DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Submission of Proposals

The responsibility for carrying out DARPA's SBIR Program rests with the Office of the Comptroller. The DARPA Coordinator for SBIR is Dr. Bud Durand. DARPA invites the small business community to send proposals directly to DARPA at the following address:

DARPA/COMPT/SBIR
Attention: Dr. Bud Durand
1400 Wilson Boulevard
Arlington, VA 22209-2308
(703) 527-0666

The proposals will be processed in the Office of the Comptroller and distributed to the appropriate technical office for evaluation and action.

DARPA has identified 160 technical topics, numbered DARPA 91-084 through DARPA 91-243, to which small businesses may respond in this the second fiscal year (FY) 1991 solicitation (91.2). Please note that these are the only topics for which proposals will be accepted at this time. The previously advertised solicitation for FY 1991 (Solicitation 91.1) which identified 83 technical topics for DARPA, opened on 1 October 1990 and closed on 11 January 1991. Proposals can no longer be accepted on those previously advertised 83 technical topics which were numbered DARPA 91-001 through DARPA 91-083. A list of the topics currently eligible for proposal submission is included below, followed by full topic descriptions. The topics originated from DARPA technical offices.

DARPA's chatter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the DARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential military applicability as the budget and other factors will allow. In the early years of the SBIR program most of the promising Phase I proposals could be funded, but as the program's popularity increased, this became more and more expensive. DARPA therefore instituted program changes to fund more Phase Is. These included increasing the number of SBIR topics, and setting more funds aside for Phase I proposals. In order to do this and still have a reasonable amount of funds available for the further development of promising Phase Is, the Phase II limit has been lowered to $250,000.

DARPA selects proposals for funding based upon technical merit and the evaluation criteria contained in this solicitation document. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposals in question is deemed superior, or it may fund no proposals in a topic area. Each proposal submitted to DARPA must have a topic number and can only respond to one topic.

DARPA has prepared a checklist to assist small business activities in responding to DARPA topics. Please use this checklist prior to mailing or handcarrying your proposal(s) to DARPA. Do not include the checklist with your proposal.

SB91-084 TITLE: Technologies for Visualization of Complex Technical Processes and Novel Approaches for Presenting/Displaying Such Information

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques for visualizing patterns in complex data, and test these techniques with the Nuclear Monitoring Research and Development (NMRD) system at the DARPA Center for Seismic Studies in Arlington, VA.

DESCRIPTION: Concepts are sought for improving the capability of the NMRD system to support seismological research based on the automated processing of large volumes of seismic data from a globally distributed network of seismic stations. This project is aimed at experimenting with the use of scientific visualization technology as a tool to help optimize the man-machine interface for research based on analysis and interpretation of parameters extracted from the data processing. The concepts are to be tested using the NMRD system to evaluate their capability to identify critical factors in the analysis process and new relationships between these factors.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating these concepts into the NMRD system and testing them with data from a seismic network in Eurasia.

Phase II: Develop software to test the new concepts using the NMRD system, conduct tests in cooperation with the analysis and research staff at the Center for Seismic Studies using a large amount of data from seismic arrays and single stations in Eurasia, and evaluate the results.

SB91-085 TITLE: Multi-spectral Data Analysis Techniques on Commercial Satellite Imagery for Arms Control Monitoring

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques for using digital imagery which is routinely collected by commercial satellite firms for applications related to monitoring arms control agreements.

DESCRIPTION: Concepts are sought for novel methods for using multi-spectral satellite imagery routinely available from commercial firms for analysis purposes related to monitoring arms control agreements, including nuclear testing, nonproliferation, conventional forces and strategic arms. Emphasis should be on development of digital image processing techniques and the fusion of information from various spectral bands to achieve monitoring capabilities.

Phase I: Provide a detailed description of the proposed improved concepts, methods and algorithms for specific applications of arms control monitoring and provide preliminary testing of these concepts with data from available multi-spectral images.

Phase II: Fully develop the software for digital image processing and execute this software in a program to comprehensively test the new concepts. Demonstrate what added information these new concepts provide in monitoring arms control agreements.

SB91-086 TITLE: Automated Seismic Analysis Using!! Supervised Machine Learning.

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel machine learning techniques for improving the performance of the intelligent monitoring system (IMS) at the DARPA Center for Seismic Studies.

DESCRIPTION: DARPA has developed an IMS which applies rule- and case-based reasoning to automatically extracted features of data from a network of seismic stations, to locate and identify small earthquakes and explosions. The system incorporates audit trails to facilitate performance evaluation and knowledge acquisition. This project is aimed at developing novel machine learning techniques that would enable seismologists (i.e., the domain experts) to effect a steady and controlled increase in the cognitive capability of the IMS to automatically analyze seismic data.

Phase I: Provide a detailed description of the proposed concepts, together with a detailed plan for incorporating these concepts into the IMS and testing them with data from a seismic network in Eurasia.

Phase II: Develop software to test the new concepts using the IMS, conduct tests in cooperation with the seismic analysis team at the DARPA Center for Seismic Studies, and evaluate the results.

SB91-087 TITLE: Electromagnetic Methods for Determining the Size of Underground Nuclear Explosions Based on Signals Recorded within a Few Kilometers

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test a method that will detect and measure the electromagnetic radiation from an underground nuclear explosion at distances out to a few kilometers and analyze these measurements to determine the yield of such explosions.

DESCRIPTION: Concepts are sought for a method to measure the electromagnetic radiation produced by underground explosions using sensors emplaced in the range from a few hundred to a few thousand meters. 1d The work is to include a theoretical investigation to determine what is to be measured, how it will be D measured, and how the measurements will be interpreted for an assessment of the yield of the device.

Phase I: Develop theories and concepts, and identify existing data, if any, that might be used to support the theories.

Phase II: Utilize and interpret the existing data, develop sensors, and collect new data at the Nevada Test Site to validate the theories.

SB91-088 TITLE: Designs for Miniaturized, Ruggedized, Low-cost Seismic Stations Incorporating Automated Signal Processing for Deployment in Third World Environments

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test an automated seismic station that can be operated under adverse conditions in third-world countries.

DESCRIPTION: A rugged, miniaturized, low-cost seismic station is needed that incorporates key signal processing and analysis features of the DARPA National Data Center and Intelligent Monitoring Systems. The new seismic station must be designed to operate under adverse environmental conditions in third-world countries and to produce digital recordings and parameter information for regional seismic events, that are compatible with standard data formats in use at the DARPA Center for Seismic Studies.

Phase I: Provide a detailed functional description of the proposed seismic station concept, together with a list of components needed to develop the station, proposed software development and estimated cost of production units.

Phase II: Develop and test a prototype seismic station of the type designed in Phase I.

SB91-089 TITLE: Identification of Technical Capability Needed to Monitor Foreign Weapons Development for Nonproliferation Monitoring

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel techniques for monitoring foreign nuclear weapons production.

DESCRIPTION: Concepts are sought for a system to monitor the production of materials that could be used in the production of nuclear weapons in foreign countries. Insofar as possible, the design should take advantage of, and be compatible with the DARPA Nuclear Monitoring Research and Development System, which accepts digital data in real time from a globally distributed network of sensors and applies expert system techniques to automated analysis of the data.

Phase I: Assess air sampling and other techniques that might be used in an automated global ally surveillance system to monitor the production of materials that could be used in nuclear weapons, and develop a concept for such a surveillance system.

Phase II: Develop and test key components of the system.

SB91-090 TITLE: Collecting and Interpreting Hydrodynamic Shock Wave Data from Low Yield Nuclear Explosions

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel methods for estimating the yield of small (ten kilotons or less) nuclear explosions based on close-in measurements of the shock waves produced by the explosions in the surrounding rocks.

DESCRIPTION: Innovative concepts are needed for a method to measure and interpret hydrodynamic and/or high-stress wave fields in the immediate vicinity of underground nuclear explosions with yield of ten kilotons or less. These wave fields would be sampled at distances from approximately 10 meters to several hundred meters from the explosions.

Phase I: Develop theories and concepts, identify existing data, if any, that might be available to test the theories, identify the type of sensors necessary for the proposed method, and determine what geologic data must be collected to support the measurements.

Phase II: Test the theory with any existing data that might be available, and develop a plan for full-scale testing of the theory at the Nevada Test Site.

SB91-091 TITLE: Yield Estimation Methodologies Using Data Collected from Soviet Seismic Networks

CATEGORY: Exploratory Development

OBJECTIVE: Develop and test novel techniques to use data collected from Soviet seismic networks in estimating the yield of Soviet underground nuclear tests, and to estimate other information pertinent to the characterization of nuclear explosions.

DESCRIPTION: Concepts are sought for improving the current methodology for analyzing and interpreting seismic recordings of underground nuclear explosions for the purpose of estimating the yield of the explosions and the geophysical conditions under which the bombs were detonated. Seismic recordings from a number of Soviet nuclear explosions at the Semipalatinsk and Novaya Zemlya test ranges have recently become available. Recordings of future Soviet nuclear explosions are expected to be available from the same network. Concepts are to be developed and tested using this data. Emphasis is to be on methods for yield estimation, assessment of yield uncertainty, and evaluation of the capability of Soviet network stations to determine yield at various yield thresholds.

