91C-2046

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Phone: (213) 373-9316

PI: JAY W. VAN PELT

Title: Innovative Tactics Enhancement to the Advanced Air-to-Air Systems Performance Model Pilot Decision Logic

Abstract: This Phase II SBIR effort will update the Advanced Air-to-Air Systems Performance Evaluation Model (AASPEM) to enhance its capability to model close-in combat between highly agile, high thrust-to-weight fighter aircraft armed with all aspect IR and radar guided missiles and guns. The Within Visual Range (WVR) logic will be enhanced so that it will represent current F-15/F-16 air-combat tactics including all aspect missile defense maneuvers, aggressive point and shoot maneuvers and vertical maneuvers. The aerodynamics and flight mechanics model will be updated so that transient aircraft agility characteristics and post-stall maneuverability can be accurately evaluated. The air-to-air missile aerodynamics and flight mechanics model will be updated so that the high angle-of-attack launch dynamics of post-stall capable aircraft can be accurately modeled. The output of the study will be a validated, upgraded, version of AASPEM together with supporting documentation and Users Manuals.

ELECTRO MAGNETIC APPLICATIONS, INC.

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Topic#: 90-169

ID#: 39776

Office: PL

Contract #: F04701-91-C-0075

PI: CALVIN C. EASTERBROOK

Title: Investigation of the Triggering of Lightning by Launch Vehicles

Abstract: Incidents of Apollo 12 and Atlas Centaur AC-67 launches show that the threat to launch vehicles from triggered lightning is real. Electro Magnetic Applications, under a Phase I SBIR contract from Kennedy Space Center, has conducted research into the feasibility of developing a methodology to assess the threat from triggered lightning to launch vehicles during ascent. The Phase I effort identified three specific physical areas which are vital to any methodology for the prediction of triggered lightning. These areas are air pressure effects, plume effects, and the glow to arc transition. The objective of proposed Phase II research is to develop a unified triggered lightning prediction model for launch vehicles during ascent. Proposed research is concentrated in the areas listed above. Already existing data on pressure distributions during flight will be acquired and built into the final model. Plume physics will be investigated both theoretically and experimentally. Experiments will be done to evaluate the glow to arc transition issues. The overall prediction model will be integrated and applied to the Titan IV to give atmospheric electric field lightning triggering thresholds.

ELECTRO-RADIATION, INC.

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Topic#: 89-161

ID#: 32485

Office: WL

Contract #: F33657-90C-2243

PI: MURRAY W. ROSEN

Title: RF/Microwave Fiber Optic Delay for Countermeasure Systems

Abstract: The program develops and evaluates a lightwave RF memory (LRFM) brassboard. Utilization of RF/Microwave Fiber Optic Memory/Delay Technology offers the capability to process coherent and spread spectrum signals and generate ECM techniques against multiple simultaneous threat emitters. The design takes advantage of broad bandwidth, linear performance and dynamic range inherent in Fiber Optic Technology. This approach offers the potential for direct RF application in a small physical size, at low risk and at low cost. The approach modulates a high speed laser diode operating at 1310nm wavelength with the RF/Microwave signal, the output of which is coupled into single mode optical fiber delay line programmed using optical switch networks. The signal is recovered using a broadband photodiode. The capabilities are combined into a robust architecture for ECM systems. The proposed approach can serve as a technological alternative in modern ECM systems and provide extended coherent ECM capabilities at RF to older systems. The Phase 2 brassboard proposed will provide electrical interfaces which may be easily adapted to a number of today's ECM systems and allow evaluation at AF test facilities.

EMCORE CORP.

24 Elizabeth Avenue

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Topic#: 90-115

ID#: 39871

Office: WL

Contract #: F33615-91C-5662

PI: DR. JING ZHAO

Title: Low Temperature Fabrication of High Quality Tc Superconducting Thin Films by Plasma Enhanced MOCVD Process

Abstract: The development of a technique for the low temperature, in-situ formation of high Tc superconducting thin films is crucial for the practical application of high Tc superconductors. The success of plasma enhanced metal organic chemical vapor

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deposition (PE-MOCVD) has been successfully demonstrated in Phase I. We will systematically optimize this state-of-the-art process for the fabrication morphology of the films. Multilayer high Tc superconducting devices will also be fabricated in Phase II. The PE-MOCVD process will permit deposition of high quality, untwinned high Tc superconducting films with a smooth surface and high density, on a variety of substrates. The process also promises to deposit the orthorhombic superconducting phase in the as-deposited state, avoiding the phase transition which exists in all of other processes. The novel PE-MOCVD process, which substitutes electron kinetic energy for conventional thermal energy and enhances compound formation with the presence of activated oxygen generated from dissociation of N₂O, will be further developed through the use of higher microwave power resulting in low temperature deposition, non-equilibrium film compositions, and high product purity. In addition, CVD process offer the additional advantages of being applicable to inexpensive and large scale fabrication.

ENSCO, INC.
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Springfield, VA 22151
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Topic#: 90-155 ID#: 39760
Office: PL
Contract #: F19628-91C-0172
PI: DR. DAVID W.A. TAYLOR

Title: Generalized Beamforming for Automatic Association

Abstract: The feasibility of using processing and control knowledge to improve the speed and accuracy of automatic seismic event association and location was examined in the preceding Phase I study. The method of generalized beamforming was demonstrated to provide an excellent framework for applying knowledge to the automatic association process. The procedure developed in Phase I was shown to be capable of associating all events for which detection data exists without relying on the success of seed location algorithms. In addition, the computation cost of this algorithm increases only linearly with the number of detection data, while with conventional algorithms, the cost increases exponentially due to their combinational nature. In Phase II, we propose to fully implement an automatic, global processing system based on the concept of generalized beamforming. This processing framework allows detailed information from specific regions to be incorporated into the automatic system.

ES INDUSTRIES
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Topic#: 89-030 ID#: 31379
Office: AEDC/PKP
Contract #: F40600-91-C-003
PI: Walton Cardwell

Title: CONTINUOUS WATER MONITORING SYSTEM FOR PROCESS COOLING WATER

Abstract: This proposal describes the steps necessary to develop an online gaschromatographic system capable of continuous monitoring of both volatile and non-volatile organic contaminants in process cooling water in a 15 minute cycle time. Phase I work consisted of development of a sampling system and columns required to separate specified contaminants. Limits of detection, accuracy and precision of the analysis system were determined. An alarm system was developed based on specified limits for each analyzed contaminant. A final report describing the proposed system and documenting the Phase I effort was provided. The Phase II effort consists of design, fabrication, installation and checkout of the monitoring system at AEDC.

EXPERTSOFT
6160 Cornerstone Court, East
San Diego, CA 92121
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Topic#: 90-062 ID#: 39738
Office: AL
Contract #:
PI: DR ANDREW M. JAINE

Title: Development of a Hypermedia Intelligent Tutoring System in an Air Force Domain

Abstract: The research conducted under this program clearly indicates that the use of a combination of artificial intelligence technologies and hypermedia provides one of the most promising approaches for improvement in instructional methods. Among the benefits that accrue from using these technologies are improvements in the portability and accessibility of instruction, and increases in instructional efficiency and comprehension. This research has detailed the specifications to implement a system to realize these benefits. This system will enable most activities required to develop courses to be performed automatically, using advanced knowledge-based technology. The primary goal of the Phase II program is to implement the designed system, and to prove the concept by developing an intelligent tutoring course in a specified Air Force domain. Expertsoft has assembled a team for this development task that has practical experience in implementing knowledge-based systems across a range of commercial and military environments. The program will produce two major products, and intelligent training system and a

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

'knowledge publishing' system, with many unique benefits in military and commercial environments. Expersoft has allocated in excess of \$400,000 for developing the commercial marketplace for these products, and has estimated the total market to be over \$400 million annually by 1993.

FAILURE ANALYSIS ASSOC.
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Topic#: 89-129 ID#: 33391
Office: WL
Contract #: F33615-91C-5612
PI: DONALD GALLER

Title: Prepare a Handbook of Accident Investigation Techniques for A/C Electrical and Electronic Components
Abstract: A handbook of accident investigation techniques for aircraft electrical and electronic components will be developed. The handbook will be used during aircraft accident investigations to determine the role of these components in the accident. Wiring, connectors, switches, microelectronic devices, lamps, and other components will be covered. Emphasis will be on techniques which can provide data on pre-accident conditions of the components and thereby lead to more precise accident cause determination. The handbook will contain procedures for identifying and handling evidence at accident sites, laboratory analysis techniques to interpret the evidence, photographs of new and damaged components, and component material properties. The handbook will be supplied both as a printed document and as an "on-line" computer program with integrated text and graphics. The computer format will provide a level of interaction that can be essential for effective use of this type of technical handbook. The "on-line" handbook will serve as the prototype of a system which may be developed in Ph III.

FLUOROCHEM, INC.
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Topic#: 89-120 ID#: 33441
Office: WL
Contract #: F33615-91C-5609
PI: THOMAS ARCHIBALD

Title: New High Performance Polymers

Abstract: Rigid-rod polymers containing cage molecules in the place of aromatic groups will be investigated. Improved conditions for the synthesis of monomers will be sought. Optimum polymer compositions will be established to maximize processibility, thermal stability and mechanical strength. The use of cage containing rigid-rod polymers in molecular composites will be developed.

FOSTER-MILLER, INC
350 Second Avenue
Waltham, MA 02154
Phone: (617) 890-3200

Topic#: 90-093 ID#: 39849
Office: WL
Contract #: F33615-91C-3206
PI: PHILLIP STARK

Title: New Strain Measurement System for High Temperature Materials

Abstract: Foster-Miller proposes to continue the successful Phase I work where high temperature, miniaturized, highly sensitive "Capacitance Strain Gauges" were developed. The resulting gauges exhibited thermal stability to 1,1000°C, measured a capacitance change with strain of 0.27 pF/ue at 10kHz, and exhibited a strain resolution of + -35ue. The Phase II program will develop capacitance gauges designed for different high performance material systems (depending on coefficient of thermal expansion, CTE, service temperature, service atmospheric conditions, ultimate strain, etc). The success of the Ph II program will indeed mark a breakthrough in the elevated temperature characterization of high performance materials. The resulting gauge will benefit a wide range of advanced materials development initiatives for the government as well as the industry. Such major efforts as the Air Force Hypersonic Research Vehicle, National Aerospace Plane, Advanced Adiabatic Engine programs will be the immediate beneficiaries of this innovative technology.

FRONTIER TECHNOLOGY, INC.
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Santa Barbara, CA 93103
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Topic# 90-026 ID#: 39703
Office: ESD
Contract #: F19628-90-C-0136
PI: Robert G. Uttley

Title: C3 Requirements for RT/MT Attack

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Abstract: There is currently a great deal of interest in developing a highly effective capability to deal with the RT/MT problem worldwide. This capability will undoubtedly require a high of coordination among various existing tactical and strategic assets and possibly the development of new systems. The ability to coordinate widely different attack elements and capabilities within a given theater of operation and under potentially hostile conditions requires a very flexible and survivable command, control, and communication architecture. Phase I considered at a high level the functions and their allocation between the command and control elements and the strike elements subject to communications limitations. Phase II will expand the depth and scope of this work into the conventional arena. This Phase II work will include formulation of viable time phased architectures and development of functional requirements. A PC-based simulation will be developed to support trade studies in each case to determine the most preferred candidate options.

FRONTIER TECHNOLOGY, INC.
530 Montecito Street, Suite 105
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Phone: (805) 965-2477
Title: Multi-Role Fighter

Topic#: 89-162 ID#: 32468
Office: WL
Contract #: F33657-91C-2213
PI: EDWARD P. JORDAN

Abstract: Frontier will develop, demonstrate and deliver two computer programs and data bases. The Integrated-Avionics Cost Model (IACM) estimates the rough order of magnitude & RDT&E and procurement costs of highly integrated avionics suites. Current cost estimating relationships are inadequate for conceptual avionics suites, multi-functional elements and avionics technologies. The IACM can be used to investigate trades among avionics cost, performance and availability and to trace mission requirements to avionics options as well. The Force Structure Model (FSM) enables analyses of the makeup of future USAF fighter/attack forces, based on realistic cost-constrained procurement options, total force size, and current inventories. The model greatly enhances fighter planning by showing required timing and combat roles for new aircraft starts, as well as inventory numbers and fleet lifetimes for making decisions on major modification.

FROST ENGINEERING DEVELOPMENT CORP.
PO Box 1294
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Topic#: 89-068 ID#: 34665
Office: AL
Contract #:
PI: HORACE M. VARNER

Title: An Improve Upper Torso Haulback and Inertia Reel for Ejection Seats

Abstract: The ACES II haulback and inertia reel produces slow or incomplete retraction with the straps partially extended from the housing. The CREST program has a requirement to provide powered haulback in 150 milliseconds rather than the 300 milliseconds required in current specifications. A maximum impact velocity of 12 ft/sec is also required. A high performance haulback reel can be designed in which linear piston/cylinders are used to power a selective drive which in turn rotates the haulback straps attached to the restraint harness. This arrangement provides an efficient utilization of the gas generator energy. Cold gas tests will be used to assess the capability of the improved haulback reel.

HITEC PRODUCTS, INC.
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Topic#: 89-119 ID#: 33700
Office: WL
Contract # F33615-90C-3215
PI: STEPHEN P. WNUK, JR.

Title: Attachment Techniques for High Temperature Strain

Abstract: Completion of Phase I resulted in the development of a simple pull test apparatus which was used to screen selected adhesive systems. The selected systems were used to attach strain and temperature instrumentation to Rene '41, carbon composite and TZM materials which were successfully tested to 2500 F. The objectives of Phase II are to complete the design of the test apparatus, to add elevated temperature test capability and to refine the test procedure as a suggested test standard. The acquisition of data using the proposed standard procedure comparing various currently available attachment systems were part of this project. The results would provide bond strength and electrical characteristics of the various available adhesive systems and provide methodology for quickly evaluating a proposed adhesive system on newly developed structural materials.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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5501 Oberlin Drive
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Topic#: 90-066 ID#: 39739
Office: AL
Contract #:
PI: DR. ROBERT HECHT-NIELSEN

Title: Mental Workload Measurement Using Brainwave Analysis

Abstract: In Phase I of this project HNC, Inc and its teaming partner, the Brain Research Laboratories of the New York University Medical Center, developed, and provided a successful preliminary demonstration of, a new method of mental workload measurement based upon EEG analysis (using the video game TETRIS as the graded-difficulty mental task). Unlike past attempts at using EEG analysis, this new method utilized the proven EEG spectral cross-coherence neurometric methods pioneered by Prof. E. Roy John of the Brain Research Labs, who is the principal investigator for the NYU portion of this project (for a review of basic neurometric methods see: A. S. Gevins and A. Remond [Eds.], Methods of analysis of Brain Electrical and Magnetic Signals: EEG Handbook pp. 449-495, Elsevier, 1987, or Science 8 January 1988, pp. 162-169). In Phase II of the project HNC and NYU expect to develop and demonstrate a mental workload measurement workstation that is capable of measuring multimodal task mental workload in real time. In order to provide ground-truth data on workload level during Phase II of the project we shall use a carefully designed multimodal mental task (METS) developed in Phase I (for which patent protection is being sought)

HUGHES ASSOC.
2730 University
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Phone: (301) 949-0505

Topic#: 89-066 ID#: 32060
Office: AFCEA
Contract #: F0863592C0015
PI: DR. LEONARD A. JONAS

Title: Energy Field for Fire Extinguishment

Abstract. In our Phase I work, previous studies of the interactions between flames and energy fields were found, reviewed and analyzed for the purposes of enhancing or causing fire extinguishment. Thirty-three publications were analyzed and ten types of energy fields were evaluated. The electrostatic field is the optimum field for fire extinguishment. A demonstration apparatus was constructed in which an electric field (or an electric current) extinguished a gas flame. Electrical charges may greatly improve the ability of fire fighter to extinguish some fires. It is technically feasible to apply an electrostatic field to a fire using modified fire fighting equipment. It is recommended that the project be continued with the development of this equipment and its testing on standard pool fires. The results of these tests may indicate a substantial improvement in the capability of fire fighting equipment. We propose to subdivide Phase II into three parts: part 1, part 2, and part 3. The first part is laboratory work to measure the effects of electric current on fire extinguishment. If this work shows that a considerable improvement is to be expected in fire fighting ability, then the second part, large-scale verification, will begin. If large-scale verification is successful, then the development and design of practical fire fighting equipment will be undertaken. If part 1 or part 2 results are unsatisfactory, the work will be stopped at that point. In any case, the results of the work will contribute significantly to the body of knowledge of fire extinguishment

HYPERSONICS, INC.
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Topic#: 90-180 ID#: 39793
Office: PL
Contract #: F04704-91-C-0040
PI: KAUL J. CONTI

Title: Advanced Aerothermal Algorithm

Abstract. A computer based algorithm is proposed that integrates an advanced Navier-Stokes hypersonic flow solver with material-response and shape-change technologies to create a powerful tool for ballistic or maneuvering reentry vehicle design.

IMAGING & SENSING TECHNOLOGY CORP.
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Horseheads, NY 14845
Phone: (607) 796-3393

Topic#: 90-105 ID#: 39860
Office: WL
Contract # F33615-91C-3807
PI: THOMAS A. DUNBAR

Title: Unique Light Source for Full Color, Dot Matrix

Abstract. Phase I has resulted in the fabrication and demonstration of several prototype, circular display, Cathode Luminescent

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Lamps (CLL). These lamps have yielded brightness values in excess of 10,000 foot Lamberts. A prototype, six inch by eight inch rectangular model, is being assembled. Plans are underway to design, build and demonstrate a rectangular CLL that will include a conformal electronics control, and power supply. Completion of an electron-optical study, together with parameter, life and environmental testing will bring the rectangular CLL to a marketable level. The final version of the CLL is expected to be ANVIS compatible and will yield the highest brightness levels of any existing backlight used in combination with LCDs for full color dot matrix cockpit display.

IMAGING SCIENCE TECHNOLOGIES
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Topic#: 89-217 ID#: 32599
Office: PL/BMO
Contract #: F04704-91-C-0006
PI: RICHARD L SCULLY

Title: LWIR UN-COOLED IMAGING RADIOMETRIC STARING ARRAY IMAGING SCIENCE

Abstract: In Phase I, the contractor demonstrated the feasibility of an un-cooled lwir imaging system as a photonic (quantum) process measuring changes in IR photon flux operating in the 20 micron region. Phase I showed that the mechanism involves a vibration coupling between a chromophore and a molecule absorbing in the IR. The properties of dichroism relating to non-linear optical properties in the film were utilized to demonstrate that the IR detection process was quantum by generating a third harmonic in the visible and verifying the change in its intensity when irradiated by IR. In Phase II, the contractor will do further studies of the coupling mechanism between diacetylene chains containing a 20 micron IR absorbing group identified in Phase I and chromophores via conjugation; and study and optimize the photodichroic structures. Phase II will include tests of optimized structures for response time and sensitivity. A feasibility prototype LWIR (20 micron) un-cooled imaging radiometric staring array will be made and tested.

INNOVA LABORATORIES, INC.
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San Diego, CA 92121
Phone: (619) 455-4500

Topic#: 90-040 ID#: 39712
Office: ROMELABS
Contract #: F19628-91-C-0177
PI: George W. Webb

Title: Microwave Characterization of Superconductors

Abstract: There is a world-wide effort to produce better high transition temperature superconducting materials that are suitable for a large variety of technological applications. One of the first applications will be the utilization of Josephson junction and related devices, made on wafers, and integrated with additional circuitry. There will be a major economic advantage to the producers of such materials to use large 3 inch diameter wafer sizes. Accordingly, there will be a continuing need for a sensitive, rapid, and economical testing procedure in the semiconductor industry. In addition, the inevitable demand for implementation of VLSI of complex circuitry will require instrumentation capable of high temperature superconducting wafer evaluation and inspection with high spatial resolution. To address these needs, we proposed on Phase I a novel technique for scanning high transition temperature superconducting wafers using a combination of field modulated microwave surface impedance spectroscopy and innovative scanning methodology. We have now convincingly demonstrated the feasibility of our approach. In Phase II we propose the development of a prototype instrument suitable for manufacture and sale.

INTEGRATED SYSTEMS, INC.
2500 MISSION COLLEGE BLVD
SANTA CLARA, CA 95054
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Topic#: 89-230 ID#: 32720
Office: PL/BMO
Contract #: F04704-91-C-0009
PI: M MICHAEL BRIGGS

Title: TVC SUBSYSTEM FOR SOUNDING ROCKETS

Abstract: The soon-to-be-decommissioned Minuteman II Stage II (MMIISTGII) rocket motor can be used as a booster for a sounding rocket if it can be retrofitted with a thrust vector control (TVC) subsystem that works near sea level. A Phase I SBIR effort was accomplished to define the needed modular TVC subsystem, which employs secondary-injection of hot gas into the rocket exhaust near the nozzle exit plane to effectively control the direction of the thrust vector. In addition, performance of a TVC-controlled sounding rocket based upon the MMIISTGII was evaluated in the context of launch from Quajelen Island, wherein it was determined that TVC is required to meet the mission altitude objectives while simultaneously satisfying the range safety requirements. A Phase II SBIR effort is hereby proposed to (1) develop a detail design of the modular TVC subsystem,

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

and (2) construct and ground-test a "breadboard" motor. The objective of the Phase II effort is to complete the design and specification of the modular TVC subsystem for MMIISTGII to an extent where the system is ready for procurement, and to provide a definitive demonstration of the TVC performance. The complete TVC module will consist of the HGII TVC assy enclosed by an aft fairing that mount four tailfins.

INTELLIGENT AUTOMATION, INC.
1370 Piccard Drive, Suite 210
Rockville, MD 20850
Phone: (301) 424-4007

Topic#: 90-119 ID#: 39875
Office: WL
Contract #: F33615-91C-5964
PI: LEONARD S. HAYNES

Title: Open Architecture for Equipment Design and Support Tools

Abstract: Under Phase I SBIR funding we have outlined an Open Architecture for Testability and Maintainability related tools. We have developed a strawman neutral format for dependency models - the most important and most difficult component of the proposed open architecture, and we have formalized that model using EXPRESS. We have shown in detail how our proposed standards fit synergistically into the framework being developed by the IEEE SCC20 committee, and we have received their provisional approval to proceed under the formal sponsorship of SCC20 (which is an ANSI approved standards developer). Most importantly, we have coordinated with a large group of vendors and users of testability and maintainability related tools, both inside and outside of DOD, and have proven that there is considerable support for such standards.

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Topic#: 89-085 ID#: 32902
Office: WL
Contract #: F33615-91C-1703
PI: DAVID E. LUDWIG

Title: High Performance String Threat Warning Receiver with Optical Filtering

Abstract: Baseline sensor parameters were established on which the clutter rejection capabilities were determined. A noise equivalent target analysis yielded the baseline sensor with the following performance parameters: 0.5 cm aperture, 4 mrad instantaneous field of view, mid wave IR operation, mid 10-11 D* detectors, 30 km detection range against a 300 w/sr boosting threat. The detection range of the baseline sensor would be limited to 10 km if simple spatial filtering were all that was employed. Extending the detection range in the presence of a highly cluttered scene to 30 km was the goal of the Dynamic Stare analysis. Two methods of analysis for determining the effectiveness of the Dynamic Stare algorithm to reduce clutter were performed: a power spectral density analysis, and a computer simulation using IR data scene from ERIM data base. Target and background motion models were employed to help define the characteristics of the temporal filtering portion of the Dynamic Stare Algorithm. The analysis indicated that the 30 km detection range could be achieved in a highly cluttered background with the baseline sensor. In addition false excursion analysis indicated that the size of a track processor could be held very small.

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Laguna Niguel, CA 92677
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Topic#: 89-146 ID#: 33161
Office: WL
Contract #: F33615-90C-2100
PI: RONALD E. OGLEVIE

Title: Microcomputer Based Earth-to-Orbit Trajectory Optimization Program

Abstract: The primary objective is the development of an earth-to-orbit trajectory optimization program capable of accommodating lifting vehicles and air breathing propulsion. Fast execution on an AT model personal computer and ease-of-use are required to facilitate rapid preliminary design. A dual-mode approach is proposed with the following features: Rapid Optimization Mode (ROM) - Provides a more accurate (but longer running) truth model for occasional verification of ROM data. The dual-mode operation alleviates many shortcomings of contemporary programs. Successful Phase I results have been obtained and an initial version of the ROM program delivered. Its simple performance optimization runs in less than 5 minutes, and yields performance very close to reference cases. The major thrusts of the proposed Phase II work are the addition of new features and performance enhancements to the basic program, and development and integration of the ROM to yield the dual-mode benefits.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-009 ID#: 39663
Office: WL/EGLIN
Contract #: FC863091-C0047
PI: DR JOHN A WOOLLAM

Title: Diamondlike Carbon Hermetic Encapsulants

Abstract: Hermeticity in electronic components is a serious problem for military hardware. Epoxy encapsulation of microcircuit chips contain chlorine and sulfur which diffuse out and cause premature failure of electronics in the presence of moist environments. In Phase I of this work we demonstrated that diamondlike carbon (DLC) is effective in preventing moisture penetration. Furthermore, DLC was found to effectively bond to materials used in microelectronics, and to withstand thermal cycling in moist, and acid environments. A simple bipolar junction transistor performance was found to be unaltered by coating with DLC and the introduction of moisture. In Phase II we will use this demonstrated effectiveness as a basis to develop a working DLC coating technology. Specifically, we will extensively test the permeability of the DLC films and compare these results to results on other films, and do accelerated life testing in moist and acidic environments. We will coat integrated circuits with DLC, followed by epoxy encapsulation and testing, including thermal cycling, and verify good step coverage, and optimize film quality vs. deposition and preparation conditions. The film thermal conductivity, internal stress and film bonding, will be measured as well. A working DLC deposition system including detailed instructions will be delivered to the Air Force at the end of Phase II.

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Topic# 90-166 ID#: 39772
Office: PL
Contract #: F29601-91-C-0074
PI: DR. GEORGE LUGER

Title: Object Oriented Programming in C++ on the CRAY for Scientific Codes

Abstract. Our Phase I research, including the construction of two finite element and finite difference codes has demonstrated the feasibility of using object oriented representation techniques, as found in the C++ programming language, for the design of scientific codes on the Cray supercomputer. Based on these successes we now proposed a Phase II research plan to exploit our findings. In Phase II some important research issues remain to be addressed. We have divided the Phase II research into three parts, the creation of an object oriented interface and browser, the specification and annotation of a set of library modules, and the design of a C++ to C translator. In this proposal we describe the stages of development of each of these parts, and how they can be integrated into a sophisticated object system for numerical codes. We discuss also the problems of computing speeds between FORTRAN and C and show how this can be addressed by our system for library annotations and our C++ to C translator. We also show the appropriateness of this approach for multiple processor computing environments. Cray Research is so interested with our approach that they have offered design assistance and programmer support during Phase II.

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Topic#: 90-027 ID#: 45662
Office: ESD
Contract #: F19628-90-C-0165
PI: Ilya Schiller

Title: Field Trainable Mission Adaptable Unmanned Air Vehicles

Abstract. An SBIR Phase I entitled "Field Trainable Mission Adaptable Unmanned Air Vehicles" (DOD SBIR AF90-027) feasibility effort demonstrated innovative, neural network-based (NN) automated route planning (ARP) for unmanned air vehicle (UAV) mission planning on a stand-alone ARP workstation. The preliminary workstation screen shows the friendly FLOT, friendly flight corridors, enemy SAM air defense sites and the UAV mission targets. The ARP user evaluates UAVs using 'conservative' and 'aggressive' automated trained NN 'pilots'. The project showed two important ARP results. 'Conservative' UAV NN pilots outperformed aggressive NN pilots in light air defenses while aggressive NN pilots outperformed conservative ones in heavy air defenses. NN pilots outperformed route planning based on predetermined and fixed way points as the NN pilot can cope with changes in SAM sites during the UAV flight. A Phase II SBIR program is proposed that will provide several major results. An easy to use workstation prototype, based on phase I principles, will provide route optimization based on constraints including the shortest time and fuel consumption routes consistent with maximum surprise and utilization of resources (e.g. available UAVs). Measures of performance appropriate to the battlefield environment will be provided.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-113 ID#: 39869
Office: WL
Contract #: F33615-91C-5658
PI: DR. PAUL H. LEEK

Title: High Brightness Cathodes for Microfocus X-Ray Generators

Abstract. This proposal would build a test microfocus X-ray generator using the high brightness electron source which was tested in Phase I. This will be used to test the operation and parameters of the high brightness source in a working microfocus X-ray source. We expect this to produce a prototype X-ray generator capable of focussing many more electrons into a microfocus spot. This cathode will also be significantly more stable and have a longer life. As a consequence of the improved performance the prototype generator will be built to operate at a higher energy and beam current than present generators.

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Topic#: 90-006 ID#: 39662
Office: WL/EGLIN
Contract #: F0863091-C0054
PI: DR STEVEN P BITLER

Title: Thermoplastic Binders For Explosive Applications

Abstract. Thermoplastic binders offer process advantages over conventional thermoset energetic material binders by allowing formulation at lower temperatures and unrestricted pot life. Thermoplastics allow greater flexibility in process control and product reprocessing through significantly lower melt viscosity in the fluid phase than the solid phase. Landec Labs has identified a class of thermoplastic polymers with unique rheological and physical properties. The melting range of these polymers can be tailored to be well below the auto decomposition temperature of a particular energetic material. In Phase I, we demonstrated the feasibility of modifying the polymer properties to meet the energetic material binder evaluation criteria. We will continue developing materials that exhibit a narrow tailorable sharp melting profile below 100 degrees C having unusually low viscosity just above the melt. The combination of low melt temperature, low melt viscosity and high filler acceptance make these materials attractive as binders for energetic materials. Landec Labs collaborates with a company that will perform binder evaluation studies and is a potential end product user and formulator of these binders with energetic particles.

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Topic#: 90-030 ID#: 39704
Office: ROMELABS
Contract #: F3060291-C-0130
PI: J.L. Gaudiot, Ph.D.

Title: Programming Parallel Architectures for Knowledge-Based Applications

Abstract. This Phase II SBIR proposal on programming parallel architectures for knowledge-based system applications continues work carried out by Language Systems, Inc. for Rome Laboratory/COES under a Phase I SBIR contract (Contract No. F30602-90-C-0053), which explored the applicability of the data-flow model to non-numeric processing. The proposed work involves requirements definition, design, and implementation of a data-flow development environment as well as validation of the implemented design via experimental development of selected segments of knowledge-based and natural language processing (NLP) systems. Multiprocessor KB/ NLP applications will be considerably simpler to develop in such an environment, and should show substantial improvement in speed of execution, based upon research performed under the Phase I SBIR effort and related work by one of the co-principal investigators, reported in Appendix A.

LIGHTWAVE ELECTRONICS CORP.
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Topic#: 89-092 ID#: 32881
Office: WL
Contract #: F33615-91C-1706
PI: DR TOM KANE

Title: Eye-Safe Coherent Laser Transmitter and Detector

Abstract. We propose an eye-safe diode-pumped single-frequency laser transmitter and heterodyne detector. The pulse energy objective of the transmitter is 25 millijoules, at a pulse repetition rate of 200 Hz and a pulse length in the range from 0.5 usec to 1 usec. Nominal wavelength is the 2.02 um line of Tm YAG. The heterodyne detector would be shot-noise-limited at room temperature, and would have a bandwidth of 100 MHz and a quantum efficiency of greater than 50%. The completed

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transmitter/receiver system would be delivered to the Air Force. The transmitter would be an injection-seeded acousto-optically Q-switched laser pumped by a maximum of four 10 Watt cw laser diode bars. An end-pumping geometry would be used, to obtain maximum efficiency in a diffraction-limited beam. The injection laser and the local oscillator laser would use the single-frequency monolithic ring design. The most difficult aspects of this project will be overcoming thermal effects and optical damage in the transmitter laser. The heterodyne detector was demonstrated in Ph I so we have high confidence that the receiver will meet its objectives.

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Topic#: 90-154 ID#: 39759
Office: PL
Contract #: F19628-90C-0111
PI: DR. THOMAS J. KANE

Title: Construction and Field Test of 2-Micron Doppler Lidar

Abstract: We propose to build a coherent laser radar system at the 2.02-micrometer wavelength of Thulium:YAG. The laser transmitter would consist of a Q-switched laser injection-seeded to achieve single frequency output. The Q-switched laser would be pumped by ten 5-Watt laser diodes. Pump light would be couple into the Tm:YAG laser crystal via optical fibers. The injection-seeding laser and the local oscillator of the heterodyne detector would be diode-pumped single-frequency monolithic ring lasers. The return signal from the telescope would be combined with the local oscillator using a single-mode fiber beam combiner. The goal for the transmitted energy would be 25 millijoules at a repetition rate of 200 Hertz, with a pulse length near 1 microsecond. The heterodyne detector is expected to be shot-noise-limited. The laser system would be field tested before delivery to AFGL for integration into the AFGL mobile laser library. Significant improvement in atmospheric transmission is possible if the Thulium:YAG laser line can be shifted to very slightly longer wavelength. We will attempt to do this, by varying temperature and host material.

LIU AND ASSOC.
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Topic#: 90-156 ID#: 39761
Office: PL
Contract #: F19628-90C-0123
PI: DR S C. OU

Title: Remote Sensing of Global Cirrus Clouds Using Satellite Data

Abstract: The objective of the proposed study in Phase II is to develop a novel, logical and coherent algorithm which will provide the specialized cloud information required for an accurate assessment of radiance degradation under typical cirrus cloud conditions, using data gathered from satellites. The proposed program includes (1) synthetic analyses for the retrieval of temperature, emissivity and fractional cover of cirrus clouds from NOAA AVHRR channels based on the theory of radiative transfer, (2) removal of 3.7 micrometer solar radiances during daytime based on 0.63 micrometer channel radiances and radiative transfer parameterizations, (3) application and verification of the cirrus retrieval algorithm to selected AVHRR data, and (4) preparation of computer software for the cirrus retrieval algorithm and ice crystal extinction program. Once the cirrus cloud temperature is retrieved, mean ice crystal size distribution can be computed from the light-scattering programs developed for hexagonal particles. It is anticipated that the end-product of Phase II will be a module in equation forms and in appropriate computer codes for spectral cirrus cloud extinction, using the cirrus parameters inferred from an effective satellite retrieval algorithm.

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Topic#: 89-234 ID#: 32733
Office: PL/BMO
Contract #: F04704-90-C-0075
PI: DR ROBERT FAN

Title: FIBER OPTICS ORDNANCE

Abstract: This proposal concerns development of fiber optics ordnance to improve the performance, testability, and hardness to nuclear weapons. During Phase I of the program, the feasibility of an optical technique for fiber optics ordnance was demonstrated. The innovative proposed fiber optic ordnance system provides (1) a new method to construct the ETS with the most radiation-resistance fibers, (2) a new method to construct the fiber optic feedthrough unit, (3) a new method to develop the fiber optic high energy termini, (4) the method of laser scanning for more efficient coupling between initiator and fibers,

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

(5) a method to improve the high energy fiber optic connectors. During Phase II, a comprehensive development and test program is proposed. New innovative fiber optic techniques for the laser ordnance will be tested. Further development of the techniques will be carried out and evaluation of the individual components and ETS system will be performed. An extensive series of tests of performance and reliability in realistic test environments will be performed.

LITHIUM ENERGY ASSOC.
246 SYCAMORE ST
WATERTOWN, MA 02172
Phone (617) 484-6453

Title: LITHIUM RECHARGEABLE BATTERY WITH INORGANIC ELECTROLYTE FOR SILO ENERGY STORAGE
Abstract: Not available for publication

Topic# 89-140 ID#: 32976
Office: PL/BMO
Contract #: F04704-91-C-0019
PI: FREDERICK W DAMPIER

MACAULAY-BROWN, INC.
3915 Germany Lane
Dayton, OH 45432
Phone: (513) 426-3421

Title: Transition and Connectivity Between Electronic Combat Digital Models and Hybrid Simulation of EO Sensors
Abstract. The purpose of this program is to develop Electronic Combat (EC) Simulation Technology for Infrared Sensors in a Multiprocessor Environment for the EC Simulation Research Laboratory (ECSRL) and, in particular, for the Integrated Defensive Avionics Laboratory (IDAL). A better near-term hybrid infrared sensor simulation capability is sought that would operate in a real-time man-in-the-loop multithreat environment that would support combined countermeasures, simulated engagements and real-time fusion bus traffic, which would be useful for proving advanced avionics integrated architectures. The results of the program will be a real-time connection of the actual AAR-44 software to missile and aircraft trajectory models, the real-time avionics bus, and the real-time display. These connections will be made with existing high speed microprocessors over a multiprocessor VME bus. The TRAP and ESAMS model would be run as coprocessors that are controlled by an event scheduler like SUPPRESSOR and the AAR-44 software. In order to take advantage of the high resolution IR system highly fidelity missile trajectory measurements, high fidelity models will be used for accurate mid-course trajectory information needed for collision course prediction and ECM effects monitoring on the perturbed trajectory. The goal of this effort is to provide an Infrared/Electro-Optical (IR/EO) sensor system technology utility assessment capability which ASD acquisition system decision makers can apply to measure the merits of alternate sensors to fulfill mission needs. The purpose is to fully develop a methodology to define and present the potential benefits of IR/EO sensors, as well as their multifunction applicability. This is done within the framework of the entire weapon system, and an effort will be to make the sensor benefits "understandable" to the decision maker (program manager). Emphasis during the study effort will be on the avionics system's needs to be assessed primarily by their impact on mission and functional performance. The methodology developed will permit the assessment of: (a) IR sensor system performance capability relative to mission functional capability requirements; (b) impact of sensor system design parameter tradeoffs on sensor system performance to identify technology drivers, and (c) sensor system performance effects on critical avionics attributes. The methodology framework will also be extended to RF sensor systems and its application illustrated in an example to demonstrate the feasibility of its use to assess other avionics sensors.

Topic#: 89-162 ID#: 32466
Office: WL
Contract #: F33615-91C-1720
PI: VERNON D. BEST

MACAULAY-BROWN, INC.
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Phone (513) 426-3421

Title: IR/EO Sensor Trends and Requirements

Abstract. The purpose of this program is to develop Electronic Combat (EC) Simulation Technology for Infrared Sensors in a Multiprocessor Environment for the EC Simulation Research Laboratory (ECSRL) and, in particular, for the Integrated Defensive Avionics Laboratory (IDAL). A better near-term hybrid infrared sensor simulation capability is sought that would operate in a real-time man-in-the-loop multithreat environment that would support combined countermeasures, simulated engagements, and real-time fusion bus traffic, which would be useful for proving advanced avionics integrated architectures. The results of the program will be a real-time connection of the actual AAR-44 software to missile and aircraft trajectory

Topic#: 89-162 ID#: 32466
Office: WL
Contract #: F33657-91C-2032
PI: VERNON D. BEST

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

models, the real-time avionics bus, and the real-time display. These connections will be made with existing high speed microprocessors over a multiprocessor VME bus. The TRAP and ESAMS models would be run as coprocessors that are controlled by an event scheduler like SUPPRESSOR and the AAR-44 software. In order to take advantage of the high resolution IR system highly fidelity missile trajectory measurements, high fidelity models will be used for accurate mid-course trajectory information needed for collision course prediction and ECM effects monitoring on the perturbed trajectory. The goal of this effort is to provide an Infrared/Electro-Optical (IR/EO) sensor system technology utility assessment capability which ASD acquisition system decision makers can apply to measure the merits of alternate sensors to fulfill mission needs. The purpose is to fully develop a methodology to define and present the potential benefits of IR/EO sensors, as well as their multifunction applicability. This is done within the framework of the entire weapon system, and an effort will be to make the sensor benefits "understandable" to the decision maker (program manager). Emphasis during the study effort will be on the avionics system's needs to be assessed primarily by their impact on mission and functional performance. The methodology developed will permit the assessment of: (a) IR sensor system performance capability relative to mission functional capability requirements, (b) impact of sensor system design parameter tradeoffs on sensor system performance to identify technology drivers, and (c) sensor system performance effects on critical avionics attributes. The methodology framework will also be extended to RF sensor systems and its application illustrated in an example to demonstrate the feasibility of its use to assess other avionics sensors.

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Topic#: 90-001 ID#: 39676
Office: WL/EGLIN
Contract #: F0863091-C0046
PI: DR DANIEL G GONZALEZ

Title: Dual-Mode MMW/IR System Using FLAPS Subreflector

Abstract The Phase I SBIR effort showed that use of the Malibu Research FLAPS phased surface allowed design of a dual-mode MMW/IR seeker with superior performance at both wavelengths. This electromagnetic phasing surface, when used as a sub-reflector, allows efficient separation of the MMW and IR focal points, use of a non-parabolic prime reflector, compensation for MMW blockage and conversion to circular polarization. These properties impart major system advantages when used in a dual-mode seeker design. The proposed Phase II project provides for engineering, fabrication and test of a dual-mode MMW/IR antenna, optics and subreflector system, with demonstration imaging detector and RF subsystems, to fully assess and validate the foregoing design and performance.

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Topic#: 90-029 ID#: 39701
Office: ESD
Contract #: F19628-92-C-0050
PI: Dr. Ta-Ming Fang

Title: Application of Hyperdistribution Transforms for Signal Compression

Abstract. We have developed and demonstrated a technique for signal compression/decompression based on new advances in the theory of generalized functions termed "generalized distributions" or "hyperdistributions". We develop a formalism for image representation based on the hyperdistribution transform (HDT), which is also related to wavelets constructed from Hermite polynomials. Compressed images are represented in terms of truncated series of these HDT coefficients. Reconstruction of images from these compressed HDT representations is demonstrated. Presently, with these initial developments compression ratios of 4:1 of unsegmented images are practical. The Phase II research proposed here will improve the compression ratios obtained by this method and the fidelity of the reconstructed images with a view to becoming competitive with conventional image compression algorithms currently on the market. Fast algorithms for carrying out HDT's are currently under development. HDT compression algorithms may have important additional advantages owing to the properties of hyperdistributions under convolution operations. The possibility exists for combining other image processing operations with HDT compression/decompression with corresponding gains in the total computer processing time.

MATERIALS SCIENCES CORP
930 Harvest Dr, Union Meeting Corporate Center
Blue Bell, PA 19422

Topic#: 89-189 ID#: 38861
Office: PL
Contract # F29601-91-C-0003

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Phone: (215) 542-8400

PI: BRIAN J. SULLIVAN

Title: Development of Acceptance Criteria in Thin 2D Carbon-Carbon Materials for Space Structures

Abstract. The properties of carbon-carbon composites make them an attractive class of materials for space system components. These materials, however, due to the nature of their fabrication and processing, inevitably contain defects. These defects will have an effect on the performance on the component which may be severe enough to warrant rejection of the part. The development of imperfection acceptance criteria for C-C material is of prime importance to the successful utilization of these materials in space structures. The expense of these materials requires that mathematical modeling be performed in conjunction with an experimental program of reasonable size in order to correlate material flaws with material performance. The Phase I study focused on demonstrating the feasibility of using mathematical models to predict the properties of thin two dimensional carbon-carbon space structure components containing defects on a scale greater than the composite material representative volume element. Models have been constructed for analyzing a variety of defects, and limited data were available for correlating model prediction with measured results. The objective of the Phase II effort is to develop the necessary computational tools and defect characterization expertise for subsequent incorporation within an inspection and analysis system for determining component acceptance or rejection of "real life" thin 2D carbon-carbon materials.

METRO-LASER

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IRVINE, CA 92714

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Topic#: 89-021

ID#: 31327

Office: AEDC/PKP

Contract #: F40600-91-C-0003

PI: CECIL F HESS

Title: TWO-PHOTON PHOTODISSOCIATION IMAGING OF WATER VAPOR TO MEASURE HYDROGEN/AIR MIXING IN HYPERSONIC PROPULSION

Abstract. Two-photon photodissociation fluorescence spectroscopy is a technique to measure nonintrusively and in real time the concentration of water vapor in combustion devices. The presence of water vapor provides key information of the mixing process of hydrogen and air, and of the density distribution which is needed in propulsion computations. A tunable KrF excimer laser predissociates the water vapor which subsequently fluoresces via two possible mechanisms, direct H₂O or OH photofragment fluorescence. The first mechanism yields quantitative concentration. The second mechanism yields a stronger but qualitative signal. Phase I work demonstrated the feasibility of these two mechanisms by performing point measurements in a laboratory controlled laminar flame. During Phase II, the temperature sensitivity of the fluorescent signal will be evaluated in a range of parameters of interest to NASP, and the measurements will be extended to line images of a turbulent flame and exhaust. These measurements will ultimately be conducted in a realistic flow facility at AEDC.

MICRO-OPTICS TECHNOLOGIES, INC.

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Topic#: 90-057

ID#: 39728

Office: AL

Contract # F41624-91-C-0006

PI: JEFFREY C. BUCHOLZ

Title: Fiber Optic Microphone Development

Abstract. The goal of this program is to develop a fiber optic microphone that can be used for voice communication in a military environment. Fiber optics is chosen because the microphone would then be immune to electromagnetic interference which sometimes degrades performance of conventional microphones. The approach used is to fabricate the microphone transducer from silicon. By this method it is possible to fabricate a small, precision device that can be produced in volume at low cost with high reliability. In Phase II, methods are developed to optimize the performance of the silicon based fiber optic microphone by engineering the materials and optical properties of the sensing membrane of the microphone. The processing technology was further developed to produce compact microphone arrays for noise discrimination and for using the microphone as the input for digital audio systems.

MIDWEST RESEARCH TECHNOLOGIES, INC

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Topic#: 90-162

ID#: 39768

Office: PL

Contract # F29601-91-C-0075

PI: DR. NORMAN A. DRAEGER

Title: Rugged AMTEC Power System Utilizing a Thin Film Solid Electrolyte

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Abstract. This proposal will describe the next phase of a research program to develop certain components of an Alkali Metal Thermal to Electric Conversion (AMTEC) system. Specifically, the program seeks to develop those components which would benefit from thin film technology. The most notable example is the use of a sputtered thin film coating for the beta-alumina solid electrolyte (BASE), which in many respects is the heart of the AMTEC device. Another use of the thin films is the electrode in intimate contact with the BASE. The thin film electrode technology may be utilized, but not further developed, in the project proposed here. It is not the purpose of the present proposal to repeat every detail covered in the Phase I proposal nor in the monthly reports issued during Phase I. Rather, the results of Phase I will be summarized to help serve as a foundation for this Phase II proposal. Likewise, no formal literature review will be made. As each section of the Work Plan is presented, extensive literature will be discussed in terms of how it relates to the proposed work. It should be noted that a great deal of the literature cited has been published in the last six months. This proposal will begin with a brief restatement of the objective of the program. This will be followed by a discussion of how the Phase I objectives were addressed, what progress was made, what was learned, and how this will be used in Phase II. Information regarding the key personnel and facilities to be utilized will be presented.

MIMD SYSTEMS, INC.

1301 Shoreway Road, Suite 430
Belmont, CA 94002
Phone: (415) 595-7303

Topic#: 90-028 ID#: 39700
Office: ESD
Contract #: F19628-92-C-0032
PI: Dr. Robert Larson

Title: A High-Performance Laptop Optimal Planning Workstation

Abstract. The Mission Planning Laptop Computer (MPLC) is a one-man carryable system that is used by aircrews in preflight, in-flight, and post-flight operations. Pre-flight, the MPLC processes and prepares data it receives from a ground station for pre-mission planning. In-flight, the MPLC initializes on-board avionics systems and provides wide ranging mission status/planning functions to the aircrew. The MPLC provides increased mission planning speed and accuracy so as to enhance mission accomplishment and aircrew survivability. Post-flight, the MPLC downloads mission and maintenance data to the ground station. The MPLC provides substantial processing speed, storage capacity, software applications, transportability, growth potential, graphics (both on-screen and hardcopy output), timely processing of tactical decision aids, radar propagation forecasts, automated combat mission folder preparation, mission planning form preparation, and other aircrew support.