Phase I: Provide a detailed description of the proposed improved concepts and methods for interpreting Soviet seismic network data for yield estimation and station calibration, and conduct preliminary testing of the concepts with data from this network.

Phase II: Develop and execute a software package to fully test the new concepts and display the results. Incorporate the results into a yield estimation system at the Center for Seismic Studies, following published software standards for the Center.

SB91-092 TITLE: Advanced Statistical Methods to Interpret Seismic Yield Estimates of Soviet Nuclear Explosions

CATEGORY: Basic Research

OBJECTIVE: Develop and test a statistical method for optimizing the estimation of the yield of underground nuclear explosions using seismic data.

DESCRIPTION: A method is required to optimize the statistical weighing of different types of seismic measurements to reduce the uncertainty in estimating the yield of underground nuclear explosions. As part of i this work, a method must be developed for calibrating network yield estimates as new information becomes available, and for incorporating hydrodynamic, in-country seismic and other measurements as these data become available.

Phase I: Develop the statistical theories and weighing concepts, and test the theories through application of existing data.

Phase II: Provide and execute software to fully test the method using all available seismic data, and provide a tested statistical software package to the DARPA Center for Seismic Studies (CSS) written following CSS software standards.

SB91-093 TITLE: Ceramic Fiber Development

CATEGORY: Exploratory Development

OBJECTIVE: Develop low cost manufacturing methods for ceramic fibers with properties suitable for use in advanced metal and ceramic matrix composites.

DESCRIPTION: Ceramic fiber/metal matrix and ceramic fiber/ceramic matrix composites have been identified by DoD as important to the development of advanced military systems. Wide spread use of components made from these composites will depend upon the availability of low cost/high performance fibers. For thermostructural applications of interest to DARPA, fibers must maintain high strength and creep resistance at temperatures up to 1500"C. Innovative methods capable of producing waveable fibers (usually having fiber diameters of about 20 microns and below) are of particular interest.

Phase I: Provide a bench scale demonstration of process capable of producing fibers with the desired high temperature creep and strength properties.

Phase II: Provide a pilot plant scale up of process to produce material for characterization, evaluation and to determine ultimate manufacturing costs.

SB91-094 TITLE: Smart Materials and Structures

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate a new class of materials which have the capability to both sense and respond to environmental stimuli and which have the capability of active control of their response.

DESCRIPTION: Smart materials offer many enhancements and new capabilities to DoD systems, particularly in performance, durability and reliability. Smart materials can provide designers and engineers with significant new capability to control geometric shape, structure movement, damping and vibration absorption, and other attributes as designed properties of the material. The proposed program should provide for the development of new materials with active constituents. These materials can be designed to react to external stimuli on either a micro-mechanical or macro-mechanical level. The development of functional adaptive materials along with advances in theory, sensors, actuators, control algorithms and signal processing as applied to smart materials is of interest.

Phase I: This effort is concerned with basic theory and proof of concept in the areas of sensors, actuators, composite design, matrix and reinforcement selection, information management and architecture, and control systems as applied to an integrated smart material or as individual topics which have potential applicability to smart materials.

Phase II: This effort is concerned with smart materials and structures characterization, calibration and validation.

SB91-095 TITLE: Sensors for Intelligent Processing! of Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop in-situ smart sensors and diagnostics that enable, through feedback, the intelligent control of materials processing in chemical vapor deposition (CVD) reactors.

DESCRIPTION: In-situ diagnostic tools and smart sensors can be used to monitor critical process parameters and product quality. Feedback of acquired signals can be used to initiate control actions for the intelligent processing of materials to optimize quality and reduce costs. Sensor design and signal processing will be based on data acquired through in-situ diagnostic studies relevant to CVD reactors. Laser-based optical diagnostics and optical sensors are desirable because of their high selectivity, sensitivity, and potential for the real-time, remote sensing of a variety of process variables. Proposals emphasizing these techniques will be seriously considered.

Phase I: Identify CVD reactor process and initiate diagnostics leading to smart sensor design for specific material.

Phase II: Incorporate smart sensors and control action feedback into candidate manufacturing task and quantify their effect.

SB91-096 TITLE: Ceramic Bearings Research

CATEGORY: Basic Research

OBJECTIVE: Develop the underlying science for ceramic bearings technology for the reliable prediction of performance, the determination of failure mechanism, and development of appropriate nondestructive evaluation (NDE) or proof testing methods.

DESCRIPTION: Ceramic bearings offer system upgrade potential for a number of DoD systems. Low density and high elastic modules are attractive properties for high-speed bearings used in instruments. Corrosion and abrasion resistance relative to metals makes them attractive candidates for a variety of hostile environments. High temperature capability of ceramics relative to metals opens up new applications and challenges. The proposal must address the development of the basic science needed for the reliable operation of ceramic bearings in these demanding applications.

Phase I: Model the failure mechanism(s) of an all ceramic or hybrid bearing in one or more applications. Identify the material properties, operating conditions, and design parameters needed for life prediction and manufacturing quality control.

Phase II: Conduct experiments to validate the model developed in Phase I, and evaluate NDE and/or proof testing methods appropriate to ceramic bearings.

SB91-097 TITLE: Halogen Assisted Diamond Deposition

CATEGORY: Exploratory Development

OBJECTIVE: Develop a low temperature, halogen assisted diamond deposition process. '

DESCRIPTION: Preliminary laboratory reports indicate that halogen assisted chemical vapor deposition of diamond can be achieved at significantly lower temperatures than that required by plasma assisted hydrogen/methane processes. Diamond, with its high thermal conductivity, is a very attractive material for the dissipation of heat from electronic devices and would be most effective if deposited directly on the device. However, most electronic systems and devices are not tolerant of the high processing temperature required for hydrogen/methane diamond deposition.

Phase I: Demonstrate halogen assisted diamond deposition directly on high power microelectronic chips at temperatures compatible with the chip manufacturing process.

Phase II: Scale-up the deposition process and demonstrate cost-effective diamond coating of microelectronic devices.

SB91-098 TITLE: Application of High Temperature Superconductors to Electronic Circuitry

CATEGORY: Advanced Development

OBJECTIVE: Determine how high temperature (nominally 800K) superconductor materials can be introduced into electronic circuitry to enhance overall properties of signal dispersion, frequency response, packing density, reduced crosstalk and reduced power dissipation.

DESCRIPTION: The recent discovery of high temperature ceramic oxide superconductors has important implications in advancing the capabilities of electronic components and circuitry. The phasing of this insertion into electronics probably will begin with the replacement of normal metal interconnects with superconducting leads and transmission lines.

Phase I: Select an appropriate electronics package and determine how a computer-aided-design (CAD) code can be modified to accommodate superconducting leads and transmission lines. Determine how the code must be adjusted to optimize the layout geometry according to the special properties and processing requirements of superconducting materials. Prioritize the types of superconducting insertions and evaluate their cost-benefit within the upgraded electronics package.

Phase II: Carry out the modifications of a CAD code to insert superconducting leads and transmission lines, from Phase I. Compare the predicted performance of the electronic circuitry to that of the standard electronics package. Translate the code into design instructions for the layout of the superconducting circuitry.

SB91-099 TITLE: Ceramic Shields for Satellite Protection Against Hypervelocity Impact

CATEGORY: Basic Research

OBJECTIVE: Explore the use of ceramics in stand-off shields for protection of satellites against hypervelocity impacts by orbital debris and/or kinetic energy pellets.

DESCRIPTION: Subsequent to deployment, a number of important and costly space systems will be subject to impacts from projectiles traveling at relative velocities as high as 15-20 km/sec. In peacetime, the primary source of such hypervelocity projectiles is man-made orbital debris. In wartime, hostile offensive action may result in the addition to this debris environment of projectiles such as pellets and fragments from the breakup of satellites. To protect these space systems, effective debris impact shields must be designed and implemented. Since the impact velocities exceed considerably the capabilities of current ground launcher technology, the design and analysis of such shields must rely heavily on the extension of laboratory impact data from "moderate" to "high" impact velocities by computer simulations of impact events. In an effort to optimize shield performance, DARPA is exploring the use of certain classes of materials which offer the potential for major improvements in shield capability. Of particular interest are ceramics. Examples include lightweight ceramic armor (e.g., boron carbide) and ceramics with microstructure (e.g., embedded carbon microspheres or fibers). Accordingly, it is the intent of this research topic to identify and demonstrate the advantageous use of ceramics in advanced shield designs.

Phase I: Identify a promising application of ceramics which would enhance significantly the performance of stand-off shields against hypervelocity impact by projectiles with masses up to 1-2 gm and relative velocities in the 5-20 km/sec regime. Provide a preliminary design, and demonstrate the enhanced capability via theoretical analysis and/or computer simulations. While the concept may be explored theoretically/numerically in this study, the use of laboratory experiments for demonstrating feasibility at some level, or investigating critical technical issues, is not excluded.

Phase II: Demonstrate the capabilities of one or more candidate shield design(s) with the aid of large-scale computer simulations of impact events and appropriate laboratory experiments.

SB91-100 TITLE: Supercritical Fluid Processing Technology

CATEGORY: Exploratory Development

OBJECTIVE: Investigate the utility of supercritical fluid processing technology for control of chemical contamination and/or reclamation of valuable chemical constituents associated with waste and other by-products of defense manufacturing and maintenance operations.

DESCRIPTION: The unique ability of supercritical fluids to selectively dissolve and extract various compounds may provide the basis for techniques to control the discharge of undesirable chemical compounds or eliminate the need for hazardous solvents in defense manufacturing operations. The proposal should detail the advantage of this approach over other more conventional procedures.

Phase I: Investigate solubility/extractability of targeted chemical compounds in supercritical fluid(s) to demonstrate feasibility of technique for proposed application.

Phase II: Define solubility as a function of temperature and pressure, and demonstrate the ability to economically scale the process to handle useful quantities of material.

SB91-101 TITLE: Novel Solid Electrolytes for Batteries

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate novel solid electrolytes for the production of high energy/power density, all solid-state batteries

DESCRIPTION: The DARPA Electrochemical Power Sources Program is investigating the production of a rechargeable, high energy/power density, all solid state battery, based on the lithium/polymer electrolyte/insertion cathode concept. Novel electrolytes are sought which might lead to an increase in the already significant room temperature ionic conductivities ($>10^3$ S/cm) achieved. High ionic conductivity over a broad (low) temperature range, chemical compatibility, processibility, and electrochemical stability are all important considerations.

Approaches that integrate a fundamental understanding of ion mobility in solid electrolytes with the design, fabrication, and evaluation of these materials will receive serious consideration.

Phase I: Develop and test promising candidate solid state electrolytes.

Phase II: Incorporate the candidates from the Phase I program into an experimental battery and test its performance.

SB91-102 TITLE: Alternative Methods for Chemical Biological Weapons Agent Demilitarization

CATEGORY: Exploratory Development

OBJECTIVE: Identify and study novel approaches for the efficient destruction of chemical/biological weapon (CBW) agents.

DESCRIPTION: Bilateral agreements with the Soviets and concerns from Congress are spurring CBW disarmament. Disposal efforts are being hampered by technology problems, policy debates, and environmental concerns. The Army has constructed a chemical weapons disposal site on Johnston Island as a prototype incineration facility. Cryofracture has also been proposed as a method of destruction, and DARPA is beginning a program in supercritical fluid oxidation for the destruction of hazardous waste. DARPA is also interested in identifying and exploring alternative destruction technologies, which are efficient, environmentally safe, and affordable, when compared to existing CBW destruction techniques. Examples might include biodegradation, steam pyrolysis, etc. In the proposal, emphasis should be given to the advantages resulting from the new technology.

Phase I: Identify and describe promising alternative CBW destruction technologies.

Phase II: Demonstrate cost effective, acceptable destruction for surrogate chemicals using this new technology.

SB91-103 TITLE: Supercritical Fluid Processing Routes to High Modules Thermoplastic Composites

CATEGORY: Basic Research

OBJECTIVE: Utilize the dissolving power and solubility control of supercritical fluids for dissolution and subsequent deposition of thermoplastic matrix material on high elastic modules carbon fibers and fabrics.

DESCRIPTION: Prior DARPA funded work has demonstrated the possibility of selectively dissolving polymeric materials in supercritical fluids and then changing temperature and/or pressure to apply coatings to fibers.

Phase I: Demonstrate that thermoplastic matrix materials for fabrication of high performance carbon fiber composites of interest to DoD can be selectively dissolved and deposited on high elastic modules carbon fibers via supercritical fluid processing.

Phase II: Determine the pressure and temperature effects on dissolution and deposition. Demonstrate that the process can be scaled-up to uniformly coat fabric and/or impregnate near net shape fiber pre-forms.

SB91-104 TITLE: Structural Ceramics Enablin1! Demonstration

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the utility of advanced state-of-the-art structural ceramics in militarily significant and technically demanding systems.

DESCRIPTION: Ceramics offer advantages in strength, elastic modules, wear and corrosion resistance, reduced weight, durability in extreme environments, and in elevated temperature use. Thus the application of ceramics in

certain military systems offers potential improvements in the performance of these systems. The proposal should identify cost-effective ways to significantly increase the capabilities of DoD systems through the infusion of advanced state-of-the-art structural ceramics into fielded weapon systems or platforms. The demonstration should use commercially available materials in any application with military utility. A design methodology appropriate to ceramics must be employed.

Phase I: Evaluate the performance enhancement potential and/or cost savings to systems in which the demonstration component would be used. Design the component to be used in the demonstration for optimum performance and reliability.

Phase II: Produce the components designed in Phase I and conduct evaluation tests to evaluate component reliability and system performance.

SB91-105 TITLE: Compressive Surface Strengthening of Pressure Densified Structural Ceramics

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate methods to increase the bend strength of pressure densified structural ceramics utilizing surface compressive stresses.

DESCRIPTION: Pressure densification of structural ceramics can result in materials with extremely small volume flaws such that bend strength fracture origins are related to surface defects. Significant enhancement of bend strength is expected for this class of ceramics if compressive stresses sufficient to prevent growth of surface flaws is applied. This approach combined with post machining heat treatments to heal surface flaws should result in significant enhancement of useful strength. The proposal should identify the method for generating surface compressive stresses, the effect of temperature and pressure on the surface compressive stress, the stress profile resulting from the compressive strengthening method chosen for evaluation, and an estimate of the magnitude of the strength increase to be expected. Surface strengthening mechanisms which continue to operate at high temperature and can be used with components having complex geometries are of greatest interest.

Phase I: Produce samples with surface compressive stresses which can be evaluated in four point bending, using a standard military specification bend bar test. Commercially available materials may be used if compatible with the proposed surface compressive stress strengthening mechanism proposed. Samples with optimized strengthening will be evaluated for surface flaw sensitivity using controlled flaw techniques.

Phase II: Components of interest to DoD with significant surface stresses in use, will be identified, fabricated and evaluated to demonstrate the capability and utility of the surface compressive strengthening method chosen.

SB91-106 TITLE: Applications of Gabor Bases to Extracting Information from the Wigner/Ville Transform

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate the nature of Gabor bases for extracting information from signals using the 0 Wigner/Ville transform.

DESCRIPTION: DARPA is investigating methods for signature identification for underwater transient signals,)n and is interested in determining the value of the Wigner/Ville transform, enhanced by Gabor bases for the solution of this problem. In particular, how should this problem be approached in a noisy environment?

Phase I: Provide a detailed theoretical study of the use of Gabor bases for obtaining information using the Wigner/Ville transform from noisy transient signals.

Phase II: Using actual data, conduct studies to verify the applicability of the theoretical results.

SB91-107 TITLE: Using Neural Networks in Intelligent Control of Manufacturing!! Processes

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate the value of neural networks in the decision making processes that are fundamental to control of manufacturing processes.

DESCRIPTION: The importance of intelligent control and smart sensors in many manufacturing processes has 'he become very evident. One of the important parts of such a system is a decision making process. DARPA is interested in determining the efficacy of neural nets for the solution of this decision making problem.

Phase I: Choose a specific manufacturing process and give a theoretical justification for use of neural gn nets as the method of choice for the decision making process.

Phase II: Take the theoretical results in Phase I and develop a practical system for solving the

SB91-108 TITLE: Ferroelectric Materials for Long Wave Staring Infrared Focal Plane Array Multiplexer Storage Capacitors

CATEGORY: Basic Research

OBJECTIVE: Demonstrate ferroelectric materials suitable for charge storage in 8-12 micron infrared focal plane array (IRFP A) multiplexers.

DESCRIPTION: The inability to store total photo generated charge is currently a limiting factor in the performance of long wave (8-12 micron) IRFPAs. For a 1 mil cell, silicon charge coupled devices can hold about 1 X 10' electrons, and complementary metal oxide semiconductor integrating capacitors can store approximately 1 X 107 electrons. In practice, the photo generated flux is attenuated (e.g., filtering, gain reduction, low quantum efficiency detectors, etc.) before storage, thus throwing away valuable signal and effectively degrading noise equivalent temperature difference. Signal/noise ratio could be significantly improved if high dielectric constant integrating capacitors were integrated into the IRFP A readout electronics.

Phase I: Perform preliminary growth and characterization experiments on candidate ferroelectric materials.

Phase II: Optimize growth and processing of most promising ferroelectric materials. Provide detailed characterization of materials and design, fabricate, and test storage devices suitable for integration with IRFPA.

SB91-109 TITLE: Biological Signal Processing

CATEGORY: Exploratory Development

OBJECTIVE: Exploit the results of recent studies of swimming and flying organisms to enhance the capabilities of man-made surveillance and communication systems.