MISSION RESEARCH CORP.

5021 Rolling Hills Place
El Cajon, CA 92020
Phone: (503) 842-8891

Topic#: 89-168 ID#: 89WL1-023
Office: WL
Contract #: F33657-91C-2133
PI: WILFRED EGGINGTON

Title: Initial Development of a Small, Remotely Piloted Cyclocrane

Abstract. The results of a recent SBIR Phase I program show that CycloCranes in general, and small, remotely piloted CycloCranes in particular, have the potential of performing several USAF missions effectively and with cost savings. In the proposed Phase II program, it is planned to accomplish the initial development of a small, remotely piloted CycloCrane. Major program tasks include, definition of USAF and non-USAF missions and determination of their requirements, preliminary design of a full-scale CycloCrane and derivation of performance, weights, stability, and control data, design fabrication, test, and data analysis of a subscale free-flight model, preparation of development plans, including costs, for a full-scale prototype aircraft, and determination of comparative cost effectiveness of the CycloCrane in the selected USAF and non-USAF missions.

MOUNTAIN OPTECH, INC

4775 Walnut Str, Suite A
Boulder, CO 80301
Phone: (303) 444-2851

Topic#: 88-158 ID#: 27089
Office: PL
Contract #: F04701-91-C-0078
PI: TIM PENNEY

Title: Spacecraft Erasable Optical Disk Recorder Prototype

Abstract. The SBIR Phase I has shown that an optical disk head could be configured to obtain high altitude operation. Since then a Mountain Optech Write-Once Optical Disk has flown on Space Shuttle missions in 1991. This program would extend the use of optical disk storage in space from write-once to erasable using the magneto-optic technique. This program would propose the exclusive of opto-mechanical, integrated circuit and packaging parts and technology that are made in the USA. The shuttle drive

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

development experience as well as expertise from our development of a military write-once optical disk for a digital map application will be used to study, design, develop, build and test a prototype engineering brassboard erasable optical disk drive for spacecraft application. The use of space grade integrated circuits and assemblies will be maximized.

NCHIP, INC.
1971 North Capitol Ave
San Jose, CA 95132
Phone: (408) 945-9992

Topic#: 90-087 ID#: 39844
Office: WL
Contract #: F33615-92C-1004
PI. David B. Tuckerman

Title: Development of Burn-In Technologies for Unpackaged Integrated Circuits

Abstract. The primary objective of this proposal is to develop and demonstrate a manufacturable process for wafer-scale burn-in of state-of-the-art semiconductor device wafers. The potential technical feasibility of two such techniques was explored in a previous Phase I contract, with positive results. One such approach has been selected as the preferred approach for this Ph II effort. The technique uses a bumped, high-density interconnect "silicon circuit board" to mate face-to-face with the device wafer, providing a functional replacement for the traditional burn-in board. The technical effort is centered on characterizing the quality of the electrical connection, optimizing the burn-in substrate for maximum reusability, and developing the electrical, mechanical, and thermal techniques needed to make the wafer-scale burn-in concept feasible and demonstrable. Two different types of functional device wafers will be configured and tested using the techniques developed herein. The results will be analyzed to determine whether wafer-scale burn-in is in fact an effective substitute for conventional (packaged IC) burn-in.

NETROLOGIC, INC.
5080 Shoreham Place Ste 201
San Diego, CA 92122
Phone: (513) 253-1559

Topic#: 90-190 ID#: 39808
Office: AFOSR
Contract #: F49620-91-C-0078
PI James R. Johnson

Title: Microcomputer-based Vehicle Routing and Scheduling

Abstract. Vehicle routing and scheduling paradigms which were developed under Phase I to assign stops to depots and to arrange stops in a valid tour will be extended to include dual bounded time constrained stops. A dynamic rescheduling paradigm will also be developed to allow schedulers to replan activities as the situation dynamically changes. The capability to optimize over multiple depots will be added to the single depot capability that was developed under Phase I. An annual routing planning tool for LOGAIR was also developed under Phase I. This tool will be extended to include time constraints on cargo delivery, optimize for trunk routes as well as feeder routes, and develop manual route editing and commercial tool interfaces for the LOGAIR scheduler.

NEW HAMPSHIRE MATERIALS LABORATORY
62A Littleworth Road
Dover, NH 03820
Phone: (603) 862-2624

Topic#: 90-100 ID#: 39856
Office: WL
Contract #: F33615-91C-3409
PI: JAMES A. SHERWOOD

Title: Development of a Methodology for Aircraft Tire-Wheel Interface Load Distribution Measurement

Abstract. In late 1986, WL/FIVMA initiated an in-house program to investigate experimental and analytical methods for aircraft-wheel-life estimation and verification. As partial fulfillment of this program, structural models of tires and a new stochastic crackgrowth model for the wheel fracture behavior are being developed. To complement these research efforts a tire-wheel interface model that yields a description of the wheel flange and beadseat loads is required. Presently, the boundary conditions at the tire-wheel interface are unknown. The objective of this research proposal is to design and implement a methodology for accurately measuring the load distribution at the tire/wheel interface. An innovative pressure transducer for measuring static and dynamic wheel-tire interface loads will be developed using piezoelectric crystals. A data collection system using telemetry will be used to record the measured loads. Wheel and tire displacements will be measured using holography and image processing systems. The pressure and displacement data will be used to develop a credible analytical model of the F-16 wheel for investigating the stress distribution a variety of loading conditions where normal and shear forces exist.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

NORTHWEST RESEARCH ASSOC., INC.
P.O. Box 3027
Bellevue, WA 98009
Phone: (206) 453-8141

Topic#: 90-157 ID#: 39762
Office: PL
Contract #: F19628-90C-0116
PI: EDWARD J. FREMOUW

Title: A Proposal to Develop a Prototype Ionospheric Tomography System

Abstract. Transionospheric command, control, communication and intelligence radio systems, including space-based radars, benefit from knowledge of plasma density (radio refractive index) in the ionosphere and gradients therein, as do OTH radars. In a Phase-I SBIR effort, Northwest Research Associates (NWRA) proved feasibility of an ionospheric tomography system (ITS) for providing such information in the form of two-dimensional images, using mutually coherent VHF-UHF signals transmitted from operational DoD satellites to record the path integral of plasma density between such a satellite and a chain of receiving stations. We did so by (1) adapting tomographic inversion software used for naval purposes in ocean-acoustic tomography, (2) designing an appropriate two-frequency coherent radio receiver for performing the necessary measurements, and (3) outlining an inexpensive means for relaying the measurements from remote ground stations to a central tomographic processing facility in CONUS. In proving utility of the tomographic processor for ionospheric imaging, we successfully inverted simulated measurements of our own and such measurements sent to us "blind" by the GL Contract Manager. From tradeoff studies, we also established a suitable receiver layout and related parameters. Herein, NWRA proposes to develop a prototype ITS under a Phase-II SBIR contract.

OPTICS 1, INC
4035 Thousand Oaks Blvd, #105
Westlake Village, CA 91362
Phone: (805) 373-9340

Topic#: 90-011 ID#: 39664
Office: WL/EGLIN
Contract #: F08630-91-C-0051
PI: ROBERT E FISCHER

Title: Corrected Optical Window for Missiles

Abstract There has been for many years a demonstrated need for aerodynamically improved missile dome shapes for IR seekers over the conventional hemispherical shape which results in both heating and drag. In order to virtually eliminate all optical image aberrations from the dome, hemispherical shaped domes consisting of two surfaces which are spherical and concentric to one another have been used almost exclusively. Tangent ogives or similar dome shapes make the optical aberrations virtually impossible to control over any field of view and/or field of regard. This Phase II SBIR program will generate optical means for correcting the optical aberrations of an ogive or similar aerodynamically improved dome. We will use a technique employing binary optical surfaces in order to eliminate the residual aberrations based on the feasibility effort demonstrated in our Phase I program. In addition, a flat paned dome solution will also be pursued

PDA ENGINEERING
2975 Redhill Avenue
Costa Mesa, CA 92626
Phone: (714) 556-2800

Topic#: 90-118 ID#: 39874
Office: WL
Contract #: F33615-91C-5653
PI: DR. LARRY HARRAH

Title: Light Curing Fuel Tank Repair Sealant

Abstract Photochemical curing resins are being investigated to act as sealants for aircraft fuel tank application. Active functional group photo-dissociation reactions are being investigated which will react with sulphydryl, disulfide, and tetrasulfide moieties in polysulfide resins to effect curing (vulcanization) of these resins. Known reactions of a proprietary active functionality are being used. The relationships between molecular substrate structure and the wavelength for which photo-dissociation is effected is under study to extend the activity into the visible range. Practical sealant formulations using photocuring of polysulfides are being developed as are photo processing techniques

PHYSICAL OPTICS CORP.
20600 Gramercy Pl, Suite 103
Torrance, CA 90501
Phone: (213) 320-3088

Topic#: 90-161 ID#: 39767
Office: PL
Contract #: F29601-91-C-0078
PI: FREDDIE LIN

Title: Large-Scale Holographic Optical Neural Network for Target Recognition Applications

Abstract: Physical Optics Corporation (POC) has constructed a 1024-neuron holographic optical neural network (HONN) and

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

successfully demonstrated target recognition operations in the Phase I program. Based on the above experience and POCs leading volume holographic and optical neural network technologies, a practical design and implementation of a prototype large-scale HONN is proposed for the Phase II program. The proposed HONN has the following unique features, not achievable simultaneously by their electronic counterparts. 1) large-scale (consists of $256 \times 256 = 65,536$ fully interconnected neurons and approximately 4.3 billion interconnection weights), 2) large-capacity (stores over 100,000 training patterns, i.e., more than 4 billion synaptic weight information in a 6×6 square inch plate), 3) high-speed operations (processes over 10,000 patterns per second, i.e., 40 trillion interconnection operations per second.), 4) compact size (10x10x10 cube inches packaging size); and 5) low cost (less than \$10,000 for the whole system). By developing a High-Order Inter-Pattern Association (HOIPA) neural network model, the HONN can be used to perform feature extractions and scale-shift-rotation invariant pattern recognition. In addition, POCs proprietary real-time photopolymer will be used to construct an all-optical neural network for adaptive learning operations. The superior target recognition capabilities of the proposed HONN will also be demonstrated.

PHYSICAL SCIENCES, INC
20 New England Business Center
Andover, MA 01810
Phone: (508) 689-0003

Topic#: 90-131 ID#: 39887
Office: WL
Contract #: F33615-91C-2165
PI. TERENCE E. PARKER

Title: Optical Instrumentation for High Temperature and Pressure Fuel Systems

Abstract. The objective of the proposed work is to develop non-intrusive diagnostic methods and a systematic data base to characterize fuel fouling phenomena relevant to high-temperature operation in jet aircraft. The proposed Phase II program will apply and extend the optical measurement techniques demonstrated in the Phase I program. These optical measurements are ideally suited to the fuel fouling problem due to their high sensitivity and non-intrusive nature. The program is structured to include a systematic study over a range of fuels and fuel system conditions to both develop and verify the optical diagnostics and to provide a fundamental data base for fuel fouling behavior. The measurements include ultraviolet and visible absorption, scattering at many different wavelengths, and fluorescence spectroscopy for a large number of excitation wavelengths. The fuel is thermally stressed in a constant wall temperature, high pressure (in some cases supercritical in both temperature and pressure) apparatus exiting into an optical cell. The absorption measurement can be used to quantify the mass of particulate in the flow as well as being exceptionally sensitive to changes in the fuel's chemical composition. Scattering measurements are used to quantify particle size and fluorescence measurements will be used to identify particulate and other species in the fuel fouling environment. The multiple diagnostic approach allows comparisons between the different measurements, which facilitates a more detailed understanding of the fuel fouling process.

PHYSICAL SCIENCES, INC.
20 New England Business Center
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Topic#: 90-133 ID#: 39889
Office: WL
Contract #: F33615-91C-2159
PI MARK ALLEN

Title: Velocity Field Imaging Instrument for High Temperature Supersonic Flows

Abstract. An innovative instrument for imaging measurement of the instantaneous velocity field in a high temperature, high pressure supersonic flow is proposed. The instrument is based on the Doppler-shifted fluorescence from the NO molecule. Planar laser sheet illumination from a single pulsed laser is used together with two intensified CCD array camera systems to image the two-dimensional velocity distribution within a plane in the flow. The Phase I program successfully demonstrated the concept with mean, single-point measurements. Extensive analytical modeling of the proposed instrument predicted good accuracy in the presence of variable temperature and pressure fields. The novel fluorescence strategy and hardware approach has been especially adapted for implementation in practical test facilities. Many of the selected components have already been proven in large-scale testing environments. The Phase II program will design, assemble, and test a prototype instrument assembled from company-provided components. The fully validated instrument will be integrated into large-scale facilities in the Phase III program.

PHYSICAL SCIENCES, INC
20 New England Business Center
Andover, MA 01810

Topic# 90-140 ID#: 39748
Office: PL
Contract #: F04701-91-C-0074

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Phone: (508) 689-0003

PI: DR. CHARLES T. BUTLER

Title: Retrieval of Atmospheric Temperature Profiles From DMSP SSM/T-1 Sounding Data With a Neural Network

Abstract: The proposed study continues the work of a Phase I effort which showed that a neural network trained on simulated SSM/T-1 brightness temperatures representing atmospheric profiles from a broad range of latitudes and multiple sessions could instantaneously synthesize accurate temperature profiles when given unfamiliar simulated brightness temperatures. Moreover, the retrievals showed an accuracy as great or greater than operational methods, even when no geographic or season cues were given to the network. Phase II extends this work to operational DMSP SSM/T-1 sounder data, removes limitations set by the simulation, adds retrieval of level thickness and tropopause information, and brings the method to the edge of exploitation in a product. The long-term goal is to develop a neurally based retrieval system that can combine inputs from multiple sensors to retrieve, using no cues, atmospheric temperature and moisture profiles and other atmospheric quantities such as cloud and wind parameters and surface temperatures in real time over large geographic areas using only a desktop computer and data obtained by direct satellite down-link. PSI will be joined in Phase II effort Aerojet Electronic Systems Division, which is the manufacturer of the SSM/T-1 and other DMSP instruments.

PHYSICAL SCIENCES, INC.
20 NEW ENGLAND BUSINESS CTR
ANDOVER, MA 01810
Phone: (508) 689-0003

Topic# 89-218 ID#: 32607
Office: PL/BMO
Contract #: F04704-91-C-0007
PI: DR MARK G ALLEN

Title: FLUORESCENCE IMAGING DIAGNOSTIC FOR HYPERSONIC WAKES

Abstract: In a Phase I effort Physical Sciences Inc (PSI) analyzed the potential value of a planar laser induced fluorescence (PLIF) diagnostic system for monitoring non-equilibrium chemical behavior in the hypersonic flow fields around ballistic range test vehicles. It was shown that many species associated with air and ablation product chemistry were amenable to sensitive, instantaneous, spatially-resolved imaging detection. PLIF approaches for instantaneous chemical species concentration measurements were particularly appropriate for application to hypersonic wake flows behind test vehicles in ballistic ranges. In the proposed Phase II effort PSI will design, assemble, test, and calibrate a PLIF diagnostic system for use in ballistic range testing. Following testing and calibration, the system will be delivered to AEDC ballistic range G where species imaging in the wakes of hypersonic test vehicles will be demonstrated. The PLIF system will provide a quantum improvement in ballistic range diagnostic capabilities in that it will allow for the first time the direct measurement of such quantities as chemical species histories, wake temperature, and mixing histories.

Q-DOT, INC
1069 Elkton Drive
Colorado Springs, CO 80907
Phone: (303) 590-1112

Topic# 89-098 ID#: 32953
Office: WL
Contract #: F33615-90C-1519
PI: DR. DAVID E REED

Title: Low-probability-of-intercept (LPI) Frequency-hop (FH) Generator

Abstract: The switching transients of present wide-bandwidth frequency-hop (FH) signal generators produce undesirable spectral components. These switching transients are typically caused by electronically switching between local oscillators (LO's) or filters. Another technique for increasing direct-digital-synthesis (DDS) bandwidth is frequency multiplication. Frequency multiplication significantly increases the spurious content of the generator output. These effects increase the detectability of the signal by producing detectable features and by increasing the required output power. An FH signal generator with controlled transients and wide bandwidth is needed to improve low-probability-of-intercept (LPI) performance. Q-Dot proposes an innovative technique for generating FH signals with controlled-hop transitions and sufficient bandwidth such that frequency multiplication and LO switching are not necessary. Transitions were formulated in Phase I which reduce spectral side lobes and produce a clean signal. A technique was also discovered for implementing an LPI waveform generator which allows a signal bandwidth of 2 GHz with an effective clock rate of 6 Gs/s. The generator promises to improve performance of existing FH systems and to give exciting new capabilities in future FH systems.

QUANTEX CORP.
2 Research Court
Rockville, MD 20850

Topic# 90-036 ID#: 39709
Office: ROMELABS
Contract # F30602-91-C-0107

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Phone: (301) 258-2701

PI: Suganda Jutamulia

Title: New Architectures for Optical Memories as Applied to High Speed Electronic Computers

Abstract. We propose to develop a working prototype for a 3D stacked layer optical memory based on electron trapping (ET) materials. A 2D page memory generated by a spatial light modulator (SLM) will be stored in an ET layer of the 3D memory. The feasibility of the proposed 3D memory has been demonstrated in Phase I. In addition to a prototype, advanced designs to meet requirements such as 10 to the 13th power -10 to the 15th power bits storage and throughput of 1 gigabit per second to 1 terabit per second will also be generated.

QUEST INTEGRATED, INC.

Topic#: 89-106

ID#: 33579

21414 68th Avenue South

Office: WL

Kent, WA 98032

Contract #: F55615-90C-3412

Phone: (206) 872-8500

PI: DR. PETER H-T LIU

Title: Numerical determination of aerodynamic coefficients using a gas hydraulic analogy water table

Abstract. The development of a hydraulic simulator by incorporating a scanning laser-sheet technique is proposed for measuring the displacement of surface waves. This technique is essential for carrying out the shallower hydraulic analogy of unsteady compressible aerodynamics, which are otherwise complicated and expensive to investigate by numerical modeling and wind-tunnel testing. The hydraulic analogy would provide an inexpensive opportunity to investigate escape system separation effects in terms of modified aerodynamic coefficients from low speeds up to Mach 7 or higher. The feasibility of the proposed development was successfully demonstrated in Ph I through experiments using a model water table and related accessories. It was demonstrated that an accuracy of 20 microns is achievable by zooming in the CCD camera to take advantage of the superior resolution of photographic film. Integration of the wave displacements measured on grid points of the model surface would allow estimates of unsteady aerodynamic coefficients critical to the performance of the escape system. The facility would be cost-effective for conducting qualitative studies and quantitative experiments of a comparative nature, especially for unsteady and transient flow phenomena. The laboratory results may be used for screening capsule configurations before wind tunnel testing and for validating numerical codes.

QUEST INTEGRATED, INC.

Topic#: 90-170

ID#: 39777

21414 68th Ave South

Office: PL

Kent, WA 98032

Contract #: F04704-91-C-0059

Phone: (206) 872-8500

PI: DR. MOHAMED HASHISH

Title: Development of an Abrasive-Waterjet Isogrid Milling System

Abstract. Isogrids are used in small ICBMs and large payload launch vehicles such as the Titan IV. Current isogrid manufacturing processes, such as conventional or chemical milling, are either economically or environmentally undesirable. A Phase I investigation was conducted to determine the feasibility of machining isogrid structures with abrasive-waterjets (AWJs). It was demonstrated that milling can be done internally on preformed aluminum tubes and that the depth of milling can be controlled to 0.001 inch. It is projected from the Phase I results that AWJmilling will be highly productive. For example, a 48-inch-diameter skirt, as used in medium size missiles, launchers, and jet engines, could be milled with an isogrid pattern in 6.3 hours per foot of length. Significant efforts are required to develop the AWJ technique for implementation and industrial use. These involve technical and economical efforts in Phase II and marketing and commercialization efforts in Phase III. In Phase II, the milling process will be refined and optimized. An AWJ cutting model will be adapted for accurate prediction of milling results. Methods for surface finish control will be developed and demonstrated. Techniques for milling of multidepth pockets will be determined along with techniques for internal milling of conical sections. Components for an AWJ prototype milling center will be specified, built, and demonstrated. For accurate comparative evaluation, the milling demonstrations will address parts currently in production using other methods. An overall economic analysis of the milling process and its strategies will be conducted. Efforts to secure Phase III follow-on funding for commercialization will be started.

QUEST INTEGRATED, INC

Topic#: 90-171

ID#. 39778

21414 68th Ave South

Office: PL

Kent, WA 98032

Contract #: F04704-91-0042

Phone. (206) 872-8500

PI. DR. MICHAEL LIND

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Precision Noncontact Small-Diameter-Bore Gauge

Abstract: Current Peacekeeper and small ICBM guidance systems require measurement tolerances of 5 microinches for the measurement of the internal bores of ceramic bearings used in the SFIR (Specific Force Integrating Receiver) and TGG (Third Generation Gyro). It is projected that SFIRs will continue to be incorporated in many other inertial guidance systems in the foreseeable future, since near-term alternatives are limited. In a Phase I feasibility study, QUEST Integrated, Inc., demonstrated a measurement device capable of characterizing the diameter and cylindricity of these 0.250-inch bores to accuracies of 8 microinches and showed how to extend the measurement accuracies to the sub-microinch range. In Phase II, the measurement head developed in Phase I will be integrated into a complete measurement system for characterizing the small-diameter bores. Phase II will also include exploratory work into expanding the measurement approach to incorporate a surface roughness measurement. The deliverable will be a prototype measurement system that will serve as a cornerstone for a commercial product development effort.

REAL-TIME INTELLIGENT SYSTEMS CORP
16 Summerhill Avenue
Worcester, MA 01606
Phone: (508) 852-4822

Topic#: 90-076 ID#: 39832
Office: WL
Contract #: F33615-91C-1799
PI. PETER E. GREEN

Title: Maintenance System for Artificial Intelligence Knowledge Bases

Abstract: This proposal is for the development of SKRAM which is a software tool whose function is to facilitate the rapid development and ease of maintenance of embedded real-time artificial intelligence software systems. SKRAM has the potential to save up to 60% of the development time and 50% of the maintenance cost of such systems. SKRAM can considerably shorten system maintenance update cycles by allowing easy modification of knowledge while at the same time verifying that the resultant system still works as specified. This proposal is also for demonstrating that SKRAM can be used to take a major part of the Pilot's Associate knowledge base and convert it into Ada code which is capable of execution in real-time. Some of the technical features of SKRAM are the use of dynamically prioritized, distributed, message based, object oriented, real-time Ada runtime environment; the use of independently scheduled rule groups which are automatically converted into Ada code, the ability to reason about the changes in the validity of data with time, the ability to import ART rules, rules which are triggered by the arrival of messages and which can send messages, and the ability to mix hard and soft deadline task scheduling.

ROCHESTER PHOTONICS CORP.
80 O'Connor Road
Fairport, NY 14450
Phone: (716) 377-7990

Topic#: 90-046 ID#: 39715
Office: ROMELABS
Contract #: F30602-91-C-0090
PI: Dr Dean Faklis

Title: Instrumentation for the characterization of diffractive optical systems

Abstract: During the SBIR Phase I research and development effort, several diffractive multichannel optical correlator (MOC) designs were analyzed for automatic target recognition and target tracking applications. It was found that through the use of surface-relief diffractive optics technology, compact and lightweight MOC systems that operate over wide fields of view are feasible and can be implemented with commercially available hardware. To characterize the actual performance of the key optical components of a MOC and related systems and to support further advancements in diffractive optics technology, we have identified innovative methods of testing the diffractive elements for diffraction efficiency and modulation transfer function. During the SBIR Phase II R&D effort, we plan to develop hardware for the characterization of diffractive optical elements with emphasis on the key optical system components for a hybrid optical/digital correlator. Our primary goal is to develop and demonstrate specialized optical testing capabilities using versatile laboratory instrumentation for the characterization of surface-relief diffractive optics. We will configure sophisticated optical, electronic and mechanical hardware for the measurement of diffraction efficiency and image quality on structured surfaces. The versatile instrumentation will be governed by software with a detailed user interface for data acquisition and control of the measurement process. We strongly believe that the integration of our optical testing methods with established fabrication processes will provide a significant innovation for the use of high-quality diffractive optical elements in several military and commercial optical systems.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-061 ID#: 39735
Office: AL
Contract #:
PI: DR. DEAN FAKLIS

Title: Achromatic Helmet Mounted Displays Using Diffractive Optics

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 utilized 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.

SAM TECHNOLOGY, INC.
51 Federal Street, Suite 402
San Francisco, CA 94107
Phone: (415) 227-4900

Topic#: 90-184 ID#: 39807
Office: AFOSR
Contract #: F49620-91-C-0013
PI: Alan S. Gevens

Title: Workstation for physiological indices of mental workload status in the cockpit

Abstract. During Phase I, we analyzed data from four USAF fighter test pilots, and investigated the feasibility of using several electrophysiological measures (brain, scalp muscle, heart and eye activity), alone and in combination, to distinguish between two tasks which differed only in mental workload. Using neural networks, we achieved an average of 97% accuracy in classifying independent testing data for the four subjects as either high or low mental workload. A review of the mental workload literature revealed that a difficult, unsolved problem was to find indices that could be used reliably in cockpits, simulators, or other non-laboratory settings. Solution of this problem is impeded by the lack of suitable systems for collecting and analyzing physiological workload data. Accordingly, we propose to develop an enabling technology to facilitate and accelerate research: the Workload Assessment Research station (WAR station).

SOFTWARE AND ENGINEERING ASSOC
100 E. William St., Suite 200
Carson City, NV 89701
Phone: (702) 882-1966

Topic#: 90-148 ID#: 39753
Office: PL
Contract #: F29601-91-C-0099
PI: GARY R. NICKERSON

Title: Combustion Processes in Liquid Propellant Rocket Engines

Abstract: Computer software is to be developed that will provide a CFD based capability for studying combustion processes in liquid propellant rocket engines. The emphasis is to be placed on cryogenic propellants, specifically LOX/LH2. Engine cycles are to be considered that use, either individually or in combination, the following processes: regenerative cooling, transpiration cooling, ablative liners, and tangential slot injection. The effects of these devices on performance and heat transfer are to be calculated. Pump fed engines are of particular interest. Both conventional and unconventional rocket nozzle configurations are to be treated. An innovative feature of the project is the application of a "Fourth Generation" language to construct a Graphic User Interface (GUI). The GUI is to be designed so that the user is effectively guided in setting up the specific problem to be solved. The software is intended for use on the very fast and relatively inexpensive computer graphic workstations that are now coming on the scene.

SPARTA, INC.
23041 Ave de la Carlota, Suite 400
Laguna Hills, CA 92663
Phone: (205) 837-5200

Topic#: 90-001 ID#: 39683
Office: WL/EGLIN
Contract #: F08635-91-C-0201
PI: DR OWEN C HOFER

Title: Munition Neutralization Laser Development and System Analysis

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Abstract: Our Phase I results showed: 1) Nd:YAG and CO₂ lasers operating at elevated coolant temperature exhibit a 20% decrease in output power and increase in beam divergence, 2) threat munitions can be acquired within the required timelines and 3) thick-walled munitions can potentially fail by the same laser damage mechanism as thin-walled munitions. Our proposed Phase II effort will greatly expedite development of a laser system for performing the airbase munition clearing mission. We propose two basic tasks and two optimal tasks for Phase II. In Task 1 a single Nd:YAG laser head will be developed which will produce approximately 500 watts at 55 degrees coolant temperatures. In Task 2, a Fire Control test bed will be developed and used to determine the sensor requirements and timeliness to perform the damage assessment function and the target acquisition function. In Task 3, the probable laser damage mechanisms for thick-walled munitions will be investigated and the impact on laser system performance requirements derived. In Task 4, multiple heads will be combined into a single system for interim testing. The same laser system will have commercial applications in welding, cutting, and processing of highly reflective metals such as copper and aluminum.

SPECTRAL SCIENCES, INC.
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BURLINGTON, MA 01803
Phone: (617) 273-4770

Topic#: 89-220 ID#: 32641
Office: PL/BMO
Contract #: F04704-91-C-0008
PI DR ROBERT L SUNDBERG

Title: RV OPTICAL SIGNATURES PROGRAM

Abstract: This project addresses the need for improved wake-plume optical signature modeling of a reentry vehicle (RV). In Phase I the optical properties upgrade approach was demonstrated by the addition of NH₃ 10 um band and the extension of the Co₂ 4.3 um band from a temperature of 3000 to 5000 k. Also in Phase I, a comparison between NLTE and LTE (SIRRM) 4.3 um Co₂ emission showed that the LTE model overpredicted the transmitted in-band intensity by more than an order of magnitude. The overall objective of the Phase II program is to improve RV optical signature predictions by upgrading the optical properties data base and by developing an NLTE kinetics/radiance model. The specific Phase II objectives are: (1) addition of new radiating atomic, molecular and particle species appropriate to RV wake-plume flows which emit from 0.7 To 25 um, (2) extension of the SIRRM optical properties data base from an upper temperature of 3000 k to a temperature of 4000 k, (3) development and delivery of an integrated NLTE kinetics/radiation transport model, and (4) utilization of the new optical properties data base in the analysis of RV optical field-measurements

SPIRE CORP.
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Topic#: 90-039 ID#: 39711
Office: ROMELABS
Contract #: F19628-91-C-0176
PI Stanley M. Vernon

Title: Development of An Advanced MOCVD Reactor for Growth of Highly Uniform InP-Based Materials

Abstract: The proposed research project is to develop an advanced-design MOCVD reactor for the growth of abrupt structures on large-diameter substrates. Our targeted goals include the growth of InP-based materials on up to 4" diameter wafers. The heart of the design is a unique water-cooled gas-inlet injector assembly to distribute the reactant gases uniformly over the entire susceptor area. The watercooling feature allows this injector to be located very close to the hot growth surface, thereby permitting the deposition of the extremely abrupt structures needed for state-of-the-art devices. A number of injector designs will be studied by the use of an innovative bisectyl-luminescence flow-visualization technique. After selection of the best design, the reaction chamber will be connected to a standard Spire gas-handling/reactor-control system. Performance of this reactor will be critically evaluated by the growth and characterization of (1) GaAs, (2) In_xGa_{1-x}As and (3) an InP-In_xGa_{1-x}As-In_xAl_{1-x}As high electron mobility-transistor structure. The proposed research and development effort is expected to lead to a reactor design which surpasses the currently available technology. Spire is well-positioned in the marketplace to proceed with Phase III commercialization, during which the engineering details of the complete system will be finalized. Market studies have shown a definite need for the type of single-wafer system being developed here, and thus its commercialization meshes well with Spire's business plans. As a supplier of deposition systems, epitaxial wafers, and contract research to the industry, Spire is firmly committed to MOCVD technology and to its commercialization.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 89-219 ID#: 32622
Office: PL
Contract #: F04704-91-C-0039
PI: DR. NASSER KARAM

Title: SIMOX Radiation Hard Linear Bipolar Structures

Abstract. Work in Phase I investigated the combination of a variety of defect reduction methods developed at SPIRE to produce Separation by Implantation of Oxygen (SIMOX) material with the very low defect density top layer that, along with a thick epitaxial silicon layer, is required for fabrication of linear bipolar devices. Incorporation of these methods results in low defect SIMOX wafers. We have recently discovered and developed a more economical, low energy SIMOX (LES) process which also results in the production of wafers with a very low defect density silicon top layer. The Phase II effort will develop a radiation hard linear SIMOX wafer structure process at Spire, including low defect, thick epitaxial growth. Various defect reduction processes, including LES as well as single and multiple implants at standard energy, will be used to produce wafers for this work. These wafers will be delivered to Texas Instruments (TI) for fabrication of linear integrated circuits using their trench isolation process. TI will also evaluate and compare the neutron hardness of the circuits fabricated in the wafers produced with the various defect reduction processes. Yield and radiation test information will be used to evaluate possible modifications to the SIMOX process.

STR CORP.
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Reston, VA 22091
Phone: (703) 648-9262

Topic#: 90-069 ID#: 39823
Office: WL
Contract #: F33657-91C-2181
PI: W. LEON GOODSON

Title: Air Force Fighter Force Planning Analysis Framework

Abstract: The Air Force faces increasing pressures from a variety of directions, including internally, to improve the coherence and balance of its force planning process for conventional forces. The analysis community needs to be of far greater help to the leadership than in the past. Now, with the conceptual development of Gen Glenn A. Kent's 'strategies to task' analysis framework, and the development of STR Corporation's OME-III methodology which treats the absolutely dominant "operational art," we can be. In Phase I, we successfully demonstrated the feasibility of implementing the Kent force planning framework using OME-III as the primary analytic engine. Parametrics were created for fighter force mix, aircraft characteristics, and air-to-ground munitions. In Phase II, STR will develop both effectiveness and cost parametrics for a variety of scenarios. In addition to delivering the parametrics, STR will develop and deliver various analytic tools to facilitate use of the parametrics.

STRESS TECHNOLOGY, INC.
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Rochester, NY 14623
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Topic#: 90-125 ID#: 39882
Office: WL
Contract #: F33615-91C-2166
PI: TONY LAM

Title: Computer Aided Structural and Life Analysis of Turbine Engine Components

Abstract: A computer based program for structural analysis and life prediction of rotating turbine components is proposed, using a methodology which has been successfully demonstrated by STI to predict service life of turbine and compressor blades, rotors and disks. The prime objective of Phase II is to complete development of a user-friendly program which the Air Force would use to independently evaluate the operating stresses and remaining service life of selected jet engine rotating components. In phase II, STI will select and develop appropriate software routines for the analysis, processing and solution of jet engine compressor and turbine blade designs. The routines will be developed to extend the finite element formulation and solution capabilities for computing steady state, thermal and dynamic stresses of jet engine bladed disks. Phase II will represent advanced development of jet engine blade life prediction programs. Upon completion of Phase 2, Jet Engine Compressor software (Jet Engine) will be available for use as an analytic tool to support the design, development and improvement of prototype engines into the 1990's.

SUNOL SCIENCES CORP
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DUBLIN, CA 94568

Topic#: 89-209 ID#: 32529
Office: PL/BMO
Contract #: F04704-91-C-0010

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Phone: (415) 828-4940

PI: PATRICK S SPANGLER

Title: SHOCK FOCUSING VALIDATION

Abstract: Shock focusing damage is of concern for any system in which a convex curved surface is exposed to high-intensity radiation. Prior to Phase I, the physics embodied in standard finite-difference techniques always predicted unlimited stress amplification from shock focusing. The Phase I program identified the shock rise-time as the mechanism that limits these stresses and identified shock dispersion and thermal conduction as natural mechanisms that limit the rise time and hence stress amplification. A Phase II program is proposed to substantiate experimentally the Phase I results and assess shock focusing for selected nose-tip materials and designs. Extensions of the Phase I techniques to highly non-linear materials and to conical nose-tips will be explored. Results will be documented in a form that design engineers can use with industry-standard computer codes to determine accurately the importance of shock focusing effects.

SURFACE OPTICS CORP.

Topic#: 90-003

ID#: 39681

P.O. Box 261602

Office: WL/EGLIN

San Diego, CA 92126

Contract #: F08635-91-C-0206

Phone: (619) 578-8910

PI: MARTIN BRESSLER

Title: Monostatic Bidirectional Laser Reflectometer

Abstract: The design of laser radars and the determination of laser radar detectability of various vehicles require accurate data on the monostatic reflectivity of many materials to far-field laser illumination of many different wavelengths. Far-field measurements usually require field experiments and large source to target distances but a laboratory setup at Surface Optics Corporation has demonstrated that accurate, far-field measurements can be made within a small laboratory space. This prototype MBR is difficult to operate, however. It requires long hours of alignment and adjustment and its data acquisition capability is much less than what should be achievable with this type of instrument. The specific objective of the just completed Phase I program of design, analysis and experiment has been to produce a complete design for an improved MBR systems. This objective has been completely met in a compact, completely automated and computer integrated design which is described in detail in the Phase I final report. A Phase II program is proposed to fabricate, assemble, test, deliver, and install a complete MBR system including computer, and software for operating the instrument, reducing the data, and for using the data to develop laser radar signatures.

SURFACE OPTICS CORP.

Topic#: 89-026

ID#: 38867

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SAN DIEGO, CA 92131

Contract #: F40600-91-C-0002

Phone: (619) 578-8910

PI: DR JOHN T NEU

Title: IN SITU OPTICAL PROPERTY MEASUREMENT SYSTEM

Abstract: Surface Optics Corporation (SOC) proposes the detailed design, fabrication, testing and demonstration of an in-situ, bidirectional reflectance (ISBDR) measurement system during a one year, Phase II program. The ISBDR was designed for measuring the infrared reflectance properties of the surface of jet engine exhaust components and other objects without having to remove samples of these surfaces. A successful Phase I effort has resulted in a small, movable system design - a system that can make measurements within a jet exhaust structure over a full range of incident and reflectance angles and over a wide spectral range; with radiometric and angular accuracies achieved by larger, fixed laboratory systems, and which incorporates means for automated measurement sequences and data reduction. The proposed Phase II effort will result in a complete prototype system including computer, operations and data reduction software. The complete system will be tested, demonstrated, and delivered to the Air Force.

TACAN CORP.

Topic#: 89-031

ID#: 31640

2330 Faraday Avenue

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Contract #: F19628-87-C-0124

Phone: (619) 438-1010

PI: Michael M. Salour

Title: Optical Switching for Ultrawideband Technology Applications, Phase II

Abstract: A new technology is proposed for investigating reliable and high-speed switching for ultrawideband technology applications. The technology is based on switching with picosecond laser pulses in single switches or in multiple switches as

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part of a frozen hertzian wave generator. The technique that is proposed here has several advantages when used with a ultrawideband technology. The advantages include 1) reliable solid state technology, 2) coded, high-repetition-rate signals, 3) very fast risetime for electrical pulses, 4) Use with spread spectrum communication or all weather radar ($0.5 \text{ GHz} < f < 10 \text{ GHz}$), 5) transmitter impedance-matched to antenna, 6) potential for switching very high voltages, and 7) applications to time division multiplexing. During phase II we will design and construct an optoelectronic switching device that can be used for numerous ultrawideband technology applications. We will also develop a model for this device and compare our experimental results to the predictions of the model. New switching materials will also be investigated and applications of this technology to ultrawideband communications will be explored.

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Topic#: 90-031 ID#: 39705
Office: ROMELABS
Contract #: F30602-91-C-0101
PI: Miles Murdocea

Title: Development of a Digital Optical Interconnection Technology

Abstract. The Phase I SBIR effort resulted in the gate-level design of a Gaussian elimination processor that solves systems of linear equations and resulted in the finding that design restrictions such as (1) uniform logic operations, (2) simple regular interconnects, and (3) small fan-ins and fan-outs do not by themselves pose severe limitations on digital optical processor performance, but taken in conjunction these restrictions do in fact reduce overall performance, primarily in increased latency and increased gate count. The Phase II effort proposes the development of novel optical interconnection technology that relaxes the fan-in/fan-out and regular interconnection constraints. The development of this interconnect technology is coordinated with the design and fabrication of mask sets for an all optical digital processor that is being designed and built in the Photonics Center at Rome Laboratory/Griffiss AFB. The Phase I Gaussian elimination architecture will be modified to correspond with the interconnection technology that results from this Phase II effort. The anticipated results from the Phase II effort are a viable optical interconnection technology for a digital optical processor, and a physical design for an optical Gaussian elimination processor that utilizes this interconnection technology.

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Topic#: 90-102 ID#: 39858
Office: WL
Contract #: F33615-91C-3007
PI: LEE F. WEBSTER

Title: Model Borne Data Management System

Abstract: This proposal continues the development of a stand alone wind tunnel data processing and acquisition system. Phase I designed the miniaturized solid state model mounted data acquisition and processing hardware including transmitter and control circuitry which allows the data stream to be transmitted through the support string to a desk top computer which is used to control the testing, record the data, monitor test progress, and provide new real time test results for comparison to predictions. This Ph II proposal prototypes the hardware and software required to evaluate the R&D and designs resulting from Phase I effort. The prototype system will be adapted to fit an existing hypersonic model and tested to demonstrate the soundness of the design and its readiness for use in other wind tunnel test scenarios. A major objective will be to establish and demonstrate the procedures for using the system and the reduction in required testing time and the increased test efficiency and economy.

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Topic#: 90-107 ID#: 39863
Office: WL
Contract #: F33615-92C-5802
PI: Dan Wood

Title: Discovery System for Manufacturing

Abstract. ThinkAlong Software proposes to complete an application of its interactive scientific discovery system--The Scholar's Companion-- in the realm of manufacturing, as a computer system which is capable of performing some of the duties of a scientist looking to discover new and important ideas. The intent of this project is to build and test applications of a data exploration and theory formation system in the manufacturing domain. Specific application areas are process control, with QPD knowledge base, and electron microscopy, with the QDPA knowledge base.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-112 ID#: 39868
Office: WL
Contract #: F33615-91C-5655
PI: TAI-IL MAH

Title: Development of Continuous Refractory Oxide Eutectic Fibers

Abstract: The utilization of Edge-defined, Film-fed Growth (EFG) technique is proposed to produce continuous $Al_2O_3-Y_3Al_5O_{12}$ (YAG) Eutectic fibers. The proposed program will proceed as follows. 1) optimize processing conditions for growing continuous alumina-YAG eutectic fibers using a commercial vendor's equipment, 2) construct an automated state-of-the-art continuous fiber growth apparatus, 3) use the apparatus built to produce large quantities of fiber and measure the mechanical properties of these fibers, and 4) establish the processing-microstructure-property relationship of the eutectic fibers.

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Topic#: 90-195 ID#: 39816
Office: AFSC/NAS
Contract #: F33657-92-C-2013
PI: JONATHAN M HAGER

Title: HEAT FLUX PIPE PROBE FOR HYPERSONIC COMBUSTOR RESEARCH

Abstract: Not available for publication

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Topic#: 89-162 ID#: 32414
Office: WL
Contract #: F33657-91C-2289
PI: STANLEY L. SPAULDING

Title: Development of the Warfighting Effectiveness Evaluation System

Abstract: This proposal is for modification of an SBIR Phase I contract to provide for an initial development effort associated with a proposed SBIR Phase II effort. The objective of the Phase II effort is the development of an operational system for use in evaluating alternative tactical airlifter design concepts. The system would relate measures of tactical airlifter productivity to measures of the warfighting effectiveness of the supported force. When used in conjunction with a simulation of tactical airlift operations such as GAMM, the system would provide a rapid turnaround analysis capability to evaluate the warfighting effectiveness impacts of airlifter and transport system capabilities, airlifter roles and missions, and airlifter fleet size and mix. It would provide quantitative warfighting effectiveness results associated with specific airlifter design alternatives. The system would include regression relationships based on analysis of detailed results of parametric runs of the VECTOR-3 AirLand campaign model; each run would describe transport system productivity and warfighting effectiveness in a simulated war. This Phase I modification would allow for development of a prototype version of the system software into which the actual regression relationships developed in Phase II would later be embedded.

VIGYAN, INC.
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Topic#: 90-099 ID#: 39855
Office: WL
Contract #: F33615-91C-3006
PI: PARESH PARIKH

Title: Post-Processing of CFD Data

Abstract: A general purpose graphics post-processor program for analysis of large databases is proposed. The software will be able to handle not only the many types of data generated by various flow codes in use today, but also data of general 3D nature produced from wind tunnel measurements and from interdisciplinary CFD. Advanced graphical techniques like volumetric rendering and ray-tracing have been proposed to highlight certain special features of the flow. Animation capabilities are proposed for the analysis of unsteady databases. A successful completion of the project will result in a user-friendly graphics tool for a quick analysis of complex, 3D data assets routinely produced by today's software and hardware capabilities.

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-086 ID#: 39842
Office: WL
Contract #: F33615-91C-1816
PI: SOWMITRI SWAMY

Title: Adabra: A Rapid Prototyping Environment for Packaging

Abstract: Solving a packaging problem has been described as a search for an optimum in a sea of constraints. We propose a rapid prototyping environment, Adabra, that provides packaging solutions at the carrier, card and system level. Adabra uses a formalism known as Parameter Propagation Network (PPN) to embed technology specific information. The formalism is uniform across technologies, but can be customized to individual technologies, and is used in Adabra to design a packaging solution. The core of Adabra's prototyping environment consists of a propagator engine that propagates data values across Parameter Propagation Networks. Other features include a graphical user interface, a server to connect to third party tools, and a build architecture. A separate maintenance architecture allows the integration of new PPN's to update Adabra's technology base. Adabra will be implemented in two parts the first part will provide carrier and mem design solution capability, the second part will provide pcb design capability and bring the implementation to the status of a product.

VOSS SCIENTIFIC
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Topic#: 90-163 ID#: 39769
Office: PL
Contract #: F29601-91-C-0077
PI: DR. ROBERT A. KOSLOVER

Title: Rapid Determination of HPM Testing Fidelity in Anechoic Chambers

Abstract. Test conduct personnel must address HPM test fidelity issues daily, but seldom have sufficient data to make accurate on-the-spot analyses. They must cause chamber conditions to mimic uniform plane-wave illumination to simulate battlefield conditions, but this is difficult for large targets with multiple POEs, such as aircraft. Test personnel find little help from the big EM codes (GEMACS, NEC-BSC, etc.), which are very hard to learn and use, but very easy to misinterpret, and don't handle key issues like absorber wave-scattering at all. Making detailed RF measurements to quantify fidelity for every test is unacceptable; there isn't enough time, and the measurements required are complex. We propose to develop a powerful and innovative computational tool, for use directly by test conduct personnel, to both rapidly and accurately assess HPM test fidelity. The Phase II software will incorporate sophisticated and highly efficient computational methods, but be extremely easy both to use and interpret. Users will not need detailed knowledge of microwave physics, and will find relevant help "on-line". This Phase II work will build upon the highly successful Phase I prototype, already a valuable tool to assess HPM test fidelity. New capabilities will greatly assist test personnel, with more antenna and test object options and extremely rapid analyses of departures from plane-wave conditions. Code validation and low-frequency experiments will also be performed.

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Topic#: 90-130 ID#: 39886
Office: WL
Contract #: F33615-91C-2161
PI: LAVERN D. WEDEVEN

Title: Vapor Lubricated Bearing Technology

Abstract: The objective is to develop the ability of vaporized liquids to lubricate high temperature surfaces into the lubrication technology needed for advanced gas turbine engine bearings. Condensed or thermally deposited vapors of perfluoroalkylether and phosphates are to be used to lubricate hybrid (ceramic/metal) angular contact ball bearings to 800F and a roller bearing to 1000F. The goal is to extend reliable elastohydrodynamic lubrication mechanisms to elevated temperatures using a new concept of Variable Property (VP) lubrication where thin film condensates increase in molecular weight with temperature.

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Topic#: 89-220 ID#: 32638
Office: PL/BMO
Contract #: F04704-91-C-0012
PI: KURT GOLDEN

Title: FAST PLASMA/ANTENNA BORESIGHT ERROR CODE

Abstract: Advanced reentry system simulations need comprehensive flow field plasma, antenna window, aerothermal heating and

AIR FORCE ABSTRACTS OF FY91 SBIR PHASE II AWARDS

ablation, and reentry antenna prediction capabilities. The coupling between the various subsystems, antennas, plasmas and hot ablating antenna windows are important to the performance of advanced on-board electromagnetic (EM) sensors and coherent signal processing. The proposed Phase II research will modify and combine existing state-of-the-art antenna window aerothermal, flow field plasma and antenna em analysis codes into an integrated set of computer modules that can be run in a stand-alone mode or inserted into an existing hi-fidelity six-degree-of-freedom (6DOF) sensor simulation. The codes will be documented, be validated against ground and flighttest data, and will be easy to use through interactive screen interfaces.