DESCRIPTION: Evolutionary pressures impacting living organisms have led to the development of extraordinary sensory and perceptual systems insuring success in diverse (i.e. air, land, sea) environments. We currently know a great deal about living organisms novel sensory mechanisms (e.g., photoreceptors, acoustic ~!II '. detectors) and are starting to make significant progress in characterizing the means used by living systems to more optimally extract/integrate their wealth of sensory information. It is expected that further success would permit: (1) the development of more robust signal processors that are selectively sensitive to informative channels and simultaneously robust relative to distractions and distortions; (2) the realization of multiple channel sensory fusion combining information from multiple dimensions and multiple channels to form unified representations of complex objects; (3) optimal designs for communicative signals and for allocation of effort in response to demands, needs,

resources and threats; (4) expectation guided signal detection and target anticipation; and (5) methods for optimal data presentations. Proposals are sought: (1) to implement significant inferred or derived strategies in hardware/software and (2) to evaluate the potential impact on military systems of alternative strategies where substantial and significant experimental and analytical work has already been completed at the level of the living organism.

Phase I: Develop proposals which identify novel methodological or technological concepts, and focus efforts on central research issue{s) with reasonable technical progress.

Phase II: Provide initial proof-of-concept demonstration.

SB91-110 TITLE: Biomimetic Design

CATEGORY: Basic Research

OBJECTIVE: Develop abstract fundamental design principles from living organisms and exploit them in the design/fabrication of enhanced materials, components, devices and systems.

DESCRIPTION: Living organisms are examples of "design for function," often far excelling the products of conventional engineering. Nature's "tools" (energy and materials) parallel those available to engineers, and both exploit design principles at the level of mechanisms, structures, and systems. Proposals are sought which abstract fundamental design principles from living organisms and act to implement such designs using biological, conventional or hybrid materials. Proposals should identify plausible gains in terms of system performance, ease/cost of production, or life-cycle maintenance demands.

Phase I: Develop proposals which identify novel methodological or technological concepts, and focus efforts on central research issue{s) with reasonable technical progress.

Phase II: Provide initial proof-of-concept demonstration.

SB91-111 TITLE: Environmental Science

CATEGORY: Exploratory Development

OBJECTIVE: Develop methodologies/technologies for: (1) the remediation of current DoD hazardous waste conditions and (2) alternative means appropriate to the avoidance and/or elimination of toxic waste production. DARPA 26

DESCRIPTION: There is a growing awareness and concern within DoD regarding the creation and/or perpetuation of environmentally hazardous conditions that may have been established by DoD or its contractors as a consequence of research, development, manufacturing, testing, operation/use, maintenance and demilitarization of military equipment and weapons systems/components. Analysis, development and exploitation of chemical and biological processes are of interest in this solicitation. Proposals are sought: (1) for analysis of the fate and effects of contaminants in soil and marine/estuarine environments (This includes, as appropriate, the development of analytical instrumentation and methodologies.); (2) for analysis, design and subsequent development/optimization of chemical and biomimetic pathways for remediation (This includes, for example, the characterization and stability of degradation/detoxification pathways, studies of contaminant partitioning, and the bioengineering of microbial organisms for enhanced performance and environmental robustness/suitability.); and (3) for development of alternative processes and materials for minimization/elimination of toxic waste associated with current technologies (This includes, for example, development of nontoxic antifouling coatings for naval vessels and superior coatings for aircraft, to eliminate the need for rework solvents.). Excluded for purposes of this solicitation are: (1) generalized environmental insult surveys; (2) efforts predominantly seeking only to identify or characterize the effects of

hazardous waste on humans; (3) proposals to more generally characterize mesoscale environmental phenomena; and (4) those efforts that characterize general atmospheric and/or air-sea interfacial processes not specifically keyed to the two themes of the solicitation as identified above.

Phase I: Develop proposals which identify novel methodological or technological concepts, and focus efforts on central research issue(s) with reasonable technical progress.

Phase II: Provide initial proof-of-concept demonstration.

SB91-112 TITLE: 193 nm Excimer Laser Development for Lithography

CATEGORY: Exploratory Development

OBJECTIVE: Develop 193 nm laser sources for use in lithography systems.

DESCRIPTION: DARPA is developing 193 nm projection lithography systems to enable cost-effective fabrication of military application specific integrated circuits (ASICs) with feature sizes at or below 0.25 microns. Several opportunities exist to support these efforts, which are developing the lithographic stepper and resists, by developing improved 193 nm laser sources. First, the excimer laser source used in the lithography system requires improvement. Desirable improvements include: increases in the repetition rate from current levels (-200-400 Hz) into the kHz range while maintaining reasonable average powers (-10-20 W); improvements in the reliability, serviceability, operating cost, and service intervals of the laser; and reductions in the size and cost of ownership of the laser. Improvements in the components (optical window materials, power supply, etc.) which affect the laser reliability are of interest, as is work on temporal stretching of the laser pulse to reduce damage to optics occurring from two-photon absorption. Second, 193 nm sources are needed for use in interferometers required for alignment of the optics in the lithography system. The ideal source for interferometry would operate at the same wavelength as the 193 nm excimer laser, would have high spatial and temporal coherence, would be continuous wave (CW), and would be compact and inexpensive. Frequency multiplied systems using longer wavelength CW lasers or compact, high repetition rate excimer lasers are possible solutions.

Phase I: Perform detailed analysis of proposed approach to new or improved 193 nm laser. Demonstrate experimentally that the improvements or new approach are likely to succeed.

Phase II: In collaboration with end users of the laser source, develop a working prototype.

SB91-113 TITLE: Neural Networks Applied to Control or Diagnostic Tasks

CATEGORY: Exploratory Development

OBJECTIVE: Design and develop prototype neural network systems that perform specific control of diagnostic tasks.

DESCRIPTION: Innovative research efforts are sought for demonstrating the utility of neural network methods in control and diagnostic tasks. Proposals must address specific applications. These include, but are not limited to: monitoring and control of manufacturing, fabrication, or materials processing; enhanced control for automated, self-adjusting systems or precision operations; diagnostics for damage/failure of mechanical systems; and optimized resource allocation. Preference will be given to proposals that address well-defined applications with potential for near-term system implementation and deployment, and for which sufficient training and testing data are demonstrated to be readily available.

Phase I: Demonstrate the applicability and utility of neural network methods for a specific application, using real data from the intended application. This phase should also address probable hardware requirements and the planned strategy for proceeding from the feasibility study to the development of the demonstration system.

Phase II: Develop a demonstration neural network system for the chosen applications. Employ and test the system on a trial basis. Develop plans for eventual implementation of fully operations system.

SB91-114 TITLE: Advanced Analog to Digital Converter Design Studies for Wide Dynamic Range, Gigasample Conversion Rate, Monolithic Chip Architectures

CATEGORY: Exploratory Development

OBJECTIVE: Investigate high performance analog to digital converter (ADC) architectures that take advantage of new solid-state device structures to enhance bandwidth and dynamic range.

DESCRIPTION: New, higher speed device technologies offer an opportunity to advance the state-of-the art in analog to digital conversion. In order to take advantage of these technologies, such as heterojunction bipolar transistors (HBTs), high electron mobility transistors (HEMTs), resonant tunnel diodes (Rills), etc., architectural designs need to take into account the specific features associated with each technology. Designs are to be developed for both wide bandwidth ADCs with at least four bit resolution and for large dynamic range, eight to sixteen bits, ADCs at as high a bandwidth as possible. In each design the practical limits in integration level and power dissipation for the chosen technology shall be made part of the design consideration. A trade off analysis between bandwidth and effective number of bits as a function of standard deviations in device characteristics shall be developed.

Phase I: Design either a wide bandwidth or high dynamic range ADC based on theoretical performance models of the selected advanced device technology. Determine the ADC's theoretical performance characteristics.

Phase II: Construct a detailed ADC design for the circuit and technology selected in Phase I. This design is to take account of actual device parameter variations as are appropriate for the technology's state-of- the-art. The final design shall be characterized in terms of bandwidth vs. effective number of bits, power consumption and chip size.

SB91-115 TITLE: Efficient Slab Lasers

CATEGORY: Exploratory Development

OBJECTIVE: Develop efficient energy extraction from slab lasers.

DESCRIPTION: Slab laser designs have intrinsic advantage over rod laser designs and can be scaled for high power outputs with good beam quality. Thermal tensing is minimized in slab designs for solid state lasers compared to rod design lasers. However amplified, stimulated emissions (ASE) and parasitic oscillations limit efficient energy extraction. Innovative concepts are needed to overcome these limitations for efficient energy extraction from slab lasers.

Phase I: Examine concepts to suppress ASE and parasitic oscillations in slab lasers, and enhance efficient energy extraction for both continuous wave (CW) and q-switched operation.

Phase II: Demonstrate the concepts examined for CW and q-switched operation in Phase I and generate concepts for efficient energy extraction at high average powers up to 1 kilowatt outputs.

SB91-116 TITLE: High Speed Electro-optic Modulators

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate high speed electro-optic (EO) modulators.

DESCRIPTION: EO modulators are devices to control amplitude, phase, frequency, polarization, spatial mode, etc., of laser radiation in real time. These devices are used in variety of applications such as coding information for communications, signal processing, etc. Innovative ideas are needed to develop very high speed modulators with low insertion losses, large optical and electrical. bandwidths.