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Topic#: 90-001 ID#: 40945
Office: WL/EGLIN
Contract #: F0863091-C-0059
PI: DR YOU-WEN ZHANG

Title: High-Speed High-Density Optical Video Data Memory

Abstract: A new optical video data memory system design is proposed which can reach 4 G bits/sec data transfer rate (500 frames/sec speed, 1024x1024 pixel resolution, 8 bits/pixel depth) and 40 G bits storage capacity (10 seconds recordings of above data stream). To reach the design goals, following new technologies are adopted: 1. Multi-channel, multi-head parallel writing technology. 2. Optical fibers to deliver the laser diode sources to the disk drive. 3. High frequency modulation to reduce the feedback noise of the laser diode. 4. Split head to reduce the moving mass, multi-function holosten to reduce the weight of the objective lens. Thus the access time is reduced, the servo performance is improved, and the system structure is simplified. 5. Partial polarization beam splitter and differential amplifier to enhance the Signal to Noise ratio. In addition to above new technologies, in our design, a new Magnetic-Optic (M-O) material Iron Garnet (discovered in our Phase I research, it has 10 times higher S/N ratio than those common materials) and a frequency double blue laser with wavelength 428 nm will be used, thus the data transfer rate and storage capacity can be increased 4 times in comparison with the old system which uses a common M-O material and a 830 nm laser diode. Because of the high S/N ratio of new material, the disk speed can be doubled even triple. In our design, new data compression technology also will be used. To demonstrate the new design, a single-channel/single-side optical disk memory system using new M-O material Iron Garnet and above new technologies will be built up. Based on this Base Program, there are two options. The Option A will use Iron Garnet and blue laser to build a 4-channel system and option B will use data compression to fully reach the design goals of 4 G bits/sec data rate and 40 G bits storage capacity.

DARPA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 89-028 ID#: 8900321
Office: MTO
Contract #: DAAH0191CR138
PI: EVERETT E. KING

Title: GaAs Wafer Level Testing for Radiation-Induced Transient Upset

Abstract. This Phase II proposal is directed toward developing a wafer-level test system which can simulate transient nuclear radiation effects in GaAs devices and integrated circuits. The approach is based on exposing the back side of the GaAs test device with a pulsed laser which has both an appropriate wavelength to penetrate the wafer and an intensity high enough to create the required equivalent dose rates in the device. The system can be used to characterize the transient radiation hardness of various GaAs processes and device structures as well as to perform transient radiation qualification and screening of parts. Anticipated benefits/potential commercial applications - a method using wafer-level laser-induced transient upset as a simulation of ionizing radiation for GaAs ICs was demonstrated in the Phase I program. Measurement of the transient upset level is critical to the development and testing/screening of radiation-hard technologies. A successful project will provide the benefit of a cost-effective and quick feedback for the optimized design of GaAs devices and circuits intended for applications requiring ultra-high upset thresholds. The proposed simulator will be able to satisfy the doD radiation transient testing and screening requirements for ultra-high upset threshold GaAs IC, and will provide a simulation technique that is uniquely suited for the development of radiation-hard GaAs IC.

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Topic#: 90-033 ID#: 9010270
Office: MTO
Contract #: DAAH0191CR285
PI: MCKRIS YOUNG

Title: Large Diameter Crystal Growth of INP Using the Vertical-Gradient-Freeze Method

Abstract. In the Phase I program of large diameter crystal growth of GaAs using the vertical-gradient-freeze (VFG) method, we at American Xtal Technology (AXT) have designed and fabricated a furnace system capable of growing 4" diameter GaAs single crystals. The system includes the furnace heater, temperature control system, crystal growth crucible, ampoule, and the pressure vessel. A vgf 4" diameter single crystal, 1.25" Long was obtained, which is a first in the GaAs industry. The E.P.D. Was 1,700/cm². The resistivity was 2.26×10 ohm-cm and very uniform across the whole wafer. Cost analysis shows that cost per wafer is very competitive, compared with the LEC method. In the Phase II program, we propose to grow longer (5.5 Kg.) 4" Diameter GaAs crystals, to optimize crystal growth parameters and to consistently produce chemically and electrically uniform wafers. Effort will also be put on increasing the single crystal yield by eliminating the sources of twinning, lineage and polycrystal formations. Doping experiments will be performed to provide different doping level wafers. After test marketing, we will identify resources for implementing commercial scale production of 4" VGF wafers, which is expected in the Phase III program. Anticipated benefits/potential commercial applications - the industries in lasers, optoelectronics, integrated optoelectronic devices and large scale integrated circuits will all benefit from the large diameter GaAs wafers with low dislocations and good uniformity.

APPLIED SCIENCE AND TECHNOLOGY, INC
35 CABOT ROAD
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Topic#: 90-026 ID#: 9010699
Office: DSO
Contract #: DAAH0192CR109
PI: RICHARD POST

Title: Computational Modeling of Fluid Flow in PECVD Reactors

Abstract. In topic 90-026, darpa identified the need for mathematical modeling of fluid flow in plasma enhanced chemical vapor deposition (PECVD) reactors. High quality computer modelling of the fluid dynamics of thermal chemical vapor deposition (CVD) reactors has been established for silicon deposition in rotating disc reactors. The addition of plasma to CVD allows localization of heat deposition to the interior of reactors in a manner which minimizes contamination of process gases by impurities, and permits additional chemistry to take place through direct electron excitation and radical production not accessible with thermal CVD. Plasma enhancement of CVD enables a substrate temperature reduction, as chemistry can proceed in the gas phase which is not possible at the lower surface temperature. We will specialize our modelling to this subatmospheric to atmospheric pressure regime where a fluid description is accurate and can be applied to diamond deposition systems. The model will include a Boltzmann description of the plasma, a 2D electro-magnetic field solver, a fluid 2D code including multispecies

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transport, a hydrocarbon chemistry code, and a surface chemistry package. The code will be validated by comparison to experiments. Anticipated benefits/potential commercial applications. (1) a code to model peevd of diamond thin films (2) improved diamond deposition reactors (3) improved understanding of the Diamond deposition process (4) lower cost IR domes and diamond multichip modules.

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Topic#: 90-027 ID#: 9010727
Office: DSO
Contract #: DAAH0192CR111
PI: MICHAEL TZANNES

Title: Phase Space, Sampling, and Interpolation Applications of Compactly Supported Wavelets

Abstract: The recently discovered compactly supported wavelets offer promise for improving performance in signal representation, noise suppression, transient analysis, compression for transmission and storage, and signal interpretation. Compactly supported wavelets are a special class of affine wavelets that have attractive properties of representing localized phenomena such as transients. They are especially attractive for computer calculation and admit efficient vlsi hardware implementations. Interpolation and reconstruction are fundamental to digital signal processing. Comparison of a wavelet-based interpolation/reconstruction theorem with the Whittaker-Shannon sampling theorem is basic to an understanding of the ways in which wavelet-based and fourier-based methods differ, and to characterizing the applications where each provides the better performance. This will provide a foundation for comparison with other methods, such as the gabor and the Weyl-Heisenberg representation. Aware will investigate the application of compactly supported wavelets to specific problems that are concerned with uniform and non-uniform signal interpolation, and signal reconstruction from sampled data. Particular attention will be given to speech signal data. Anticipated benefits/potential commercial applications - benefits are anticipated in speech compression and synthesis products, in speech segmentation subsystems for commercial and military applications; and in other military signal processing applications.

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Topic#: 90-012 ID#: 9010230
Office: ASTO
Contract #: DAAH0191CR325
PI: R SCOTT MORRIS

Title: Fluorescence Imaging Sensor for Relocatable Target Detection

Abstract. A Phase I study of laser-induced fluorescence (LIF) in various materials has demonstrated the feasibility of an active LIF sensor to detect and image relocatable targets. An eighteen month Phase II program is proposed, consisting of four tasks, to develop such a sensor system. First, LIF studies will be extended to cover a range of target observables. Second, a laboratory system will be designed and constructed, using an available high power ultraviolet (UV) laser as an active illuminator and an intensified ccd camera for image capture. Third, this system will demonstrate imaging of both LIF and reflected UV from targets at distances of 500-1000 m and the sensor performance will be characterized. Finally, as an optional task, a detailed design study of a prototype airborne sensor will be carried out. This program will reduce the risks of the subsequent development of an airborne sensor for relocatable targets where the radar, visible and infra-red signatures have been suppressed. Anticipated benefits/potential commercial applications - the proposed research will lead to a new capability in ultraviolet imaging technology. Military applications include detection of relocatable targets, camouflage unmasking, biological agent detection, obstacle avoidance and IFF. Commercial applications include crop inspection, oil slick detection and mapping, etc.

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Topic#: 90-072 ID#: 9020054
Office: MTO
Contract #: DAAH0192CR195
PI: HARRY SHIELDS

Title: Excimer Laser-Produced Plasma X-Ray Source

Abstract. A Phase II SBIR program is proposed to develop a high-brightness x-ray source for advanced semiconductor fabrication by x-ray lithography. The x-rays are generated in a laser-produced plasma which is created by a high intensity excimer laser. Two key elements in the laser system are an advanced high power excimer laser which embodies technology originally developed for the U.S. Navy submarine laser communications program and a patented pulse compressor developed by JAMAR. The phase

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I program has successfully carried out several important feasibility demonstrations including, - compression of the laser pulse duration from 60 ns to 4 ns and extraction of 1 j pulse energy, - focussing of high peak power pulses to a intensity of 2 tw cm-2 on x-ray target materials (120 μm focal spot diameter), - generation of 8-14 Å x-rays with an efficiency of ~5%. The proposed Phase II program will extend this work to higher target intensity, higher conversion efficiency and higher pulse repetition rate to result in a source brightness of ~1.5 W/sterad. Tasks are included to address system engineering for commercialization and interface with a wafer stepper. Anticipated benefits/potential commercial applications - this source will address the requirements of two market segments where x-ray lithography using synchrotrons is not cost effective. First, it will provide a low cost, versatile x-ray source for process development and device prototyping. Second, it will be sufficiently powerful for manufacturing of low volume, specialized devices such as military and commercial application specific integrated circuits (ASIC's).

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Topic#: 90-050 ID#: 9010156
Office: LSO
Contract #: DAAH0191CR208
PI: R. RAUH

Title: Variable Emittance Coatings for Infrared Signature Suppression

Abstract. A program to develop variable emittance coatings for infrared signature variation is proposed. The coatings would allow active modulation of the IR emittance or reflectance of surfaces by the application of a low voltage (<5v) dc electric current. The variable emittance coatings are based on electrochromic optical switching in thin films of transition metal oxides. The emittance modulation is obtained by varying the infrared reflectance (or absorbance) of an electrochromic material that overlays an emissive (or reflective) substrate. The emittance would be actively and reversibly modulated, requiring approximately 0.1 Wh/m² for full emittance switching. A variable emittance structure for the 3-5 and 8-14μ regions was demonstrated in Phase I. The Phase II program objectives are to improve fabrication procedures, based on sequential physical vapor deposition of the thin film device components, to achieve a >80% yield for structures with 20/80% emissivity modulation, to realize a scaled-up 1 foot square prototype, and to demonstrate application of the coating to a flexible polymer substrate. All fabrication will be related to commercially acceptable deposition processes suitable for coating large areas. Anticipated benefits/potential commercial applications - variable emittance coatings will provide infrared signature suppression in real-time under diverse mission conditions. The coatings are applicable to air, sea, space and ground-based military components. Besides counter surveillance applications, variable emittance coatings could find commercial applications as thermal control surfaces on terrestrial and spaceborne vehicles.

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Topic#. 90-058 ID#: 9010488
Office: SSTO
Contract #: DAAH0191CR297
PI: JOHN SHORE

Title: Speech Recognition Package

Abstract. Because speech recognition R&D is conducted in large part through the creation and modification of computer software, productivity depends heavily on software engineering issues - the ease of writing new software and reusing existing software. These issues are relevant not just to the work within a particular R&D group, but also to the exchange of technology among different groups. In particular, technology transfer among speech recognition groups is inhibited by the lack of convenient and powerful means for exchanging programs and data. To address this problem, a new speech recognition package (SRP) will be developed using advanced software engineering techniques, including abstract interfaces, object oriented programming, and self-describing objects. These techniques have already been applied to speech and signal processing objects. These techniques have already been applied to speech and signal processing in the commercially-successful entropic signal processing system (ESPS) and *waves+* (the ESPS graphics interface). All of the Phase I technical objectives have been met. We have shown how ESPS programs can provide self-contained modules suitable for the SRP. We have developed a suitable software engineering methodology for the SRP. And we have demonstrated this methodology by implementing several low-level modules. The Phase II effort will complete the design and implementation of the SRP. Anticipated benefits/potential commercial applications - the speech recognition package (SRP) will benefit the federal government because of the considerable speech recognition and signal processing R&D it supports. The SRP will enable this work to proceed faster and more efficiently. Because the SRP will be developed as an extension to an existing commercial product already in use at speech recognition

DARPA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

laboratories, the probability of commercial success is high.

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Topic#: 90-050 ID#: 9010036
Office: LSO
Contract #: DAAH0191CR151
PI: P. SEKHAR

Title: Soluble Conducting Polymer Based Thin Films with Electrically Controllable Visible/IR Signature

Abstract. Very recent unrelated work at gumbs has led to significant developments in conducting polymer technology. A number of novel soluble conducting polymers were synthesized. The color and IR transmittance of the polymers are controllable via control of the applied potential (or doping level). Furthermore, these polymers have proven processibility as thin films and environmental stability. The conducting polymers with the most superior spectral properties as identified in phase I will be used to fabricate electrically controllable visual and IR signatures in thin films. The conducting polymers deposited from solution onto conductive plastic substrates and solid electrolytes will enable application to odd-shaped objects. This panel performance will be investigated to illustrate the correlation between optical contrast and applied potential. The work will also pursue the goal to improve the synthetic technique of conducting polymers for improving conductivity and yield. Anticipated benefits/potential commercial applications - if the project is successful, in addition to the envisioned application as low transmissivity/reflectance materials, applications include wherever conductive coatings are required, including for such uses as radar signature reduction, odd-shaped electrodes for batteries, electrochromic displays, and ultra-fast electro-optic switches.

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Topic#: 90-045 ID#: 9010652
Office: DSO
Contract #: DAAH0192CR139
PI: JEAN ROBILLARD

Title: Non-Photocopyable Document Coating

Abstract. In Phase I, the contractor proved the feasibility of an optical switching mechanism or a non-photocopyable document coating. This work led to the design of a transparent film that drastically alters its transmission when attempts are made to photocopy a document, and the coating is reversible and returns to transparent after exposure to radiation from the photocopier. Two parallel approaches were investigated in Phase I. 1) a switching composition using photopolymerization of diacetylene monomers cross-linked by a benzothiazoline spiropyran, 2) a switching composition using polythiophenes crosslinked by spiropyrans. Both of these show promise and both will be investigated further in early Phase II work but one will be selected early for optimization of the structure of a non-photocopyable coating. Phase I will include comprehensive studies of optical absorption, adjustment of switching time, reducing optical density and low-cost manufacturing approaches for anticipated high volume production. Anticipated benefits/potential commercial applications - successful Phase II development will lead to a reasonably priced non-photocopyable document coating which would be "easy to apply" by incorporating with adhesive backing. There were 6.8 Million documents classified in 1990 averaging 6 pages each, 4% are top secret, while 51% are secret. This gives a potential annual market of over 21 million pages per year. Also, software codes could be protected.

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Topic#: 90-044 ID#: 9010349
Office: MTO
Contract #: DAAH0192CR191
PI: BLAINE JOHS

Title: Non-Invasive Control of II-VI Semiconductor Growth

Abstract. HgCdTe is important for focal plane array infrared detectors, and as the gulf war demonstrated, these arrays are enormously important in imaging, and guidance systems. Yet HgCdTe and related compounds are difficult to grow with uniform flatness, high homogeneity, and with precise control of layer thicknesses, surface smoothness, and proper ratios of alloy constituents. Increase of properties perfection will result in increased performance, higher device yields (a severe problem presently), and lower costs. Another II-VI class of semiconductors of military importance is Zn_{1-x}Cd_xSe and Zn_{1-x}Cd_xTe. In Phase I we successfully demonstrated that in-situ spectroscopic ellipsometry can precisely determine layer thickness (monolayer sensitive), surface conditions, alloy ratios, and temperature of II-VI semiconductors grown by metal organic vapor phase epitaxy (MOVPE). Data were taken during growth but analyzed after wafers. In order to control growth data need to be analyzed in "real-time," with feedback to the growth system. "Real-time" ellipsometric analysis was achieved during mbe

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growth of GaAs under a separate contract with DARPA, thus we are confident that it can be achieved in MOVPE growth, in spite of it being a much more difficult task for MOVPE. Thus the goals in Phase II are to effect real-time ellipsometric data analysis, and use this in controlling MOVPE growth. In Phase III this capability will be commercialized. Anticipated benefits/potential commercial applications - spectroscopic ellipsometry will allow non-invasive control of II-VI semiconductor growth resulting in controlled alloy constituent ratios, better surfaces, and precise layer thicknesses. This increased control of crystal and device perfection will result in increased device performance, higher yields, and reduced costs.

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Topic#: 90-025 ID#: 9010123
Office: DSO
Contract #: DAAH0191CR209
PI: RICHARD MITCHELL

Title: Supercritical Fluid Processing of Propellants

Abstract: This Phase II effort is directed at applying critical carbon dioxide as a processing diluent for the manufacture of high total solid rocket propellants. The Phase I effort demonstrated that a ninety percent total solids inert composite propellant could be mixed at thirty-five degrees celsius in one hour mixing time. The simulated propellant was formulated with various mixtures of thirty and two hundred micron sodium chloride as the inert replacement for the energetic ammonium perchlorate oxidizer. This program will utilize critical fluid processing to prepare energetic, high total solids propellants and demonstrate the feasibility of the process with small motor ballistic performance tests. Three types of propellant formulations will be utilized in this program; a baseline, industry standard, composite propellant, and energetic minimum signature propellant, and a conventionally difficult to process tepanol, ammonium perchlorate propellant. The key objective of this program is to determine if the critical fluid processing technique can be used to process formulations with oxidizer particle size distributions of less than two microns. Previous hazards testing studies have shown that propellants with oxidizer particle sizes of two microns or less show a substantial decrease in overall hazards sensitivity class from class 1.1 To class 1.3. Successful critical fluid processing of small particle oxidizer propellants is expected to lead to high energy class 1.3 formulations. Costs savings are also expected to be realized from the reduced processing times and extended pot-life obtained from the low temperature critical fluid process. Anticipated benefits/potential commercial applications - one benefit anticipated from this research is the ability to mix high and very high total solids propellants which have much reduced sensitivities. Higher energy propellants would allow larger pay loads or increased range for solid motors with little or no increase in motor dimensions.

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Topic#: 90-048 ID#: 9010379
Office: ASTO
Contract #
PI: ROBERT GORDON

Title: ACT-Based Sigint Receiver IF Signal Processor

Abstract: Present and future sigint receiving systems must be capable of providing rapidly tunable frequency conversion, switched-bandwidth and/or center frequency pre-detection IF and/or post-detection baseband filtering and transversal equalization, interference excision and programmable time delay in the transmission paths of all signals of interest in order to intercept and characterize signals of unknown parameters in a disadvantaged carrier to noise environment. Noting the ability of acoustic charge transport (ACT) monolithic GaAs-based device to serve as either a tapped variable analog delay line, analog memory, variable bandwidth and/or center frequency bpf or programmable transversal equalizer, a recently completed six month SBIR Phase I study applied the characteristics of present and projected ACT devices to the generation of an advanced sigint receiver design with the above capabilities. Accordingly, using the foregoing design study as a starting point, a 12 month Phase II follow-on program is proposed to develop, implement and thoroughly evaluate, in a suitable end-to-end sigint test bed, a brassboard feasibility model ACT-based receiver IF processor. The latter will include, as a baseline, a VHF adaptive channelizer/tracking filter, DDS-based dechopping downconverter and rapidly scanned HF IF narrow bpf. Proposed add-ons to the above baseline include ACT-based interference excisor and delay-multiply feature detector. Anticipated benefits/potential commercial applications - the advanced ACT-based sigint receiver IF processor feasibility model developed during the proposed Phase II brassboard implementation program will form the basis for a Phase III follow-on productization effort culminating in a fully packaged sigint receiver IF processor preproduction prototype, ready for retrofit and field testing in a "host" sigint receiving system. Successful demonstration of the latter will lead to the manufacture and deployment of these IF processor products in sigint receiving systems fielded by the U.S. Army, Navy, Air Force and other government agencies.

DARPA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-012 ID#: 9010166
Office: ASTO
Contract #: DAAH0191CR150
PI: AUGUST RIHACZEK

Title: Relocatable Target Sensor Technology

Abstract: The objective of this program is to detect relocatable ground vehicles that are camouflaged or hidden underneath trees. During Phase I we demonstrated the potential of our advanced signal processing to perform this task. For the proposed Phase II program we plan to fully automate the algorithms and test them on a large variety of target and clutter data in order to establish the detection performance. Anticipated benefits/potential commercial applications - the new detector will detect any concealed man-made targets, not just relocatable military targets. For example, it could be used to detect clandestine operations concealed in the woods.

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Topic#: 90-072 ID#: 9020085
Office: MTO
Contract #: DAAH0192CR219
PI: PHILIPPE BADO

Title: High-Flux X-Ray Lithography Point Source

Abstract: Researchers from Medox Research have demonstrated a new type of laser architecture that allows for the efficient generation of optical pulse trains. It was shown during our Phase I that these pulse trains can be tailored for optimal x-ray generation. The main goal of this Phase II program is to build a prototype laser-driven plasma source producing intense flux of x-rays. We will optimize the system parameters (pulse duration, interpulse separation, pulse train shape, target material) to boost the overall x-ray production. Commercial sources derived from our prototype will meet DARPA'S wafer processing rate requirement. Anticipated benefits/potential commercial applications. The x-ray source developed under this Phase II will serve as prototype for our Phase III commercial x-ray lithography station. This source will help the us to recapture the semiconductor market from Japan.

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Topic#: 90-038 ID#: 9010210
Office: ESTO
Contract #: DAAH0192CR206
PI: ROBERT MELLEN, SR.

Title: Implementation of New Gallium Arsenide Technique (Vertical Float Zone) Developed at Naval Research.

Abstract: The Naval Research Laboratory currently produces high purity, low defect, one inch diameter monocrystal GaAs by the liquid encapsulated vertical zone melting technique (LEVZM) in a specially designed quadrant controlled Q-EDG furnace developed by the Mellen Company, Inc. The unique feature of their present Mellen furnace is its ability to precisely control the local heat flow characteristics within the molten zone in the axial, azimuthal, and radial directions (3d). In Phase I, Mellen used a larger, 5" diameter Q-EDG furnace, modified to include a "stealth" heater, to mechanically and thermally test the feasibility of 3-4 inch diameter growth. Tests indicate that success is within our grasp. General design and testing of the proposed new furnace for use in a manufacturing environment to produce 4" dia high purity, single crystal GaAs as bulk material have been completed in Phase I. Phase II of this work, proposed herein, discusses the thermal and mechanical considerations cited in the Phase I final report along with a work plan to build the furnace and then test these new concepts under Phase III. A combination of proprietary existing EDG technology and proprietary new technology is utilized in this proposal to overcome the thermal and mechanical requirements of this LEVZM process. Anticipated benefits/potential commercial applications: The LEVZM growth technique used in conjunction with a modified quadrant controlled EDG furnace system will be able to consistently produce 3" to 4" diameter single crystal boules of GaAs. The process developed may be applied toward growing other III-V and II-VI semiconductor single crystal materials

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Topic#: 90-032 ID#: 9010510
Office: ESTO
Contract #: DAAH0191CR323
PI THOMAS MIX

DARPA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Novel Integrated Circuit Substrate

Abstract: New substrates with dielectric constants of the order of 2 or less and higher power dissipation capacities than the current standard substrate, 96% alumina, are among the requirements for the faster integrated circuits being developed. Merix proposes to develop a new, ceramic, integrated circuit substrate material with a novel structure which will meet these requirements. Anticipated benefits/potential commercial applications - the new substrate will remove some of the existing barriers to the development of faster, higher powered ic chips

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Topic#: 90-008 ID#: 9010188
Office: ASTO
Contract #: DAAH0192CR047
PI: JOHN WHITE

Title: High Power Demonstration of a Novel Blue-Green Semiconductor Laser for Tactical Airborne Laser

Abstract: Phase I demonstrated approximate area scaling of threshold and maximum available output power from an InGaAs/GaAs vertical-cavity, surface-emitting laser (VCSEL) with resonant periodic gain (RPG). This indicates that amplified spontaneous emission and parasitic transverse lasing is effectively suppressed by the RPG structure. Peak powers of nearly 50 kw over a 500 ns pulse width were obtained from pots only 3mm in diameter. Output power was limited by the optical pumping damage threshold, which was only slightly above the lasing threshold for the material studies in Phase I. Design issues addressed in Phase II will be ways of lowering the lasing threshold while increasing the damage threshold. Anti-reflection coatings and surface passivation techniques will be investigated. Phase II will also investigate the critical question of what degree of spatial coherence across the output beam can be achieved by coupling in an external cavity. Three optimized resonators have been designed for this purpose in Phase I, and will be tested in Phase II. During Phase II we will demonstrate all the technology necessary to scale the laser to several joules of output energy. This laser will be more efficient than competing solid-state concepts because it can be pumped directly with an incoherent array of high-power AlGaAs diode lasers. Anticipated benefits/potential commercial applications of the research or development. Positive results will mean a significant advance in the realization of semiconductor devices as high power lasers and the development of a high power transmitter with relatively simple design that offers custom wavelength design and longitudinal mode selectivity. Commercial applications include communications, remote sensing, and a variety of spectroscopic applications

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Topic#: 90-009 ID#: 9010701
Office: ASTO
Contract #: DAAH0192CR147
PI: RONALD SMITH

Title: Coil Winding Machinery for Interferometric Fiber Optic Gyro Manufacturing

Abstract: Interferometric fiber optic gyro (IFOG) optical fiber coil windings are precision level windings between flanges. To make these windings insensitive to thermal gradients across the wound pack, the innermost wound layers is at the center of the measurement path fiber coil. Alternate pairs of subsequent layers are drawn from lengths of fiber on opposite sides of the center innermost layer. This arrangement causes any thermal gradient present in the coil structure to be symmetrical about the center of the fiber loop, with the result that measurement errors from the two halves of the loop cancel one another. Although the principle is sound, such windings are difficult to realize in practice, because the alternating layer pair geometry tends to introduce winding flaws which degrade precision and make reliable production of the winding difficult. Optelecom has devised and tested proprietary methods of level winding between flanges which facilitate maintaining the required precision. In Phase I we demonstrated that winding techniques can be successfully applied to producing full precision windings with the alternate layer pair winding geometry using a winding station adapted from one of our high speed fiber payout winders. Phase I technical success is indicative that the prospects are good for successful development of winding equipment for low cost IFOG coil winding. In Phase II we plan to develop a winding machine capable of making 1,000 coils per year. Anticipated benefits/potential commercial applications - winding cost alone for IFOG coils is presently \$500 per axis or more. This is disproportionate to the degree of complexity of the winding task. One of our Phase II goals is to reduce winding cost to less than \$200 per 1km coil. IFOG units will have widespread military applications. In addition, certain commercial applications such as use for industrial robotics and recreational marine navigation will become feasible when the cost is reduced.

DARPA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-080 ID#: 9020562
Office: CSTO
Contract #: DAAH0192CR192
PI: ALLAN GERRISH

Title: All-Optical Gigabit LAN

Abstract: All-optical networks offer the long range solution to the challenge of providing high-speed computational resources and data access for a large number of users. Current barriers to all-optical networks include optical switching (including control), optical buffering and computation, and network protocol compatibility. Optivision has found a solution to some of these significant barriers, which, if proven to be successful in the proposed Phase II prototype development, could result in the early implementation of an optical space division switch that is compatible with current and emerging high-speed network protocols. The specific innovation offered is the use of a polling receiver in conjunction with a matrix vector multiplier optical switch to provide in-band signalling and control of the switch. During the first baseline year, a proof-of-principle prototype in-band controller will be designed for the serial-hippi protocol, fabricated, integrated with an existing crossbar switch and out-of-band switch controller, and functionally tested using a in-house test bed. During the second year, an enhanced network test bed will be used for a complete closed loop functional demonstration of the in-band optical switch. In addition, the in-band control approach will be extended to multiple switch networks and to multiple protocols using analysis and simulation. Anticipated benefits/potential commercial applications - the prototype in-band controller developed here provides the technology development needed for field placement of an optical switch in high-speed networks. Commercial opportunities include applications requiring large scale simulation, modelling, visualization, systems analysis, and shared data basing, such as aircraft design, weather forecasting and scientific research. Compatibility with existing electronic switches will ensure a commercial market.

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Topic#: 90-129 ID#: 9020311
Office: ASTO
Contract #: DAAH0192CR174
PI: GAJENDRA SAVANT

Title: PV Space Power Generation Using Holographic Wavelength Separating Concentrators

Abstract: During Phase I of its DARPA SBIR program, Physical Optics Corporation (POC) was able to demonstrate the feasibility of using a thin film (10 um) diffractive holographic solar energy concentrator as a key component for reducing the weight and increasing the power density for satellite photovoltaic power systems. Using a wavelength splitting dual cell (GaAs/GaSb) system, and the holographic lens (hololens) resulted in a projected power density increase of 30% and a decrease in weight density of 42.7% when compared to existing DOD/NASA photovoltaic energysystems. Environmental compatibility of the materials for space orbit was also demonstrated in Phase I. Phase II will result in the design and fabrication of a 1 m2 hololens photovoltaic panel array which will use a self deployable solar array and a dual cell system. Diffraction efficiencies in excess of 80% and concentration ratios in excess of 100 suns are projected for Phase II. Test data from the 1 m2 panel will be obtained with regard to optical performance and environmental compatibility. An assessment of the system self deployability and determination of figures of merit as well as transition of this technology to a mass manufacturing environment will conclude Phase II. Anticipated benefits/potential commercial applications - commercial applications for this technology will be for terrestrial-based concentrating photovoltaic arrays such as for electric utilities. Increased conversion efficiencies of 25-30% should result as well as a significant decrease in weight of the concentration module. Applications of this technology will also be useful for remote sites and military portable photovoltaic power systems.

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Topic#: 90-040 ID#: 9010027
Office: ESTO
Contract #: DAAH0192CR205
PI: RICHARD COOVERT

Title: Manufacturing Cost Reduction of EI Display Etching and Deposition Technology

Abstract: The program will develop methods identified in Phase I to reduce the manufacturing cost of full color electroluminescent displays. Chemical vapor deposition equipment for building prototype el panels will be installed and processes qualified for making insulating films. Simplified etch processing and an alternate structure will be evaluated and qualified for fabricating multicolor displays to test performance and reliability. A pilot deposition system for insulators and phosphors will be qualified and used to establish cost reduction benefits with larger batch processing in Phase III. Anticipated benefits/potential

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commercial applications - decrease the cost of processing full color teledisplays, which is a flat panel display technology that meets all military specifications and has outstanding performance for commercial applications.

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Topic#: 90-032 ID#: 9010214
Office: MTO
Contract #: DAAH0192CR108
PI: JOHN COLEMAN

Title: Discrete Ferroelectric Non-Destructive Read Out Memory Device

Abstract: Radiant technologies has developed and patented a novel non-destructive read out (NDRO) ferroelectric memory suitable for both military and commercial applications. The structure uses thin lead lanthanum zirconate titanate (PLZT) film as the memory medium. The ferroelectric NDRO structure has been successfully fabricated and operated by radiant technologies and is presently in development for prototype devices. The ferroelectric NDRO is a radically new device whose long term reliability will depend upon the understanding of its operating physics. The Phase II program will fabricate the ferroelectric NDRO device, test its performance, and characterize its underlying physics. Phase II will lay the foundation for the fabrication of an integrated circuit memory IC in Phase III. Anticipated benefits/potential commercial applications: a ferroelectric based NDRO memory should exhibit $1e10$ write cycle and unlimited read cycle performance in addition to having significant resistance to radiation effects. The technology can significantly reduce the cost and increase the effectiveness of space based non-volatile memory systems or other systems used in a radiation environment. With a cell size smaller than standard SRAM, a ferroelectric NDRO memory will have the performance and price advantage to penetrate commercial EEPROM and SRAM markets and establish new markets world wide.

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Topic#: 90-027 ID#: 9010087
Office: DSO
Contract #: DAAH0192CR110
PI: BENJAMIN FRIEDLANDER

Title: A Transient Detectability Assessment Workstation

Abstract: We propose to develop a software package for the analysis and detectability assessment of acoustic transients. This package will be implemented on an 80486-based workstation and will incorporate advanced signal processing techniques and recent theoretical results on performance analysis. This package will make it possible to: (I) compare different detection/classification techniques for selected classes of transients and operating conditions (noise environment, propagation conditions, signal to noise ratio) to discover which technique works best in which situation, (II) assess the detectability of a given transient signal, i.e., Determine whether it can be reliably detected over a reasonable range of operating conditions, and whether it can be correctly classified; this involves the computation and plotting of analytical performance curves; (III) visualize side-by-side different transformations or representations of the transient signals (e.g., Spectrogram, Gaborgram, wavelet transform, Wigner-Ville, bispectrum) to study their characteristics and to develop new classification clues; (IV) develop a parametric model for a given transient and incorporate it in the database, to be used for classifying new transients. This product will be very useful to users involved in the exploitation of transients for tactical and strategic surveillance (both on the surveillance side and the intelligence side), as well as to the ship quieting program of the Navy. The proposed system will enable users to apply the most advanced processing techniques to their particular application, and obtain a performance assessment based on analysis as well as simulation. This product can be used as a research tool, as an operational adjunct processor, and as a pre-processor for transient detection/classification based on neural networks. Anticipated benefits/potential commercial applications: the proposed product will be immediately useful to the DOD community involved in transient processing. Using its components, we intend to develop a commercial product which will provide advanced signal processing algorithms to a broader range of users.

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Topic#: 90-028 ID#: 9010196
Office: MTO
Contract #: DAAH0191CR262
PI: JAMES BECHTEL

Title: Fiber Optic Sensor for Real-Time Temperature Measurement During Semiconductor Processing

DARPA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Abstract: We propose to develop a new type of multichannel, fiber optic sensor to provide dynamic and steady-state temperature measurements of semiconductor wafers during processing. Precise thermal control in semiconductor processing is critical for making devices with submicron geometries and is of crucial importance in rapid thermal processing (RTP). The proposed sensor consists of multiple, high-temperature fiber optic probes using ratio pyrometry to measure wafer surface temperatures. Our Phase I results have already dramatically demonstrated the feasibility of the concept with both theoretical and experimental verification of our approach. Based on our Phase I results and additional experience with fiber optic sensors, including the development of two related temperature sensors, we expect the operating range of this sensor to be from 400 k to greater than 1600 k with better than 0.5% Accuracy. This sensor is chemically inert, nonintrusive and immune to RF or plasma interference. A response time of milliseconds (already experimentally demonstrated in Phase III) will enable dynamic temperature measurements and real-time process control. Future applications will include improved temperature control with the latest developments in conventional or fuzzy logic controllers for semiconductor processing, and enhanced device yields, performance and speed. Anticipated benefits/potential commercial applications of the research or development. Our sensor will improve semiconductor process temperature monitoring and control. These innovations will enable the fabrication of smaller, faster and more complex devices with greater product yields. The accuracy, repeatability, and rapid response time are especially valuable in RTP applications. Other potential commercial applications occur wherever remote and inert real-time temperature sensing is required, including engines, explosive environments, and high-power rf instrumentation. This sensor enables pyrometry to be conducted in non-line-of-sight regions with isolation of the system electronics from the viewing region.

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Topic#: 90-024 ID#: 9010170
Office: DSO
Contract #: DAAH0192CR003
PI: ERNEST KIM

Title: Development of Diamond Thin Film Process

Abstract: Phase II will focus on: a) difficulty in controlling stress in the film, b) adhesion of deposited film to different substrate materials, c) greater detail in modelling of the fluid-dynamics and the relationship of the fluid-dynamic to process characteristics and film properties, and d) reproducibility of diamond film properties. This research and development proposal focuses on the applications of our diamond deposition model and our *in-situ* monitoring instruments to characterize and control diamond and diamond like film deposition processes. In Phase II project, TTL techniques proposes: 1) to implement the additional instruments which have been installed in our plasma deposition system and optimization of the more deposition performances, 2) to develop a more in-depth process model useful for controlling the deposition process, 3) to implement additional software (NIST "man 2") for analysis of spectroscopic ellipsometer data, 4) to implement in-situ instruments for film stress measurement, and 5) to optimize instrument package for adaptation for scale-up productions. This research will be performed using *in-situ* monitoring instruments such as glow-discharge mass spectrometer/energy analyzer (GDMS/EA), optical emission/atomic absorption spectrometer (OES/AAS), spectroscopic ellipsometer (SE), and langmuir probe. In addition to these instruments proposed in Phase I work, Raman spectroscopy and IR pyrometer will be utilized for management of gas and species temperature and with SE to management of stress contained in the growth diamond film. Anticipated benefits/potential commercial applications - TTL will commercialize the completion of this research in these ways: a) development of additional research, b) development of process control instrumentation, and c) development of coating business for those who do not wish to do the diamond deposition themselves

DNA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

APPLIED RESEARCH ASSOC., INC.
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Topic#: 88-003
Office: DNA
Contract #: DNA91-C-0009
PI: Noel H. Ethridge

ID#: 91DNA-029

Title: Dynamic Pressure Gage Development for Subsonic Flows

Abstract. The objective of this project is to develop an improved differential pressure gage for determining dynamic pressure within blast and shock wave flows where the flows are subsonic. Derivation of dynamic pressure from a measurement of the difference between stagnation pressure and side-on or static pressure requires use of the side-on pressure record to correct for compressibility effects. Currently the side-on pressure waveform must be measured by a separate gage located apart from the differential pressure gage. This waveform may differ from that occurring at the differential pressure gage location. Under this project, the differential pressure gage probe will be modified to add a gage to measure the side-on pressure in addition to the differential pressure. This modified probe will be evaluated in shock tube tests. In Phase I, the differential pressure gage probe was modified to incorporate a sensor to measure the side-on overpressure. Its performance was investigated in shock tube tests with the probe at different angles with respect to the flow. The tests were limited in number and the maximum shock overpressure was 20 psi. In Phase II, the probe will be tested in a different shock tube over a pressure range extending to 50 psi. The final test proposed for evaluation of the probe is exposure on the large HE test DISTANT IMAGE.

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Topic#: 89-005
Office: DNA
Contract #: DNA91-C-0069
PI: Daniel C. Osborn

ID#: 91DNA-023

Title: Instrumentation for Electrical Parameter Measurement

Abstract: This Phase II SBIR program will provide the capability to measure how the radar absorbing and reflecting properties of system surface materials are affected by the nuclear ionizing radiation environment. No suitable Aboveground Test (AGT) or Underground Test (UGT) instrumentation now exists to perform such testing. The program will provide the DNA Test Directorate with the capability to test future military systems having a requirement to maintain a specific radar cross section (RCS) under irradiation. It provides this instrumentation development independent of any particular weapons system program. The instrumentation is hardened and self-contained, taking sequential sets of measurements vs. frequency, and storing the data in local memory. The Phase II effort will develop the necessary instrumentation and techniques to measure electrical parameters of materials in radiation (AGT/UGT) environments, and will verify performance by measuring responses of radar absorbing materials (RAM) in an electron beam AGT environment.

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Topic#: 89-005
Office: DNA
Contract #: DNA91-C-0088
PI: Richard Donovan

ID#: 91DNA-031

Title: Low Z-Strain Gage

Abstract. This activity will further PVDF film for use as a low Z sensitive strain gage. Building on the feasibility demonstrated in the Phase I program, Phase II will provide a production gage design and optimized signal recording instrumentation. The production designs will be calibrated over a temperature range of -50 degrees C to 90 degrees C, and up to 5% strain. The production design will undergo radiation response testing as a qualification for underground testing (UGT). Also to be performed is a verification of the gage in a UGT. To support commercial development as part of Phase III, a marketing plan for the gage will be developed jointly with commercial partners.

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Topic#: 90-004
Office: DNA
Contract #: DNA91-C-0122
PI: Arthur Deverill

ID#: 91DNA-030

Title: New Technologies for Improved Simulation of Nuclear Weapon Effects

Abstract. Technical feasibility of a simple, low cost, uniform, and homogeneous HE test charge through the use of a consumable

DNA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

container which eliminates container debris as a test environment contaminant was demonstrated in Phase I. The Phase II effort will concentrate on engineering development, fabrication, test, and evaluation of a single point suspension spherical thin wall container for air burst testing using liquid explosives. Engineering development will include the final engineering design of a prototype operational system with container, suspension sub-system, provisions for filling and downloading, initiator, and basic performance instrumentation. Fabrication and testing will include container materials testing to validate strength and retention capability of various HE agents, including nitromethane, and prototype operational tests at the 1000 lb. equivalent TNT charge size using design directly scaled from that required from the 20 ton equivalent air burst application. A minimum of one (1) inert and two (2) live HE charge operational tests will be conducted. A preliminary technical data package (TDP) for the manufacture of the HE charge systems will be included in the final report. Two proof tests at the DNA Permanent HE Test Site (PHETS) at WSMR are proposed as a Phase II option.

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Topic#: 89-004 ID#: 91DNA-028
Office: DNA
Contract #: DNA91-C-0028
PI: Nino R. Pereira

Title: A Time-Resolved Hard X-Ray Spectrometer

Abstract. Phase I research has demonstrated that a time-resolved spectrometer for bremsstrahlung flash x-rays can be built in analogy to an existing time-integrated spectrometer using differential filtering. The time-resolved spectrometer will consist of six spherical filters of different materials, from aluminum to tungsten. The radiation is measured with fast photoconductive detectors, neutron-irradiated GaAs. Recording is done with 6 digitizers of a standard type. The data are unfolded by an existing computer code. This instrument will be delivered to DNA at the end of a Phase II research effort. In addition, we want to explore a 30-channel spectrometer using optical sensors and recorders, and a few-channel spectrometer for simple estimates of radiation hardness or electron energy.

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Topic#: 89-005 ID#: 91DNA-026
Office: DNA
Contract #: DNA91-C-0113
PI: Bruce N. Nelson

Title: High Bandwidth Accelerometer for Shock Environments

Abstract. The proposed Phase II program will develop and field evaluate fiber optic based acceleration measurement systems for use in both conventional explosives and nuclear testing. In this program a total of six accelerometers (three shock hardened and three radiation/shock hardened) and an electronic interface to support three accelerometers will be developed and evaluated in both the laboratory and the field. Accelerometers could be more widely used in both conventional explosives and nuclear testing if designs could be made to operate reliably and survive in high shock environments. The novel design of the fiber optic accelerometers proposed in this program promise to offer a more rugged accelerometer with a wider measurement bandwidth capability than that presently available in piezo-resistive and piezo-electric accelerometers. Additional advantages of this fiber optic accelerometer include inherent immunity to the effect of EMI and EMP, immediate compatibility with fiber optic data transmission lines, and sum-difference output detection scheme that has proven immunity to the adverse effects of radiation fiber darkening, fiber optic microbending losses, fiber optic connector losses and optical source light intensity variations.

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Topic#: 90-001 ID#: 91DNA-024
Office: DNA
Contract #: DNA91-C-0049
PI: Patrick Walker

Title: A Technical Hypertext System

Abstract: Horizons Technology, Inc. (HTI) proposes to continue development of the Technical Hypertext documentation methodology for DNA technical documents. This effort is proposed as Phase II of a Small Business Innovative Research (SBIR) project. Phase I of the project was recently completed with a successful proof-of-concept implementation of a Technical Hypertext version of a portion of the Airblast Phenomena Chapter of the "Capabilities of Nuclear Weapons Effects Manual - 1 (EM-1)". The Phase II effort will produce complete hypertext versions of Chapter 2 (Airblast Phenomena) and Chapter 8

DNA ABSTRACTS OF FY91 SBIR PHASE II AWARDS

(Nuclear Radiation Phenomena) for distribution to the weapon effects community. Several other technical documents of interest to the DNA community will also be examined to determine the suitability and desirability of later Technical Hypertext implementations. After evaluating several documents from the nuclear and chemical survivability areas, or from the underground test (UGT) area, a prototype application design for a selected document (or related set of documents) will be developed. In conjunction with the development of a prototype Technical Hypertext version of EM-1, Chapter 2, HTI will investigate alternate mass-storage technologies with an eye to the impact such technologies have on the development and distribution of Technical Hypertext documents. At the end of this effort, HTI will recommend the most desirable mass-storage technology. Following DNA selection, HTI will produce a high density master for the Airblast Phenomena Chapter for proof-of-concept and demonstration of the chosen technology.

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Topic#: 90-004 ID#: 91DNA-025
Office: DNA
Contract #: DNA91-C-0138
PI: Gary Hess

Title: Plasma Driven Water Shock

Abstract: The feasibility of the Plasma Driven Water Shock (PDWS) technique to simulate underwater nuclear detonations has been shown in Phase I. Circuit tuning has effectively optimized the stored electrical to radiated mechanical energy conversion efficiency. A minimum efficiency of 40% was demonstrated based upon a 130 J measured yield 12 inches from the discharge. A peak pressure of 1,120 psi was obtained with a 300 KV discharge of 320 J stored energy in a water capacitor. The technique is easily scaled up in yield. The present results are equivalent to nearly 0.1 grams TNT but at least 5 grams TNT equivalent is possible in a scaled version. Even higher chemical explosive equivalent may be possible with very large circuits. This technique has the potential to program a precise radial dependence in the peak pressure with an innovative idea for control of the discharge.

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Topic#: 91-011 ID#: 91DNA-022
Office: DNA
Contract #: DNA91-C-0082
PI: Conrad Felice

Title: Physical Property Measurements Using Computerized Tomography

Abstract: The goal of this effort is to establish the use of computerized tomography as an accurate and reliable alternative method for measuring physical properties of zeolitized tuff. The feasibility of this approach was established in Phase I. The main emphasis of the Phase II effort will consist of establishing procedures for applying the CT scanning technique to routinely evaluate the physical properties of geologic materials encountered at NTS. This will include formulating detailed procedures to accurately account for the gas/water adsorption characteristics of zeolites, determining the effect of sample inhomogeneity on measurements, and the correlation of physical and mechanical test results.

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Topic#: 89-011 ID#: 38278
Office: ONR
Contract #:
PI: DR PETER S KIRLIN

Title: BARIUM-TITANIUM OXIDE THIN FILM OPTICAL GUIDED-WAVE PHASE MODULATOR

Abstract: The development of integrated optics is expected to follow that of the semiconductor industry and payoff of the proposed research is based on the economic and technical advantages that thin films devices have over their bulk counterparts. In addition to the technological applications, there is scientific interest in these films as a window into processes in physical optics that are poorly understood. The invention and subsequent development of the laser have spawned a large number of complementary optical technologies. Major research and development efforts are currently underway in the areas of optical processing and computing. Miniaturization and integration will rely on suitable optical materials in thin film form. BaTiO₃ has electro-optic and second harmonic generation coefficients that are among the highest known. Achievement of single crystal films and control of crystalline orientation will enable the largest nonlinear coefficients to be exploited for a particular application. The latter criterion was satisfied during Phase I as both [100] and [110] oriented films of BaTiO₃ were grown for the first time on BaTiO₃ by a unique MOCVD process.