Phase I: Develop concepts for very high speed modulators with low insertion losses. Modulation bandwidths up to 100 GHz or more are desirable.

Phase II: Demonstrate concepts developed in Phase I and determine materials/device fabrication

SB91-117 TITLE: Microlasers

CATEGORY: Exploratory Development

OBJECTIVE: Develop diode pumped solid state microlasers.

DESCRIPTION: Diode pumped solid-state microlasers with single frequency are desirable for many applications. These microlasers are longitudinally pumped and can be self frequency doubled or self q-switched. The output wavelength can be shifted by parametric wavelength conversion. Such lasers when mass produced at low cost, enable linear and two dimensional arrays of microlasers to be fabricated and phase combined for high average powers.

Phase I: The goals of this effort are to examine numerous materials candidates and laser cavity designs to completely absorb the diode pump source for microlasers, and demonstrate the output waveform i.e., q-switched pulses with maximum energy.

Phase II: Demonstrate scaling to linear and two dimensional arrays of microlasers and wavelength converters and develop concepts for phase combining the microlasers for high average powers.

SB91-118 TITLE: Tunable Coherent Infrared Radiation Source at 3-5 Microns

CATEGORY: Exploratory Development

OBJECTIVE: Develop a compact, tunable infrared radiation source at 3-5 microns for electronic warfare applications.

DESCRIPTION: A tunable, coherent radiation source at 3-5 microns is desired for electronic warfare applications. The average power is in hundreds of Watts. Tactical platforms dictate the size and weight requirements. Priority will be given to the design which is most compact and light weight. In addition, simplicity in design and safety in operation are necessary requirements.

Phase I: Provide a design and substantiate it with both analytical and numerical calculations.

Phase II: Perform a proof-of-principle experiment.

SB91-119 TITLE: Innovative Applications of Electron Beam Welding

CATEGORY: Exploratory Development

OBJECTIVE: Explore the potential of high energy electron beam welding.

DESCRIPTION: Typical electron beam welding is performed with electron beam energy at less than 100 KeV and the welding is typically performed inside a vacuum chamber. This approach limits the size of the object to be

welded. Moreover, the range of the electron beam in welded material is typically less than 1 mm. The use of high energy (10-20 MeV) electron beam will allow welding at atmospheric pressure and enhance the range in the welded material. Furthermore, the radiation coming from the electron beam welder can be used to monitor the process in real time.

Phase I: Analyze the interaction between the high energy electron beam and metals. Provide a preliminary design of the real time monitor.

Phase II: Build the monitor hardware and perform bench testing.

SB91-120 TITLE: Vacuum Microelectronics Development

CATEGORY: Exploratory Development

OBJECTIVE: Explore innovative designs in vacuum microelectronics for power amplification.

DESCRIPTION: Vacuum microelectronics describes a device technology based on arrays of sub-micron-size field emission sources. Presently gated field emitter arrays have ach!eved valu~ of normalized. . transconductance (97 Siemens/cm~ and average electron current density (lkA/cm) that exceed the limits of gridded thermionic cathodes by orders of magnitude. The advent of practical high-performanc:e gated emitters would have particular impact on microwave and mm-wave source technology. One of the main roadblocks to success is the unreliability of the current emitters. This program will emphasize the basic understanding of the factors which limit the lifetime of the emitters. Priority will be given to those designs which can overcome these obstacles.

Phase I: Identify all major causes that limit the lifetime of high current density emitters and provide a preliminary design that can bypass these factors.

Phase II: Perform a proof-of-principle experiment.

SB91-121 TITLE: Corrosion Monitor for Supercritical Water Oxidation

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques for the remote monitoring of potential corrosion damage to pressure boundary components of supercritical water oxidation process vessels.

DESCRIPTION: Supercritical water oxidation of various compounds used in chemical agents, propellants, and other hazardous materials can produce potentially corrosive salts. Methods are sought to detect corrosion damage in supercritical fluid reactors without shutting the process down for inspection.

Phase I: Demonstrate a method that will remotely detect corrosion damage in systems operating at temperature and pressures above the critical point of water.

Phase II: Fabricate a remote corrosion monitoring system that will quantitatively determine the extent of corrosion in operating supercritical water oxidation process vessels and piping.

SB91-122 TITLE: Contribution/Control of Polymer Reaction in Responsive Armor

CATEGORY: Exploratory Development

OBJECTIVE: Gain a better understanding of how polymeric material responds to shock so as to be able to tailor that response to optimize the employment of polymers m projectile defeat.

DESCRIPTION: A responsive armor technology employing a polymer, in conjunction with other materials, has been demonstrated. This armor technology performs in a manner similar to reactive armor, but with reduced effectiveness. The goal of this research is to optimize the performance of polymers employed in responsive armors to maximize the effectiveness of these armors. A key concern is to reduce the collateral effects associated with armor systems employing explosives.

Phase I: Develop a methodology for evaluating polymers with respect to their utility in responsive armors and employ/develop appropriate analytic tools to develop a list of the most promising materials. Then conduct tests to evaluate the most promising polymers.

Phase II: Employing the results of Phase I, develop prototypes of responsive armor systems employing the most promising polymers for proof- of-principle testing.

SB91-123 TITLE: Novel Penetrator Defeat Mechanisms for Light Armor Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: Identify and develop novel penetrator defeat mechanisms for kinetic energy and/or chemical energy penetrators that could be utilized to up light armor vehicles with minimum weight and space impact on the vehicle structure.

DESCRIPTION: Light armored vehicles have relatively thin hull structures of steel or aluminum with limited penetrator defeat capability. These vehicles must remain light, mobile and, in many cases, air-transportable. Of interest are new and novel penetrator defeat mechanisms that would provide the potential to up armor these vehicles without degrading their mission capability. Mechanisms that could address kinetic energy penetrators up to 3Omm and hand-held chemical energy weapons would be most desirable.

Phase I: Develop penetrator defeat mechanism, identify functional materials, develop functional fabrication techniques, and establish desired performance goal(s).

Phase II: Fabricate target sections and conduct proof-of-principle demonstrations of the penetrator defeat mechanism(s).

SB91-124 TITLE: Unique/Novel Lightweight Appliqué Armor Attachment Technologies

CATEGORY: Exploratory Development

OBJECTIVE: Examine potential attachment methods for appliqué armors and assess the advantages and disadvantages of each.

DESCRIPTION: Conventional attachment methods such as bolts, studs or screws suffer from mechanical deformation on impact rendering the attachment technique unusable.

Phase I: There are probably other techniques which lend themselves to quick attachment and detachment, but nevertheless are as effective as bolt-on appliqué. Conduct analysis of other attachment schemes and assess their possible advantages and disadvantages.

Phase II: Develop working models of proposed attachment schemes and compare them with existing techniques. Predict where the novel attachment schemes might serve to advantage.

SB91-125 TITLE: Metallic Composite Armor for Light and/or Ultra light Applications

CATEGORY: Exploratory Development

OBJECTIVE: Utilize metallic composite technology to produce a ballistically superior material that exhibits optimized base armor properties of hardness and toughness, to produce light and/or ultra light armors.

DESCRIPTION: Light and/or ultra light applications dictate base structure materials of thin metals or composites with weights which vary from 2 psf to 10 psf. Metallic composite armor may offer significant improvements in protection by providing both structural and ballistic properties in a single structure with an overall weight reduction.

Phase I: Select materials, develop fabrication techniques, and identify projected performance goals.

Phase II: Fabricate armor sections for proof-of-principle demonstration test.

SB91-126 TITLE: Novel Ceramic Processing Techniques

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel ceramic processing techniques to manufacture effective, inexpensive tank armors.

DESCRIPTION: Existing ceramic armor concepts are too expensive and not as effective against antiarmor projectiles as desired.

Phase I: Develop concept for novel processing techniques which will produce one or more of today's ceramic armor candidates for greatly reduced costs, or produce a vastly improved ceramic armor.

Phase II: Perform proof-of-principle demonstration of the processing technique and test/characterize the resulting ceramic material.

SB91-127 TITLE: Fracture. Erosion and Failure Models for Armor/Antiarmor Hvdrocodes

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel statistical approaches for accurately and efficiently incorporating micro-structure theory, material fracture theory or molecular-bonding theory into armor/antiarmor hydrocodes (MESA, CTH, or EPIC) to improve fracture or erosion predictions.

DESCRIPTION: Existing material models used by hydrocodes are empirically based. Hydrocode results depend on having complete libraries of experimentally determined material parameters. Methods for determining these parameters are often less than ideal, with experimental conditions not accurately reflectmg the actual conditions experienced during an impact event. Consequently, hydrocode calculations, although usually quite good, have limited validity. The purpose of this effort is to develop material models which are more closely based on fundamental physics and improve the predictive nature of today's hydrocodes.

Phase I: Develop concept for using novel statistical approaches to incorporate fundamental physics into material response and failure models suitable for use with today's hydrocodes.