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Topic#: 89-010 ID#: 38128
Office: ONR
Contract #: N00014-91-C-0257
PI: CESAR BANDERS

Title: FOVEAL MACHINE VISION SYSTEMS

Abstract: One fundamental problem with tracking and automatic target recognition imaging systems is the overwhelming amount of sensor data which must be processed. The Phase I effort demonstrated the feasibility of using variable acuity machine vision systems, called foveal systems, which feature imaging sensors and signal processing with graded acuity analogous to that prevalent throughout biological vision. Foveal systems offer improved vision performance, greater platform intelligence and autonomous operation, and lower system cost. Foveal systems operate much more efficiently than uniform acuity systems because resolution is treated as a dynamically allocatable resource. The proposed Phase II effort will conduct the performance analyses prerequisite to system prototyping. The Phase II effort will also investigate in detail the relationship between the acuity gradient and foveal system performance in dynamic pursuit scenarios will be investigated.

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Topic#: 90-003 ID#: 40761
Office: ONR
Contract #: N0014-92-C-0090
PI: M. Asif Khan, PhD

Title: Aluminum-Gallium-Nitrogen Electron Mobility Transistor for High Temperature Applications

Abstract: GaN high electron mobility transistors or HEMTs are proposed for use as high temperature microwave devices. HEMTs are excellent for both power and low noise amplification since they possess a high carrier concentration and an enhanced carrier mobility. Ga has a large bandgap of 3.2 eV which gives it a greater breakdown voltage and a higher saturated electron velocity than GaAs. GaN, in addition, is stable in air to around 800 degrees Celsius which makes it ideal for high temperature use. High quality GaN films can be deposited by APA Optics using LPMOCVD on sapphire. This technique is commonly used for GaAs epitaxy and has been used on a production level. We demonstrated for the first time during the Phase I program enhanced electron mobilities in AlGaIn/GaN heterojunctions. And most recently, we fabricated point contact diodes using GaN that operated at temperatures as high as 700 degrees Celsius. The proposed Phase II will utilize the improved material quality and high electron mobilities perfected in the Phase I to demonstrate HEMT based devices in GaN. Devices will be grown, fabricated and then tested at elevated temperatures greater than 400 degrees Celsius.

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Topic#: 90-005 ID#: 55007
Office: NASA
Contract #:
PI: Sandra R. Collins

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Large Area InP Solar Cells on Silicon

Abstract: AstroPower proposes the development of a new heteroepitaxial solar cell design offering high performance, thin film InP solar cells on silicon substrates. To date, conventional solar cell designs have yielded poor performance when applied to InP films on silicon. The new structure is designed to lower residual stress and dislocation density in the InP film by tailoring film geometry to accommodate the fundamental differences in the material properties of InP and silicon. The new solar cell design in conjunction with a combined CVD/LPE growth technology is expected to lower the dislocation density of the InP film at least two orders of magnitude from the present state-of-the-art, so that it is capable of supporting high performance solar cell devices. The new solar cell design eliminates device quality dependence on film area, offering the realization of the first large area InP solarcell.

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Topic#: 90-005 ID#: 40754
Office: AFWL
Contract #: F33615-91-C-2143
PI: Jerome S. Culik

Title: High-Performance, Radiation-Hard, Ultra-Thin, Silicon-Under-Glass Solar Cells

Abstract: This program will demonstrate extremely high specific power, radiation insensitive, thin silicon solar cells. These solar cells can be directly substituted for existing state of the art silicon solar cells with the effect of simultaneously increasing specific power, power/area, and power supply life. This proposal describes a lightweight, radiation-hard, high-performance, ultra-thin silicon solar cell that incorporates light-trapping and a cover glass as an integral part of the device. Ultra-thin, light-trapping structure as have been fabricated and the light trapping demonstrated. The device will have immediate application wherever high power output and survivability are important. Our light-trapping solar cell design utilizes a micro-machined, grooved back surface to increase the optical path length by a factor of 20, and will be highly tolerant to radiation because the base width is less than 25 microns and virtually insensitive to reduction in minority-carrier lifetime. This high performance, lightweight, silicon solar cell offers a dramatic improvement in specific power, power/area, and high temperature and radiation tolerance.

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Topic#: 88-005 ID#: 30742
Office: AF
Contract #: F33615-91-C-2144
PI: GERALD H NEGLEY

Title: ALUMINUM-GALLIUM-ARSENIDE TOP SOLAR CELL FOR MECHANICAL ATTACHMENT TO A SILICON CONCENTRATOR WITH IMPROVED AMO EFFICIENCY

Abstract: Free standing, transparent AlGaAs on AlGaAs top solar cells have been fabricated for mechanical attachment in a tandem solar cell stack. The result is the first free-standing, transparent, tunable bandgap top solar cell. The proposed mechanically-stacked multi-junction (MSMJ) solar cell concentrator system can provide efficiencies of 36% (AMO, 100X). AlGaAs/Si tandem solar cell designs and geometries that are compatible with the end uses required by ongoing space power considerations are provided for in this Phase II program. AstroPower has fabricated AlGaAs top solar cells with bandgaps from 1.66 eV to 2.08 eV during the Phase I program. Results of the Phase I SBIR have demonstrated top solar cells with efficiencies of 18% (100X, AMO) which would yield stack efficiencies of 31% (100X, AMO) when stacked on a silicon bottom cell. The Phase II program represents an approach to improve the performance of space photovoltaic power systems. Free-standing, tunable bandgap top solar cells with over 95% transparency to sub-bandgap photons will be commercially available.

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Topic#: 90-014 ID#: 40719
Office: SDC
Contract #: DASG60-92-C-0004
PI: Michael G. Mauk

Title: Liquid Phase Electro-Epitaxy for Silicon and III-V Compound Semiconductors

Abstract: Ultra-bright green and red light emitting diodes will be developed using a new electro-epitaxy technology which produces single-crystal, high-quality III-V compound semiconductor layers overgrown on GaAs substrates masked with reflective metal films. These "buried" metal reflectors will increase the optical power of LEDs by reducing losses associated with optical

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

absorption in the substrated. The Phase I work is the first demonstration of epitaxial "buried" mirrors formed by liquid-phase electro-epitaxy. The successful Phase II program will be applied to the fabrication of high-performance photodiodes and solar cells. The feasibility of epitaxial "buried" mirror structures for surface-emitting lasers will be investigated.

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Topic#: 91-003 ID#: 91-369
Office: SDC
Contract #: DASG60-92-C-0039
PI: R. Frey

Title: Coherent Laser Radar Monopulse Tracker

Abstract: The objective of the proposed monopulse signal processing approach is to decouple laser speckle from target angle error measurements. The coherent laser radar monopulse signal processing implementation that has been conceptually designed in Phase I will be capable of processing both the amplitude and phase information that is contained in the monopulse return. The Phase II program will have two major activities: 1. a detailed simulation which will address both the amplitude and phase aspects of the heterodyne mixing process, complex target signatures, representative acquisition uncertainties due to target/sensor platform dynamics, and angle error algorithm optimization, and 2. the design and fabrication of data acquisition hardware/software that will be used to collect diverse data sets, against a variety of targets, which will enable the validation of the simulation as well as increase its fidelity

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Topic#: 90-014 ID#: 40731
Office: ARO
Contract #:
PI: Mary G. Moss, PhD

Title: Miniature Temperature Sensors

Abstract: Phase I demonstrated the forming of thin-film, NTC temperature sensors from ion-implanted nitrile-containing polymers (I2PS). The sensors are applicable for use individually, or as components of a conformal array. The advantages of the I2PS include: close thermal contact with the substrate; patternable to small or large geometries (10 microns and up) by standard photolithographic methods; high film resistivity (2 megohms/square) reduces power requirements and the effects of lead resistance. Phase II work includes improving stability and control of resistance and R-T characteristics, and constructing three test devices: a miniature sensor used in microelectronics circuits or micromachine devices, an active sensor for protecting IC's from over-heating, and a temperature sensing array for measuring thermal gradients. Phase II performance objectives include controllable resistance-temperature characteristics with a maximum use temperature of 100 degrees Celsius and a stability of 0.05 degrees Celsius/years.

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Topic#: 89-011 ID#: 38038
Office: NSWC
Contract #: N60921-91-C-0127
PI: J I SOOS

Title: Single Element Modulator/Deflector for Wide Bandwidth Optical Satellite Communication

Abstract: In this program Brimrose Corp will demonstrate the feasibility of a free-space laser satellite communication system incorporating a unique Acousto-Electro-Optic (A-E-O) deflector, modulator device, developed under a Phase I SBIR program. The Acousto Electro-Optic modulator has the ability to simultaneously modulate and deflect a laser beam. The deflection is achieved acousto-optically; therefore beam steering is achieved without moving parts. The device also has a large optical aperture, and therefore it can simultaneously modulate and deflect the output from conventional and diode array lasers. By combining this device with optical communication system design concepts, a superior communication system will be built. For example, a unique feature of this A-E-O device is the ability to control the optical power in each deflected first order beam. This allows optimization and conservation of power required to communicate with each receiver, making more optical power available where it is necessary to achieve a longer communication range.

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 89-003 ID#: 38332
Office: ONR
Contract #: N62269-91-C-0567
PI: GARY CATELLA

Title: BETA-BARIUM BORATE GROWTH AND TESTING

Abstract: This Phase II program would continue the growth and testing of the nonlinear optical material beta-barium borate. During Phase I, improvements were made in crystal size, yield, and quality using a modified top-seeded flux growth method. Average boule size increased. Single crystal boule yield, average boule mass and the percentage of inclusion free material more than doubled. Samples were tested for optical transmission, absorption, damage threshold and linewidth narrowed OPO performance. Results indicate that Cleveland Crystals BBO is suitable for a variety of applications and can be substituted for Chinese material. Phase II program goals will be increased BBO boule size and quality to allow full exploitation of BBO's unique optical properties.

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Topic#: 90-015 ID#: 40806
Office: RADC
Contract #: F19628-90-C-0149
PI: Randy Simon

Title: Multi-GHz Shift Superconducting Shift Registers

Abstract: Shift registers are fundamental building blocks for signal processing systems and digital electronics in general. Superconducting (Josephson) shift registers offer the advantage of high-speed operation and extremely low power dissipation. In this program, we propose to fabricate and test Josephson shift registers based on a circuit architecture (single flux quantum) that can be used with either the conventional hysteretic junctions that can be made using niobium and niobium nitride technology or with the microbridge junctions that can be made using cuprate high-temperature superconductors. The application of these circuits we have chosen is the pseudo-random bit sequence generator. We will demonstrate shift register-based pseudo-random sequence generators first using niobium circuits and then using niobium nitride circuits. These circuits will function at 4.2K and at least 8K, respectively. Finally we will demonstrate elements of single flux quantum shift register circuits in either YBa₂Cu₃O₇ or Ba(1-x)K(x)BiO₃ circuit technology allowing for either 15K or 60K operation.

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Topic#: 90-003 ID#: 40760
Office: AFSTC
Contract #: F29601-91-C-0076
PI: Javier A. Valenzuela, PhD

Title: Non-Contaminating Compressor for Closed-Cycle Cryocoolers

Abstract: Creare will develop a compressor that works at cryogenic temperatures: 80K or nearly 350 degrees below zero Fahrenheit. The compressor works at high pressures for Joule-Thompson (J-T) cryocoolers. J-T cryocoolers contain heat exchangers and expansion elements that are orders of magnitude smaller than Reverse Brayton or Stirling cryocoolers. Further, J-T cryocoolers contain no active components in the cold end. Hence, in theory, they can reach a high efficiency. Exclusive of the compressor a one-stage J-T can attain 50% of Carnot, while a 3-stage J-T goes up to 75% of Carnot. Unfortunately, J-T cryocoolers have a weak link: the compressor. Today's high pressure compressors use lubricants and rubbing seals that contaminate the cooling system gas, which in turn causes the J-T restrictor to clog and fail. Hence, gas cleanup systems must be installed downstream, but they need frequent maintenance, and will not function properly in space. This project will develop a new compressor that has no rubbing seals and needs no lubricants. Thus, it won't clog the restrictor, and it removes the need for a gas cleanup system. It also increases the efficiency making it a candidate for cooling space sensor systems. The compressor can also serve in coolers for portable night vision systems that use only a fraction of a watt. Other applications are closed-cycle J-T recondensers for MRI systems, and miniature refrigerators for superconducting devices.

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Topic#: 89-013 ID#: 38060
Office: AF
Contract #: F33615-91-C-5553
PI: J. MICHAEL PINNEO, PHD

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: LOW FRICTION DIAMOND FILMS FOR HIGH PAYOFF CERAMIC BEARINGS APPLICATIONS

Abstract: Thermal management is a pervasive issue in high power, high frequency electronic components. The ability to maintain or reduce device operating temperatures determines device (and system) reliability and maximum output, operating and conversion efficiencies and, for some devices, output wavelength. The objective of this research program is to develop the technology for fabricating low cost chemical vapor deposited diamond heat sink/electronic packaging systems which use diamond's unexcelled thermal conductivity. The thermal conductivity of CVD diamond films as a function of bonding ratio, non-carbon impurities, and film morphology will be determined. Alternatives will be investigated to reduce material cost by increasing the growth rate and deposition area of the diamond CVD process. Diamond fabrication and metallization process will be developed to enable the use of CVD diamond as a heat sink/package material and, in cooperation with the project sponsor, candidate electronic components will be selected for early application of CVD diamond electronic packaging systems.

DISPLAYTECH, INC.
2200 Central Avenue
Boulder, CO 80301
Phone: (303) 449-8933

Topic#: 90-014 ID#: 40729
Office: ARO
Contract #: DAA103-91-C-0051
PI: Michael D. Wand

Title: Tight Pitch Ferroelectric Liquid Crystals for Analog Voltage-Limited Electro-Optic Modulators

Abstract: Ferroelectric (chiral) smectic C* liquid crystals have been shown to exhibit high speed, multistate electro-optic and display device applications, particularly when incorporated into the surface stabilized ferroelectric liquid crystal light valve. The recently discovered Deformed Helix Ferroelectric Liquid Crystal (DHFLC) effect opens the door to linear gray scale or linear phase modulation in a ferroelectric liquid crystal device. DHFLC devices require tight C* pitch materials, which are not commercially available. This work will afford such materials. Some of the new materials will be pure FLC components designed for tight C* pitch, long N* pitch, high polarization, low viscosity, and chemical stability. Combining the new components with other compounds will give mixtures with broad temperature ranges and fast electro-optic response times.

ELECTRON TRANSFER TECHNOLOGIES, INC.
P.O. Box 160
Princeton, NJ 08542
Phone: (609) 921-0070

Topic#: 90-014 ID#: 40725
Office: SDC
Contract #: DASG60-92-C-0042
PI: William M. Ayers, PhD

Title: Point of Use Generation of Gases for Optoelectronic Device Fabrication

Abstract: In Phase II, Electron Transfer Technologies will focus on improving the stibine yield, designing and fabricating a prototype stibine generator, and through a collaborative effort, grow and characterize GaSb. The GaSb materials will be grown with both stibine from the generator and traditional metalorganic sources for a comparative study. The stibine generator may also be used to fabricate InAsSb strained super lattice materials for 10 micrometer detectors and InAsSb/InAsSb 3 micrometer lasers. Through these iterative tests, the stibine generator design will be modified and optimized to provide the highest quality stibine at the required flow rates. The Phase III commercial stibine generator design will follow from the results of these tests. The value of on-site stibine generator is: 1. a presently unavailable source of pure stibine; 2. faster growth rates of antimony containing compound semiconductor materials; 3. lower carbon incorporation for better device performance; and 4. lower risk of toxic exposure due to on-demand generation and low pressure operation.

ENERGY COMPRESSION RESEARCH CORP.
910 CAMINO DEL MAR, STE A
DEL MAR, CA 92014
Phone: (619) 259-3222

Topic#: 89-005 ID#: 38375
Office: DNA
Contract #: DNA001-91-C-0046
PI: OVED ZUCKER

Title: ENERGY STORAGE ENHANCEMENT IN HIGH ENERGY DENSITY CAPACITORS USED IN REPRATED APPLICATIONS AND CHARGE REVERSAL

Abstract: The Phase I effort was directed towards developing theoretical models to choose the optimum resistivity profile, the investigation of fabrication techniques to realize a resistivity gradient of the proper electrical and mechanical properties, and the fabrication of an actual resistivity gradient. The overall objective of this effort is to show that a technique exists which will substantially increase the energy density of capacitors. Increasing the energy density will allow for very lightweight and compact power sources for a variety of applications. The proposed Phase II program will be directed at experimentally verifying

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

improved capacitor performance when a resistivity gradient is used to reduce field enhancement. A small scale advanced capacitor will be designed, fabricated and tested. This small device will demonstrated the ability of this technology to improve the voltage holding of a capacitor incorporating a resistivity gradient.

FOSTER-MILLER, INC.
350 Second Ave.
Waltham, MA 02254
Phone: (617) 890-3200

Topic#: 90-011 ID#: 40769
Office: ONR
Contract #: N00014-92-C-0001
PI: Lawrence H. Domash, PhD

Title: Optical Computer for Fractal Image Analysis

Abstract: Phase I research developed a design for a new type of optical processor able to act as a "fractal sensor" to instantaneously measure fractal dimension of an image, data set or pattern. High speed measurement of fractal characteristics is of interest for a variety of military, scientific and commercial purposes, including image understanding, clutter rejection, texture classification, analysis of chaotic physical systems, control of turbulent fluids, and industrial process control. To exploit the highly compressed fractal (scale spectral) signature represented in the optical correlation plane, an electronic neural network postprocessor will add hidden neuron layers and the capability for learning fractal texture classification. By hybridizing analog optical and digital electronic neural layers, large fractal images can be reduced to small feature vectors with very high speeds, allowing a variety of precise training architectures. Such an optical processor has connections to wavelet analysis and can label a segment of a satellite surveillance image "cloud" or "sand dunes" instantaneously and with high confidence.

HYPRES, INC.
175 Clearbrook Road
Elmsford, NY 10523
Phone: (914) 592-1190

Topic#: 91-015 ID#: 91-199
Office: RADC
Contract #: F19628-91-C-0102
PI: Edwin E. Stebbins

Title: Superconducting Digital Correlation Impulse Receiver

Abstract: HYPRES proposes an aggressive Phase 2 program to develop a 4096 stage single bit correlator. The correlator will be a single integrated circuit that will operate at a minimum of 10 GS/s. The signal processing performance of the IC would be 81.92 Tera Operations/Second. The correlator is estimated to dissipate 40mW. Currently reported GaAs devices capable of 10GS/s operation would require 40W on-chip. The ultimate program goal is to develop a single integrated circuit that digitizes an incoming signal and performs 64K stage single bit correlation at 20GS/s rate. The principal benefit is expected to be in high-speed real-time signal analysis of coded impulse streams for LPI/LPE military radar and ultra-secure communications.

HYPRES, INC.
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Topic#: 91-015 ID#: 91-205
Office: SDC
Contract #: N00014-91-C-0264
PI: Masoud Radparvar, PhD

Title: Superconducting Analog to Digital Converter

Abstract: The high transition temperature of nbN is technologically important because it allows NbN-based circuits to be cooled with small and reliable closed-cycle refrigerators. We have demonstrated the feasibility of operating NbN-based Josephson circuitry in a CR environment and largely mitigated the associated technical risk. In order to advance the NbN technology further, we propose to design, fabricate, and evaluate a 12-bit A/D converter. The proposed effort will lead to provide components suitable for biomedical imaging systems requiring 16-bits of resolution at 100 MS/s. It will also address DoD's needs in focal plane array systems that require high resolution A/D converter coupled to each pixel of the array to facilitate signal processing.

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Elmsford, NY 10523
Phone: (914) 592-1190

Topic#: 90-015 ID#: 55006
Office: ONR
Contract #: N00014-91-C-0284
PI: David Osterman

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

Title: Thin Film Superconducting Quantum Interference Device Amplifiers

Abstract: In Phase II, the circuit elements developed in Phase I will be combined and implemented in integrated niobium superconducting circuits. The final product will be an optimized SQUID amplifier with five multiplexed inputs. To accomplish this, SQUID amplifier circuits will be designed so as to optimize their performance in conjunction with the multiplexing circuits. An incremental approach of fabrication, testing and redesign, if necessary, will then be followed. This strategy will entail fabrication runs first, of SQUID amplifiers alone, followed by runs combining the amplifier with two-input multiplexers, and ultimately a run combining the SQUID amplifier with five-input multiplexers.

IONWER, S

2215 Addison

Houston, TX 77030

Phone: (713) 667-1691

Title: Monitoring/Modifying Thin Film Growth

Abstract: Not available for publication

Topic#: 90-013

ID#: 40801

Office: ARO

Contract #: DAA101-91-C-0045

PI: J. Albert Schultz

IRVINE SENSORS CORP.

3001 Redhill Avenue, Bldg 3, Suite 208

Costa Mesa, CA 92626

Phone: (714) 549-8211

Title: Neural Network Implementation for Strategic Sensor Enhancements

Abstract: An innovative new implementation of artificial neural networks for strategic sensors will be developed which will address two problems: how to interconnect in real-time each detector of a mosaic focal plane array to each node of a neural network layer where there are at least as many nodes as detectors and where each interconnection has independently variable weight; and how to interconnect all of the nodes within a layer with independently variable weights. Irvine Sensors Corporation's innovation was a highly dense, three dimensional method of interconnecting integrated circuit chips and approach to circuit layout. Phase I found that not only is this feasible, but it is potentially capable of human recognition capabilities. The projected capabilities of almost $10E8$ neurons per cubic centimeter, $10E12$ interconnects and $10E18$ interconnects per second challenge human performance levels. The Phase II program will develop and demonstrate the interconnect density and interconnection rate potential of this concept.

Topic#: 90-003

ID#: 40817

Office: ONR

Contract #: N00014-91-C-0192

PI: John C. Carson

J.B.S. TECHNOLOGIES, INC.

631 Kendale Lane

Thousand Oaks, CA 91360

Phone: (805) 496-0144

Title: Versatile High Performance Holographic Optical Coatings

Abstract: A design and fabrication process will be developed in Phase II for creating matched filter holograms. The procedure involves: assembling the data base characterizing the spectral properties of targets and a high clutter background; using matched filter analysis to determine the optimum filter spectral profile for maximizing the signal-to-clutter ratio (SCR); using the computer code developed in Phase I to determine the best holographic recording procedure for generating the hologram; and recording, developing, and testing the hologram. The holographic filters can be used in numerous applications such as increasing the SCR in the detection of specific vegetation or minerals from a satellite, and by developing the filters, to detect boosters at UV and visible/near IR wavelengths against the high clutter Earth background.

Topic#: 90-001

ID#: 40745

Office: ONR

Contract #: N00014-92-C-0008

PI: Jeffrey B. Shellan, PhD

LASER PHOTONICS TECHNOLOGY, INC.

1576 Sweet Home Road

Annherst, NY 14221

Phone: (716) 636-3636

Title: Sol-Gel Composite Second Harmonic Generator and ElectroOptic Modulator

Abstract: In Phase II, Laser Photonics Technology will design, build and optimize two devices exhibiting superior second order

Topic#: 90-011

ID#: 40796

Office: AFOSR

Contract #:

PI: Ryszard Burzynski, PhD

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

nonlinear optical characteristics. The first device is a waveguide second harmonic generator which will be constructed with a novel sol-gel composite and will be prepared with a noneconventional pump beam arrangement. The second device is an electrooptic modulator which is expected to outperform competing technologies. The composite material under examination is expected to operate at higher frequencies than those composed of traditional materials. The successful development of these devices will yield components versatile enough to be a part of any high performance integrated optical circuit.

LINARES MANAGEMENT ASSOC., INC.