Phase II: Develop necessary theory, analytical modelling, numerical modelling, and algorithms for physics based modelling of fracture, failure and erosion in 3-D hydrocodes EPIC (Alliant Technologies), MESA (Los Alamos National Lab) and/or CTH (Sandia National Lab).

SB91-128 TITLE: High Power Flat Panel Light Sources for Visible Signature Control

CATEGORY: Advanced Development

OBJECTIVE: Develop rugged, efficient, high-power flat panel light sources for use as surface or near-surface elements to modify the apparent brightness of structures in the field.

DESCRIPTION: Luminous output should be at least 100 watts per square meter. Thickness should not exceed two inches. Variable power control, color control, and flexibility are desirable, but not required. Production cost of the system should be minimized. Power output, efficiency, spectral characteristics, and cost should be specified.

Phase I: Provide hardware demonstrators of approximately one (1) square foot and appropriate testing.

Phase II: Provide refinements of the Phase I concept, a demonstration of improved, large-scale ,1 hardware, and define production techniques and costs.

SB91-129 TITLE: Optical Window Materials/Systems with High Visual and Infrared Transmissivity and High Electrical Conductivity

CATEGORY: Advanced Development

OBJECTIVE: Develop window materials/systems with the characteristics outlined below.

DESCRIPTION: Desired characteristics consist of the following: 80-90% image transmission over at least +/-10 degrees in the visible and 8-12 micron infrared; surface electrical conductivity of at least 20 Ohms per I square; sizes up to 12" x 18" with structural strength/robustness to withstand 2 psi overpressure and field usage; thickness should not exceed one inch; transmissivity in other bands (e.g., 1.0 and 3-5 microns) is desired; and cost for a 12" x 18" system should be estimated.

Phase I: Provide hardware samples and conduct appropriate testing.

Phase II: Provide refinements to the Phase I concept, conduct a demonstration of improved full or I near-full size systems, and define production techniques and costs.

SB91-130 TITLE: Low-cost rent Materials with Hi h Thermal Conductivity

CATEGORY: Advanced Development

OBJECTIVE: Develop lightweight, inexpensive, solid materials/systems with high visual transmissivity (> 90%, 0.3 -1.0 micron) and high thermal conductivity (comparable to copper).

DESCRIPTION: The system should be capable of being applied in sheets to the exterior of an object and should be comparable in strength and toughness to plastics such as plexiglass. Production cost should be minimized. Estimates of the above should be presented.

Phase I: Provide hardware demonstrators of approximately one (1) square foot and conduct appropriate testing.

Phase II: Provide refinements of the phase one concept, a demonstration of improved, large-scale hardware, and define production techniques and costs.

SB91-131 TITLE: High Payoff Mine/Barrier Concepts

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel, cost effective concepts for mines or barriers.

DESCRIPTION: Concepts should be easily/flexibly deployable, difficult to detect and counter, and should represent a significant advancement or cost/burden reduction over current systems such as scatterable mines, wide area mines, and antihelicopter mines. Targets may be personnel, vehicles, aircraft, railroads, or other militarily significant items.

Phase I: Address cost effectiveness/advantages relative to current systems, key technical issues and plans to resolve, and an operational concept for employment.

Phase II: Demonstrate key technologies and effectiveness, and refine cost and operational concept projections.

SB91-132 TITLE: Methods to Attack Target Vehicles by Reducing or Eliminating Effectiveness of Firepower, Mobility, Communications, and/or Rendering Targets Vulnerable to Further

CATEGORY: Exploratory Development

OBJECTIVE: Explore new and innovative means of defeating armored and other vehicles other than massive destruction or disruption of armor.

DESCRIPTION: This work will be part of a broader Mission Intervention Program. Concepts are sought for innovative and novel means of attacking target vehicles by impairing or eliminating effectiveness of firepower, mobility, communications, and/or rendering targets vulnerable to further attack. Technologies which can disrupt the tempo of military operations, command and control, target acquisition, degrade the ability of follow-on forces, or interrupt logistics can also be considered. Technologies which would support anti-drug or antiterrorist operations are of interest. Concepts for penetration of heavy armor are not of interest in this request.

Phase I: Refine the proposed concepts and provide an optimized design and performance analysis of proof-of-principle hardware. Subcomponent development may be appropriate.

Phase II: Construct and test the demonstration hardware.

SB91-133 TITLE: Individual Soldier Protective Ensemble Cooling

CATEGORY: Exploratory Development

OBJECTIVE: Develop concepts for using large numbers of inexpensive sub-millimeter sized, mechanical, chemical or electromechanical devices, cooling tubes, heat exchangers, phase changers, etc., to assist in cooling soldiers wearing nuclear biological contamination protective equipment.

DESCRIPTION: Protective ensembles worn by today's and future soldiers for chemical protection, small arms protection, and environmental protection require cooling if the soldier is to be able to operate for extended periods of time in warm temperatures. Cooling concepts based on macro-sized heat exchange or refrigeration equipment are too large and heavy.

Phase I: Develop innovative concept(s) for appropriate arrays of sub-millimeter sized, mechanical, chemical or electromechanical devices, cooling tubes, heat exchangers, phase changers, etc., and develop concepts for incorporating devices into a protective suit. Investigate resulting system concept(s) to determine advantages and disadvantages identify critical components, and develop an appropriate research and development program plan to build proof-of-principle demonstrators of the critical components.

Phase II: Construct and test proof-of-principle demonstrator.

SB91-134 TITLE: Flexible, Deformable Surfaces Formed from Arrays of Submillimeter Sized, Linear Electromechanical Actuators

CATEGORY: Exploratory Development

OBJECTIVE: Develop a two-dimensional array of interconnected, submillimeter, electromechanical devices and the processing system to precisely control shape of a portion of exterior surface. Potential applications include projectile steering surfaces and aircraft wing surfaces.

DESCRIPTION: Micro-machines, micro-motors, and micro-actuators have been developed which are smaller than 1.0 mm' in volume, extremely light, and exhibit extremely rapid response times. This project seeks to explore the feasibility of using this technology to build light, adaptable surfaces which deform for some useful purpose.

Phase I: Develop innovative concept(s) for appropriate individual electromechanical devices, concept(s) for connecting devices into an array, and concept(s) for a processing/control system. Investigate resulting system concept(s) to determine advantages and disadvantages of concept for the intended application.

Phase II: Construct and test proof-of-principle demonstrator.

SB91-135 TITLE: Acoustic Sensors for Automatic Target Recognition of Ground Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: Explore and develop low cost acoustic sensors and algorithms capable of detecting and performing classification of tactical ground vehicles.

DESCRIPTION: The incorporation of an acoustic sensor system in a combat vehicle would provide a passive, non-line of sight capability with 360 degree coverage. Operating autonomously, an acoustic sensor would allow early detection and classification of approaching vehicles. The acoustic sensor could also operate in conjunction with other sensors to provide unique target descriptors to be used in multi-sensor fusion. The goal for the acoustic sensor is that it operate mounted on a moving tank as part of a multi-sensor suite.

Phase I: Develop an innovative concept for a new acoustic sensor array, and a concept for processing and control. Develop concepts to discriminate between targets (friend or foe, wheeled vs. tracked, tank vs. APC, T-80 vs. T-62, APC vs. ADA, etc.) Develop concepts for determining target direction/location and for filtering environmental noise.

Phase II: Develop and implement selected concepts into a functional system to be demonstrated in a field environment. Target classification is required, target identification is desired. High P d' Pc, and a low false alarm rate are required.

SB91-136 TITLE: Integrated Fiber Optics/Photonics System for Netted Sensor Systems

CATEGORY: Advanced Development

OBJECTIVE: Develop and demonstrate a generic fiber optics/photonics sensor system capable of detecting/sensing, collecting, processing, diagnosing, and displaying ground based/airborne weapon systems' status.

DESCRIPTION: A continuous, distributed sensor system suite (i.e., optical fibers, switches, sensors, and connectors; fiber optic and laser sensors; and optical transmitters and receivers, optoelectronic integrated circuits, integrated optical, circuits, high speed electronics, interconnections, and packaging) capable of being integrated with existing and future ground/airborne weapons systems is desired. Areas of fiber optic sensors measuring interest include, but are not limited to: temperature, pressure, strain, linear and angular position, acoustics, acceleration, vibration, rotation, electric and magnetic fields, velocity, flow, etc. These distributed and multiplexed fiber sensors would allow measurement/monitoring in both spatial and temporal domains by combining fiber optic sensing

technologies with techniques to telemeter, to diagnose with expert systems, and to portray with state-of-the-art graphic user interfaces.

Phase I: Design and develop an innovative fiber optic/photonic system and define potential optimization paths. Calculate system effectiveness, accuracy, noise immunity, and development cost.

Phase II: Fabricate, test, and demonstrate a complete system in laboratory and field environment. Develop system design handbook for weapon system managers, design and production engineers.

SB91-137 TITLE: Fiber Optic Radio Frequency Transducers for Remote Reception of Electromagnetic Energy

CATEGORY: Exploratory Development

OBJECTIVE: Explore and develop innovative radio frequency (RF) sensors for the detection/transmission of energy.

DESCRIPTION: There is a need to identify and demonstrate the feasibility of new materials, system or device structures that respond to RF energy from 1-100,000 MHz. These new materials and devices must have the potential for attachment to fiber optic networks supporting high speed data collection, analysis, and diagnostics. Advantages could be derived from lower cost, simpler fabrication, more accurate and precise measurements, or any other characteristic significant to RF sensors.

Phase I: Identify and develop a plan for RF sensing device(s) connected to a fiber optic cable, conceive basic physical measurements for such devices that offer improvements beyond the present state-of- the-art devices operating at microwave frequencies.

Phase II: Develop final design and fabricate prototype samples of device(s) selected for demonstration. Measure and report on RF performance characteristics.

SB91-138 TITLE: Applications of Acoustic Charge Transport Signal Microprocessor Technology

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate significant enhancements in a military application through the use of an acoustic charge transport (ACT) based signal microprocessor.

DESCRIPTION: ACT technology has evolved in recent years from a basic research activity, through the demonstration of a variety of specific devices, to the currently available" signal microprocessor." The" signal microprocessor" is a high capability, digitally programmable integrated circuit which can process analog signals by mathematical computation, thereby providing the same type of functionality for analog signals as the traditional microprocessor does for digital data. Such a device combines analog processing speeds and simplicity with the programmable versatility traditionally attributed only to digital processing techniques. Indeed, the signal microprocessor can be implemented all-digitally as an integrated circuit surrounded by converters, but even the currently available ACT -based microprocessor is 1,000 times faster than any available digital version and can operate on signals in the video, IF, and radio frequencies while digital versions operate only at audio frequencies. Functionally, the ACT -based microprocessor can be represented as a digitally programmable transversal filter. A standardized item provides 128 taps, currently available 6-bit tap weigh accuracy, and 150 MHz bandwidth. The unit requires only external DC power and a standard personal computer printer interface for control. The hardware is supported by user friendly software package which automatically and dynamically controls tap weights in response to user objectives, specified in a wide variety of ways. Units can be stacked for greater accuracy or cascaded for more taps/delay lengths. It is clear that such a device presents a powerful capability that has application in a variety of military electronic systems. It is the intent of this topic to identify and demonstrate such applications.

Phase I: Base efforts on the proposal of promising applications where the signal microprocessor will provide an enhancement of an existing military electronic system concept, or allow for the development of a new capability. Provide a design study where the enhanced capability is theoretically demonstrated and a preliminary design completed. However, the use of laboratory experiments for demonstrating feasibility at some level or investigating critical technical issues is not excluded.

Phase II: Build a feasibility demonstration version of the system concept and demonstrate its performance.

SB91-139 TITLE: Fiber Optic Transducer and Network Systems for Distributed Large Area Advanced Over the Horizon & High Frequency Receiving Systems

CATEGORY: Exploratory Development

OBJECTIVE: Explore innovative approaches for using fiber optic cables and their associated trans conducers/subsystems to enhance the performance and/or reduce the cost of very large phased array receive antennas used in advanced surveillance or communication systems operating in the high frequency (HF) band.

DESCRIPTION: HF receives arrays for over the horizon (OTH) systems generally contain a large number of elements in a linear array covering a significant physical area. Such arrays employ receivers at every element or sub-array node, and require elaborate cable networks for signal routing, array control, and power distribution. Typically, cable networks are subsurface for environmental protection and, along with the receivers, form a major portion of the hardware/construction costs of the array. In the future, when advanced requirements and designs might dictate even more elaborate arrays, the receive site costs could become prohibitive. It is the intent of this topic to explore potential cost savings for such arrays by the innovative use of fiber optic technology, which may allow for radically new approaches in array design and construction. This topic seeks novel array architectures to exploit the potential of fiber optic technology, specifications for new or enhanced devices required to make such architectures realizable, and ultimately the basic demonstration of the feasibility and performance of the novel concept.

Phase I: Present the innovative idea or approach for the application of fiber optic technology to large)r HF arrays. Present the general array architecture with analysis or data indicating potential payoff. Analytical tasks would include a detailed analysis of the performance of the concept, taking into account all relevant factors including losses, bandwidth dynamic range, noise, etc. Performance analysis could be in terms of individual elements and/or the array as a whole and should result in a clear understanding of performance-cost tradeoffs and the performance specifications of the fiber optic devices necessary to make the concept realizable. Produce an assessment of risk and identify critical technology issues. Experimental tasks critical to demonstrating basic feasibility could also be proposed. Phase I proposals to specifically develop fiber optic devices must relate the research to the requirements of HF receiver arrays, and explain the choice of performance goals for proposed devices in terms of benefit to the overall array.

Phase II: Demonstrate the feasibility of the concept developed and analyzed in Phase I, using a single element or small sub-array, as appropriate. The project may include the development of upgraded devices, and would include updated design and cost analysis based on experimental findings.

SB91-140 TITLE: Modular Architecture for Computer Image Generation

CATEGORY: Exploratory Development

OBJECTIVE: Explore and implement concepts for modular image generation hardware which will allow for user flexibility in meeting changing display requirements.

DESCRIPTION: The computer image generator is usually the most expensive component in existing simulators. Once the user determines his requirements, he often selects the least expensive hardware that will satisfy them because of budget constraints. If requirements change (i.e., increase beyond the capabilities of his initial image generator) he is often forced to purchase a new one. A particularly desirable alternative would allow the user to

build upon the equipment that he has already purchased to meet these new requirements in much the same way as a personal computer user can add memory, co-processors, graphics enhancements, etc. To make such an approach even more attractive, it should not be specific to any particular supplier of hardware.

Phase I: Prepare a concept(s) for a modular architecture which will allow a user to obtain a wide range of image generation capabilities using off-the-shelf hardware as add-ons to a basic image generator configuration.

Phase II: Demonstrate a selected concept as an alternative to existing image generation hardware in a network of simulators.

SB91-141 TITLE: Table-top. Distributed Simulation of Logistics in Battlefield Simulations

CATEGORY: Exploratory Development

OBJECTIVE: Explore and implement concepts to realistically portray the effects of logistics (i.e., personnel replacement, resupply, and maintenance) in the distributed simulation of combined arms warfare.

DESCRIPTION: The modeling of logistics in the distributed simulation of a combined arms battle is generally of a lower fidelity than the modeling of the combat arms. It is recognized that logistics constraints affect the tempo of the battle; however, as it is currently implemented, the logistics model is incomplete. It only approximates the delays introduced by resupply, replacement and maintenance, and it does not realistically task combat service support personnel in their wartime duties. As a result, the training received by the support staff is degraded, and the credibility of the simulation suffers.

Phase I: Prepare concepts for realistic modeling logistics, and concepts for how that model might be implemented at a workstation(s) as part of a larger network of simulators.

Phase II: Develop, test, and validate selected concepts in a stand alone local area network for training support staff as part of an existing network of simulators for the simulation of a combined arms battle.

SB91-142 TITLE: Workstation for Parametric Analysis of Weapons/Weapons Systems in Distributed Simulation

CATEGORY: Exploratory Development

OBJECTIVE: Explore and implement concepts which allow for the rapid assessment of the effects of postulated weapon system capabilities in a virtual environment.

DESCRIPTION: Distributed simulation networks provide a virtual environment in which weapons systems still under development can be evaluated and hopefully improved. Usually the proposed design or concept is sufficiently well defined that simulator hardware can be built and placed on the network. The effect of such a weapon system can then be quantifiably measured in the presence of the other battlefield operating systems in the virtual environment. Therefore, a distributed simulation network can be used as an aid to refine weapon system concepts. It would be helpful to have a workstation which could generate a weapon such as a tank in the virtual environment and allow the designer to quickly alter its capabilities such as speed, rate of fire, main gun maximum effective range, etc., or postulate additional capabilities so that the designer could create a new weapon concept. Any weapon system characteristic that is recognized under the communication protocol is a candidate for evaluation. Access to this unrestricted capability within the distributed simulation environment gives a designer the tools to quickly, cheaply and accurately measure the effectiveness of postulated capabilities of systems not yet even prototyped, let alone built.

Phase I: Prepare a concept for a workstation which will allow a designer access to an existing network of simulators which adhere to a documented standard, and simulate a weapon system with a changeable set of capabilities.

Phase II: Implement the concept and demonstrate compatibility with an existing network.

SB91-143 TITLE: Adaptive Digital Array Processing for Clutter and Jammer Suppression in Spatially and Temporally Variant Environments

CATEGORY: Advanced Development

OBJECTIVE: Develop, analyze, and assess architectures, techniques, and algorithms for adaptive active phased array processing to suppress jammers and clutter in spatially and temporally variant environments.

DESCRIPTION: There is a need for analysis and assessment of integrated active phased array antennas and processor architectures for adaptive suppression of jamming and clutter interference applicable to radar systems used on high speed airborne moving platforms. Techniques and algorithms developed may be applicable to a wide variety of airborne radar and missile array systems that suppress land and sea clutter as well as stationary, moving, or responsive electronic countermeasure systems.