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Phone: (508) 653-5458

Topic#: 91-014 ID#: 91-146
Office: ONR
Contract #: N00014-91-C-0061
PI: Robert C. Linares

Title: Large Area Single Crystal Diamond/CBN Structures and Diamond Films

Abstract: Linares Management Associates will develop the technology for producing single crystal diamond substrates of over 1 cm square during Phase II, and to scale-up the process to 2 inch diameter diamond wafers in the company funded Phase III. Processes for the growth of high purity diamond films will be developed, the electronic properties will be determined, and FETs will be built and tested on doped films on diamond and other substrates, and the electronic properties of the pure and ALE techniques for diamond and CBN substrate and film growth, is expected to lead to cost effective manufacturing of these materials for device and integrated circuit development. The program places heavy emphasis on accumulating fundamental knowledge of materials which will assist in device design, and on developing processes which can scale up to manufacturing high volumes of high quality substrates and films at an acceptable cost.

LITHIUM ENERGY ASSOCS

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Topic#: 89-005 ID#: 38445
Office: ONR
Contract #: N00014-91-C-0093
PI: FREDERICK DAMPIER

Title: HIGH POWER LITHIUM RECHARGEABLE BATTERIES WITH INORGANIC ELECTROLYTES

Abstract: During the Phase II project, the sources of the resistive losses in several rechargeable lithium-inorganic electrolyte battery systems will be identified and investigated and new technology developed to improve the pulse discharge performance to meet SDI requirements. Lithium/inorganic electrolyte cells such as the Li/CuClE2 cell using SOE2 based electrolytes have been found to give excellent cycle life and energy densities but the maximum electrode pulse power 190 mW/cmE2 obtained earlier indicates that further development is required. The high electrical conductivity of several inorganic electrolytes and the very early stage of development of the positive electrode and electrolyte technology suggest that Li/inorganic electrolyte cells may be developed in Phase II to provide outstanding performance. The proposed project could have potential use for terrestrial rail gun laser and similar weapon system.

MAXDEM, INC.

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San Dimas, CA 91773
Phone: (818) 793-5224

Topic#: 90-014 ID#: 40720
Office: SDC
Contract #: DASG60-92-C-0046
PI: Neil H. Hendricks, PhD

Title: Thermally Stable, Low Dielectric Polymers for Advanced Electronics

Abstract: Maxdem demonstrated that polyquinolines exhibit dramatic improvements in a wide range of key properties required for advanced electronics when compared to polyimides, the current state of the art. These properties include very low dielectric constants and dissipation factors, high dielectric strength, excellent thermal stability, extremely low stress/thermal expansion coefficients, exceptionally low moisture absorption, indefinite storage life, excellent solvent resistance, etc. The new polyquinolines are excellent candidates for use as interlayer dielectric substrates in high density packaging, including multichip modules. Key elements of the Phase II project include: a) the preparation of several kilograms of one highly promising polyquinoline, and the development of a comprehensive data base which describes all relevant handling, processing and performance characteristics; b) Technical collaboration with General Electric Electronic Technologies lab and other electronics manufacturing companies, c) Improvement of the efficiency of key monomer syntheses, and demonstration of scale-up of polymer synthesis, in order to prepare for pilot plant production of polyquinolines during a subsequent Phase II commercialization effort.

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 89-003 ID#: 38524
Office: ONR
Contract #: N00014-91-C-0001
PI: GEOFFREY T. BURNHAM

Title: LOW COST TWO DIMENSIONAL LASER DIODE ARRAY PRODUCTION TECHNIQUES

Abstract: Diode pumped solid state lasers offer advantages over other lasers, such as high power, compactness, and long life. Obstacles to wide deployment are the cost and reliability of large area AlGaAs laser diode arrays. In Phase II, Northeast Semiconductor, will use Molecular Beam Epitaxy to produce high quality laser diode arrays. The superior growth control and uniformity possible with MBE can give the high yield needed to reduce the cost of laser diode arrays. This array product will open near applications in remote sensing, space communications and countermeasures.

OPTICOMP CORP.
P.O. Box 10779
Zephyr Cove, NV 89448
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Topic#: 89-011 ID#: 38540
Office: ONR
Contract #: N00014-91-C-0253
PI: Peter S. Guilfoyle

Title: Global Optical Free Space "Smart" Interconnects

Abstract: The Phase II objective is to introduce a new class of digital logic. OptiComp has focused on digital optical logic family in order to capitalize on the inherent benefits of optical computing, such as: high Fan-In and Fan-Out; low power consumption; high noise margin; high algorithmic efficiency using "smart" interconnects; and free space leverage of gate interconnect bandwidth product. Phase II will demonstrate each of the five advantages versus other logic family performance such as GaAs.

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Topic#: 90-010 ID#: 40739
Office: ONR
Contract #: N00014-91-C-0155
PI: Jon Flower, PhD

Title: Automatic Parallelization Tool for Sequential Programs

Abstract: We propose the development of a parallel processing paradigm that unifies shared memory, distributed memory and vector architectures. The anticipated performance of algorithms developed using these techniques exceeds current capabilities. A set of tools will be developed to automate the process of converting existing sequential programs for parallel execution using the new technology. The paradigm supports static and dynamic load balancing in a manner transparent to the application developer and also permits fault tolerant applications to be created without recoding existing algorithms. The method also supports distributed processing across an inhomogeneous network of sequential and parallel supercomputers.

PARKVIEW WORKS, INC.
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Topic#: 90-015 ID#: 40808
Office: AFOSR
Contract #: F49620-92-C-0016
PI: Gert Hohenwarter, PhD

Title: Superconducting High Temperature Thin-Film Vortex-Flow Transistor

Abstract: The superconducting flux flow transistor appears to be a promising candidate for active high temperature ceramic thin film circuits. The SFFT has potential applications in interfaces between digital Josephson Junction electronics with semiconductor circuits, for example. Oscillation at frequencies up to 7.5 GHz was observed, single and multi-stage amplifiers have been designed and built. Mixing at 35 GHz has been shown. Dual gate SFFT devices have been designed, fabricated and tested. Phase shifters with 200 series SFFTs produced linear phase shift with control current. We propose to evaluate the applicability of SFFT devices to monolithic microwave oscillators, high gain stages in conjunction with Josephson vortex flow transistors and interfaces between digital Josephson circuitry and room temperature electronics. Prototype circuits will be fabricated and tested. We will also investigate alternate fabrication methods.

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

PHYSICAL OPTICS CORP.
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Topic#: 90-011 ID#: 40813
Office: AFOSR
Contract #: F49620-92-C-0068
PI: Ray T. Chen, PhD

Title: Low Threshold All Optical Crossbar Switch on GaAs/GaAlAs Channel Waveguide Array

Abstract: In Phase II, Physical Optics Corporation proposes a low threshold 10x10 all-optical crossbar switch. Large index modulation generated through free carrier injection provides us with a device interaction length much shorter than any switching device based on the second order (x2) and the third order (x3) nonlinearity. An optically activated modulator with 5 micrometer optical window was demonstrated in Phase I. Modulation depths from 33% to 85% have been observed by shining a HeNe (632.8 nm) laser light to control 1.3 micrometer guided wave in GaAs/GaAlAs channel waveguide. Unlike conventional all-optical devices, where high power laser is needed to generate the array required optical-optical interaction, the OAM based on GaAs channel waveguide and waveguide array needs only a ~ mW laser (for example, 670 nm laser diode) to activate the modulation. As a result, system compactness and its resulting cost effectiveness are expected, and switching speed as fast as subpicosecond is feasible by H⁺ ion implantation. In Phase II, a fully packaged 10x10 all-optical crossbar switching device, including laser diode array, GRIN lens array, activation window and 10x10 GaAs channel waveguide array will be demonstrated.

PHYSICAL OPTICS CORP.
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Torrance, CA 90501
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Topic#: 90-011 ID#: 40814
Office: SDCHI
Contract #: DASG60-92-C-0003
PI: Freddie Lin, PhD

Title: gh Density Reconfigurable Optical Interconnects Based On a Multiplexed Holographic Fabry-Perot Resonator

Abstract: The potential use and feasibility of tunable resonated holograms for reconfigurable optical interconnects was investigated in Phase I. Their unique properties include high channel density, high contrast, small crosstalk, capability of forming two dimensional arrays, and flexibility of designing a variety of interconnect architectures. The TRHs are composed of a single or multiplexed holographic grating embedded in a high finesse tunable optical resonator such as a Fabry-Perot resonator. The structure combines properties of diffraction gratings and resonators: the incident light changes direction and its intensity can be modulated as the resonator is tuned. Tunability can be achieved using ferroelectric liquid crystal modulators, PLZT or other electrooptic materials. The goal of Phase II is to develop several types of reconfigurable interconnect devices based on TRHs. A 2-D array (10x10) reconfigurable interconnect device based on TRH will be developed. Anticipated reconfiguration time will be 25 microsecond and crosstalk < -20 db.

PHYSICAL SCIENCES, INC.
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Andover, MA 01810
Phone: (508) 689-0003

Topic#: 90-001 ID#: 40749
Office: AFOSR
Contract #: F49620-92-C-0031
PI: Steven J. Davis, PhD

Title: Vibrationally Assisted Transfer Laser

Abstract: An innovative concept for the development of a short wavelength chemical laser is proposed. The concept combines energy transfer from metastable species with vibrational energy produced in the chemical formation of ground state laser species to enhance the energy transfer process. The Phase I results demonstrated that vibrationally excited ground state IF(X,v) significantly enhances the formation of IF(B) when the transfer partners NF(a) and Ox(a) are used. A kinetic model based upon this concept predicts that this system may be scaleable to laser densities. This novel concept is not only promising for the development of a tunable IR laser but may have general application to numerous other systems. The Phase II program will build upon these promising results and has an overall program goal of demonstrating a short wavelength chemical laser.

RASOR ASSOCS, INC.
253 HUMBOLDT CT
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Topic#: 89-004 ID#: 38633
Office: AF
Contract #: F33615-91-C-2121
PI: DR NED S RASON

Title: CESIUM VAPOR CONTROL CIRCULATION AND PURGE

Abstract: A new type of liquid cesium reservoir maintains a temperature-independent cesium pressure, continuously recirculates

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cesium vapor through a thermionic fuel element (TFE) and purges it of impurities. This device, the "cesiator", is based on gas-buffered heat pipe principles and offers new TFE design options for fission product/impurity handling. The Phase I research verified the basic feasibility of the cesiator concept, showed analytically that the requirements for TFE operation can be met and developed the experimental techniques and a reference design for investigation in Phase II. In the Phase II research, the technology base for TFE application of the cesiator will be established through an iterative preprototype design, test and evaluation series. A prototype cesiator design will be defined that is compatible for use with current TFE and thermionic reactor designs, as well as with new options for TFE design made possible by the cesiator. A prototype cesiator will be integrated and tested with a simulated or actual TFE thermionic cell with injection of simulated fission product.

REVEO, INC.
200 Saw Mill River Road
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Topic#: 91-014 ID#: 91-630
Office: ONR
Contract #: N00014-91-C-0149
PI: Sadeg M. Faris, PhD

Title: 3-D Stereo Displays for Advanced Workstations

Abstract: Humans have always depended on their stereoscopic vision for their survival. The pair of eyes and the brain constitute the most powerful stereo image processing system capable of parallel processing at an astonishing throughput. Since the invention of photography in 1839, many imaging technologies have been invented and deployed, yet these imaging technologies are still primitive when compared with the stereo vision of humans. Therefore, the quest for the ideal stereo technology continues, as well as the demand for artificial stereo vision. The need to carry out missions in remote and/or hostile environments which require the dexterity and intelligence of human operators for the manipulation of certain objects in those remote and/or hazardous environments while keeping the operator protected. This cannot be done effectively unless an artificial vision system mimics the operator's stereo vision. Reveo has demonstrated the Pol technology for use in 3-D stereo displays for advanced imaging processing workstations in Phase I. In Phase II, Reveo will deliver both projection and direct-view 3-D stereo display prototypes, which will then be turned into products for the Phase III market.

SATCON TECHNOLOGY CORP.
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Topic#: 90-007 ID#: 40776
Office: AFWL
Contract #: F33615-91-C-2153
PI: R.L. Hoekney

Title: Magnetic Bearings and Electrical Drive System for Centrifugal Freon Compressors

Abstract: Contact-type bearings in machines which handle fluids or gases cause numerous problems. The most significant are: need for lubrication, heat generation, and limited life. The application of magnetic bearings to this class of machinery would solve all three major problems simultaneously. The principle innovation of the SBIR program is the integration of active bearings and a brushless drive, with emerging control techniques and a dynamic system model to develop a "smart machine". Commercial markets include household refrigerators, automobile air conditioners, refrigeration for food processing, and vending machines.

SCHMIDT INSTRUMENTS, INC.
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Houston, TX 77005
Phone: (713) 529-9040

Topic#: 90-014 ID#: 40730
Office: SDC
Contract #: DASG60-91-C-0109
PI: Howard Schmidt, PhD

Title: N-Type Semiconducting Diamond for Device Applications

Abstract: Diamond's physical properties make it an ideal material from which to construct electronic devices for a variety of advanced applications, including use in high temperature, high frequency and/or high radiation environments. However, controlled doping technology for diamond, especially for n-type material, does not presently exist, and must be developed before its potential for device applications can be fully realized. In Phase I, Schmidt Instruments demonstrated a new and general technique for doping diamond, Fast Atom Doping (FAD). FAD/CVD overcomes the limitations of standard doping technologies and has two key features ensuring an efficient and successful Phase II effort: 1. FAD/CVD supports rapid evaluation of any candidate diamond dopant; 2. FAD/CVD will support demonstration device production with precise control over dopant concentration, gradient and type. In Phase II, Schmidt Instruments will determine and then optimize the conditions for producing n-type material. From this base, representative diamond electronic devices, e.g. diodes, code cathodes, and bipolar and field

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effect transistors, will be constructed and evaluated.

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Somerville, MA 02143
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Topic#: 90-001 ID#: 40795
Office: SDC
Contract #: DASG60-91-C-0117
PI: Jonah Jacob, PhD

Title: Scaling CW Electron Beam Pumped Rate Gas Lasers to Ultra-High Average Power

Abstract: Research Laboratory has verified in Phase I that an Ar:Xe laser system can achieve laser efficiencies of between 4 and 6% with electron beam pumping at pump power densities as low as 10 watts/cm³. This promises cost-effective scaling of Ar:Xe laser systems to multi-megawatt average power levels while maintaining high electrical efficiency (4-5%) and near-diffraction-limited beam quality. In the Phase II effort, SRL will validate methods for correction and control of the optical distortions resulting from CW pumping. Control of thermal distortions will be achieved by optimally contouring the spatial profile of electron beam power deposition in the active volume. With the optimal deposition profile, high order optical distortions will be negligible and a diffraction limited beam will be obtained after tilt and focus corrections are made. In addition, measurements of small signal gain, non-saturable loss and saturation flux will be conducted at pump power densities of 10-20 watts/cm² to provide critical design data required to scale Ar:Xe laser devices to the high power required. Commercial applications include laser mammography and laser metalworking.

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Topic#: 90-011 ID#: 40743
Office: AFOSR
Contract #: F49620-91-C-0056
PI: Steven A. Lis, PhD

Title: Ultra-Dense Optical Storage

Abstract: Current available EM guns have limited launch energy capability. For a given muzzle energy, the launch velocity is inversely proportional to the projectile mass ^{1/2}, therefore, the achievement of hyper velocities with current gun systems will require ultra lightweight high strength projectiles. SPARTA designed an advanced composite lightweight projectile, as well as the fabrication and delivery of full scale proof-of-concept parts, in Phase I. Phase II will extend the research by incorporating a total systems approach including advanced materials and projectile design, plasma bore interaction and tailoring of gun system/range parameters to achieve the 10 Km/sec launch velocity goal. Proof-of-concept full scale ballistic testing with various launch energies will be performed using an existing EL gun test facility.

SPIRE CORP.
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Bedford, MA 01730
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Topic#: 90-014 ID#: 40717
Office: DNA
Contract #: DNA001-91-C-0139
PI: Stanley M. Vernon

Title: Monolithic High-Speed Electro-Optic Modulator Using Delta-Doped Multi-Quantum Wells and Lateral-Electric-Field-Induced Absorption

Abstract: Spire Corporation will develop a monolithically integratable electro-optic modulator with a multigigahertz bandwidth and a large ON-OFF ratio which will utilize In(x)Ga(1-x)As multi-quantum wells and delta-doped InP barrier layers. The design wavelength is 1.55 micrometers, with other wavelengths being easily attainable. The technique of applying a lateral electric field to induce a large change in the transmission of the stack of quantum wells is new, and promises very large ON-OFF ratios. It works with light which is incident normal to the wafer surface, thus enabling simple array geometries, and avoiding the problems inherent to the waveguiding requirements of most previous device designs. In addition, high speed operation, up to 100 GHz, is predicted due to the use of delta-doped configuration which will achieve a very low device capacitance. Successful development of this technology will establish production-scale source of advanced photonic/opto-electronic components for use in advanced, high-speed, signal processing applications.

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

THERMACORE, INC.

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Topic#: 91-001 ID#: 91-062
Office: SDC
Contract #: DASG60-92-C-0093
PI: John H. Rosenfeld

Title: Liquid Film Evaporation Cooling of Optics

Abstract: Phase I experimental work at Thermacore shows that an optimum cooling mode appears to exist. In these tests, surface tension forces were used to mold a very thin (0.1 to 0.5 micrometer) liquid layer on the surfaces of porous powder particles. Stable operation at a power density of up to 400 W/cm² has been observed with this new cooling mode, while maintaining a low temperature loss. It is believed that by reducing the liquid film thickness to this low level, the temperature loss (and noise) of bubble formation are substantially reduced. Thin film evaporation becomes dominant. Liquid film evaporation heat transfer in capillary pumped (heat pipe) implementation promises a large commercial payoff. Commercial applications include size reduction of solid-state high power electronics chips by 50-80%, and reduction of radiator size (and mass) by 25-35% for space-based high power cooled electronics.

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Topic#: 89-004 ID#: 38803
Office: AF
Contract #: F33615-91-C-2145
PI: JOHN H ROSENFELD

Title: SORPTION RESERVOIRS FOR THERMIONIC CONVERTERS

Abstract: Not available for publication

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Topic#: 89-007 ID#: 38800
Office: AF
Contract #: F33615-91-C-2160
PI: JOHN H ROSENFELD

Title: LOW-MASS, INTRINSICALLY-HARD HIGH TEMPERATURE RADIATOR

Abstract: Requirements for high-temperature waste heat rejection include a need for hardened lightweight radiator equipment to operate near 875K. Current designs under consideration plan to use materials such as titanium composite as the heat pipe radiator wall material. This material is potentially difficult to fabricate in a thin-walled vacuum-tight vessel. It is also relatively low-melting point. A layered niobium composite material is being developed as an alternative to titanium composites. His material shows promise for survivability, weldability, neutron absorbtivity, debris and micrometeoroid resistance, and 3 to 5 kg/m² radiator mass while serving as a wall material for high temperature radiator components. Phase II will implement the use of advanced refractory composites as a hardened radiator wall material. Requirements will be defined and used as a basis for a complete 875K heat rejection system design.

TRISTAN TECHNOLOGIES, INC.

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Topic#: 89-015 ID#: 38857
Office: AFOSR
Contract #: F49620-92-C-0026
PI: Douglas Paulson, PhD

Title: Large Array SQUID Magnetometer for Non-Destructive Evaluation

Abstract: Tristan Technologies and Vanderbilt University propose to apply SQUID magnetometry to problems in nondestructive evaluation which are important to SDIO. We propose to build a non-destructive evaluation instrument that can be used in either of two complementary configurations: as a coil array for studying deep sources with applied fields, or as a high-resolution imaging system. Tristan will assess the effectiveness of SQUID NDE for a broad range of nondestructive evaluation problems related to high-performance aircraft bearings, nuclear reactor fuel tubes, VLSI and hybrid electronic microcircuits, IR focal plans arrays, titanium billits for aircraft turbine blades, high-temperature superconducting electronic devices and magnetic shields, and riveted joints in military and commercial aircraft. Innovation in the proposed instrument will allow us to span orders of magnitude in sample size, spatial resolution, SQUID sensitivity and both strength and frequency of the applied magnetic field. In various applications, SQUID magnetometers could facilitate the development of high-performance devices, reduce manufacturing costs, help prevent catastrophic failures in aircraft, satellites, weapon and other military systems.

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-010
Office: SDC
Contract #:
PI: James M. Ortolf

ID#: 40737

Title: Innovative Research Testbed

Abstract: This program will develop a prototype Innovative Research Testbed that shall be a parallel integration of commercial-off-the-shelf, government owned and research software. Underlying research shall be done into tools for development of distributed, heterogeneous simulations. A graphical methodology for parallel software design will be investigated, along with automatic design partitioning for heterogeneous processor networks. The parallel partitioning and optimization research will lead to an expert system for providing user recommendations on efficient parallelization. Lastly, research into genetic algorithms will be done, for a learning capability in the expert system. As research areas are completed, the graphical interface and parallel analysis software will be demonstrated. Unclassified software representative of an SDI/TMD environment shall be implemented on the prototype workstation serving as the starting point for a future distributed network testbed. The IRT will be designed for continual modification and extension, through the incorporation of results from ISTO and other research efforts: these test articles will become part of an expanding and more capable IRT test environment.

ULTRAMET
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Topic#: 89-006
Office: NASA
Contract #: NAS3-91-C-26253
PI: DR ROBERT H. TUFIAS

ID#: 38820

Title: LONG LIFE HOT ROCKETS

Abstract: Increases in the operating temperatures of chemical rocket combustion chambers burning MMH/NTO liquid propellant have been achieved with iridium-coated rhenium thrusters by Ultramet. This work has resulted in a 20-second improvement in specific impulse with no sacrifice in lifetime. At average temperatures exceeding 2200C (4000F), no degradation in performance nor change in internal dimensions has occurred after more than 15 hours of testing. The application of this technology to chambers burning H2/O2 liquid propellant would also result in significant performance increases due to the increased allowable operating temperature. Based on the likely combustion products, however, the H2/O2 environment will be more oxidizing than MMH/NTO. By limiting the free access of oxygen to the iridium surface (and the free egress of oxidation products from the surface), a refractory oxide overcoat would moderate the oxidation of the underlying iridium, prolonging its useful life. The primary objective of Phase I was to demonstrate that a refractory oxide overcoat could be used to reduce the oxidation rate of the primary oxidation-resistant coating (iridium). The specific goals of the program were to screen materials and processes applicable to operation at 2200C, define one potential system, and fabricate a test chamber to demonstrate the viability of the system. In Phase II, Ultramet proposes to further investigate and optimize these materials and processes, demonstrate their performance in actual tests of 5-lbf chambers, and scale up the process.

XACTON CORP.
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Topic#: 90-003
Office: AFSTC
Contract #: F29601-91-C-0022
PI: Bal K. Jindal

ID#: 40758

Title: Mercury Cadmium Telluride for Long Wavelength (15-25 Microns) Infrared Sensor Applications

Abstract: Xacton developed a new process to produce high quality single crystals of Mercury Cadmium Telluride with possible use in infrared sensors infrared spectrum. This process already succeeded in the 10 micron range and to a limited extent in the 15-16 micron range. This project will determine if this process is feasible for growing Mercury Cadmium Telluride for use in the 15-25 microns range, which SDI needs for dim cold targets and high sensitivity areas. This technology can produce Infrared Focal Plane Arrays for various Defense Applications, such as surveillance, target detection, tracking, missile guidance, thermal imaging, navigation, and night vision. Commercial applications include fiber optics, medical, and scientific instruments.

SDIO ABSTRACTS OF FY91 SBIR PHASE II AWARDS

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Topic#: 90-001 ID#: 40742
Office: AFOSR
Contract #: F49620-92-C-0018
PI: Richard B. Minch

Title: High Flow Low Dimer Bismuth Vapor Source

Abstract: A generic technology is proposed for the generation of high mass densities of monatomic metal vapor which is directed toward generating large mass flows of monatomic bismuth vapor for a BiF (A-Z) blue-green chemical laser. Xemet will design and fabricate a complete chemical micro-mixing nozzle for a BiF chemical laser, and a monatomic bismuth vapor generator which supports a 25 KW CW BiF chemical laser which is scalable to 500 KW CW. Applications will be attempted for MBE, CVD, MOCVD, ion implantation, tribology and direct writing of micro-circuits.