Phase I: Develop and assess computationally efficient algorithms for array beam forming and techniques for adaptive weight selection for pattern sidelobe control.

Phase II: Demonstrate the potential performance of the techniques developed in Phase I with the aid of measured data or other existing field measurements and data.

SB91-144 TITLE: Detection and Targeting Electro-optic/Infrared Imaging Sensors/Processing for Ground Targets with Suppressed Signatures

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate innovative sensors for the detection and targeting of next generation reduced-signature ground vehicles.

DESCRIPTION: DARPA is investigating advanced technologies for detecting and targeting next generation ground vehicles which seek to achieve survivability by hiding in dense cover and employing deception and denial techniques. The use of camouflage netting and thermal blankets are examples of readily available technology used to reduce the detectability of ground vehicles. Next generation ground vehicles can be expected to employ more advanced techniques to further reduce their detectable signatures. DARPA is interested in innovative sensor and processing technologies to defeat advanced signature reduction techniques and ensure the ability to detect, classify, and target these next generation ground vehicles. Approaches may take advantage of unusual regions of the electromagnetic spectrum, unique signature phenomenology differentiating man made and natural objects, innovative combinations of sensors, or innovative signal processing techniques. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally useful.

Phase I: Provide a theoretical analysis which details the detection theory of the proposed sensor technique based on physical principals, and provide an analytical assessment of available experimental data to support the theory. Also include a prediction of the increase in operational capability as a result of the technique (e.g., improved detection range, increased probability of detection, reduction in false alarm rates etc.).

Phase II: Based upon successful theoretical analysis, develop laboratory demonstrations to verify the technical approach.

SB91-145 TITLE: Detection and Targeting Sensors For Ground Targets with Low Radar Cross Sections

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate innovative sensors for the detection and targeting of next generation reduced-radar signature ground vehicles.

DESCRIPTION: DARPA is investigating advanced technologies for detecting and targeting next generation ground vehicles which seek to achieve survivability by reducing their radar signatures to defeat moving target "to indication and/or imaging radars. The use of radar absorbing material is an example of readily available leg technology used for this purpose. Next generation ground vehicles can be expected to employ even more advanced techniques to further reduce their radar signatures. DARPA is interested in innovative sensor and processing technologies to defeat advanced radar signature reduction techniques and ensure the ability to detect, classify, and target these next generation ground vehicles. Possible approaches may take advantage of unusual regions of the electromagnetic spectrum, unique signature phenomenology differentiating man made and nature objects, innovative combinations of sensors, or of innovative signal processing techniques. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally useful.

Phase I: Provide a theoretical analysis which details the detection theory of the proposed sensor technique based on physical principals, and provide an analytical assessment of available experimental data to support the theory. Include a prediction of the increase in operational capability as a result of the technique (e.g., improved detection range, increased probability of detection, reduction in false alarm rates, etc.).

Phase II: Based upon successful theoretical analysis, develop laboratory demonstrations to verify the technical approach.

SB91-146 TITLE: Application of Vitreous Materials

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel methods for employing vitreous materials in armor systems to enhance their ability to defeat kinetic and chemical energy penetrators.

DESCRIPTION: Glasses have been employed as layers and fillers in armor systems for a number of years. The goal of this research is to explore novel methods for employing glasses in armor systems to enhance the effectiveness of these armors. A key concern is to reduce the weight while enhancing the effectiveness of armor systems.

Phase I: Develop and test novel concepts for employing glasses in armor systems.

Phase II: Employing the results of Phase I, develop prototype armor systems employing glasses in novel proof-of-principle testing.

SB91-147 TITLE: Develop Numerical Approaches to Accurately Predict and Model Behind Armor Effects for Chemical Energy or Kinetic Energy Armor Penetrating Projectiles

CATEGORY: Exploratory Development

OBJECTIVE: The hydrocodes in use today need to be able to follow not only the projectile and its interactive path through the armor, but the fragments of the armor as they are created and the trajectories that they follow until the termination of their flight path.

DESCRIPTION: The state of modeling fracture and failure in all hydrocodes is such that this has not been achieved.

Phase I: Develop an understanding of fracture and failure in sufficient detail to accurately model it.

Phase II: When models have been developed and validated, they should be installed in currently used hydrocodes. It is conceivable that several models will exist in the same hydrocode and that each will be useful in a certain regime (e.g., ductile and brittle fracture). The limitations of each model should be documented.

SB91-148 TITLE: Nonlinear Detection of Weak Signals in Clutter

CATEGORY: Basic Research

OBJECTIVE: Develop nonlinear system concepts that can be applied to an aggregated system of simple algorithms, sensors, or processors. It should provide a high speed and highly accurate processing capability that can be used to detect very weak signals imbedded in clutter.

DESCRIPTION: Recently developed models of aggregated systems of large numbers of processing elements indicate that high sensitivity (hypersensitivity) and selectivity may be achieved in detecting very weak signals. Interesting results are forthcoming from several diverse disciplines including theoretical physics of ensembles (e.g., simulated annealing), neural networks, chaos theory, and computer simulation of large nonlinear systems. These models indicate that individual processing elements may change state incrementally, and yet induce rapid and hypersensitive response of the total system. This effort will concentrate on developing a distributed, nonlinear, dynamical system processing (i.e., a large number of nonlinear elements that change a small amount) approach that will detect weak signals (i.e., visible, infrared, radar, radio frequency, acoustic, etc.) imbedded in clutter.

Phase I: Identify mechanisms and conditions for nonlinear dynamical systems that can be applied to specific sensors, optical systems, algorithms, and processors. Develop and exercise a model(s) to determine the incremental state changes and the hypersensitive response of the total system. The goal will be to incorporate hypersensitivity into optical or electronic systems to detect weak signals, especially in cluttered environments.

Phase II: Demonstrate nonlinear, dynamic processing techniques to detect specific weak signals from a chosen sensor, optical system, algorithm, and/or processor. Demonstrations can use recorded signals, but live signals would be preferred.

SB91-149 TITLE: Investigation of Metallurgical and Processing Effects of Implementing New Alloys for Shaded Charge Liners

CATEGORY: Exploratory Development

OBJECTIVE: Develop new technologies for cold forming shaped charge liners from heavy metals and heavy-metal alloys.

DESCRIPTION: The technology for mass-producing high-precision copper liners which are used in most shaped charge warheads in fielded US weapon systems is well established. Recent research suggests that performance increases are possible by using liners of heavier metals or alloys in warheads. These materials are less ductile than copper, and the metal forming methods used for copper are less suited to the manufacture of heavy metal liners. The purpose of this effort is to develop novel methods for forming liners from metals such as tungsten, molybdenum, tantalum, etc., and their alloys.

Phase I: Develop methods for forming high-precision, heavy-metal liners for shaped charges.
Produce twelve heavy-metal liners in 81-mm diameter for loading, testing, and metallurgical analysis at US government laboratories. The warheads will be test fired for jet characterization and penetration into rolled homogeneous armor (RHA).

Phase II: Extend the results of the Phase I research by producing liners in 120 to 150-mm diameter according to a design provided by the sponsor. These liners are to be loaded and test fired for jet characterization and penetration into RHA. A liner will also be submitted for metallurgical analysis.

SB91-150 TITLE: Optimizing Thickness in Laminated Armors

CATEGORY: Exploratory Development

OBJECTIVE: Gain a better understanding of how the impedance mismatch between differing materials in a laminate armor contributes to projectile defeat so as to optimize the mix of materials and their thicknesses in laminate armors with respect to projectile defeat.

DESCRIPTION: It is well known that mitigating shock is one means of enhancing the ability of a passive armor system to defeat projectiles. The goal of this research is to both explore mixes of materials as well as layer thicknesses in laminate armors to maximize the effectiveness or these armors. A key concern is mass and space efficiency.

Phase I: Evaluate the effectiveness of differing material mixes and thickness in projectile defeat, and develop and test the most promising mixes.

Phase II: Employing the results of Phase I, develop prototype laminate armors for proof-of-principle testing.

SB91-151 TITLE: Aggregate Software

CATEGORY: Exploratory Development

OBJECTIVE: Explore and develop software, applying artificial intelligence/expert systems, and models for aggregating low level data to higher level summaries.

DESCRIPTION: While a great deal of work has been done on data fusion, applying artificial intelligence/expert systems to aggregate basic data into summaries will facilitate decision analysis and operations. Such a technology would enhance simulation models for war games, intelligence, etc. This would ed also apply to actual intelligence collection and reporting, as solutions will capitalize on advance artificial intelligence applications, neural network techniques, distributed computing and fractural applications.

Phase I: Current intelligence models are not capable of aggregating first level intelligence products such as TACELINT, PHOTINT, and COMINT reports into finished analytical intelligence reports. Develop concepts for innovative approaches to fusing the first level intelligence products of models' collection algorithms.

Phase II: Develop software application or intelligence model fusion leading to decision aids capable of assisting in the generation of intelligence fusion products. Also address the application of this technology to the use of intelligence and other disciplines.

SB91-152 TITLE: Effectiveness of Metal Back Plates on Ceramic Armor

CATEGORY: Exploratory Development

OBJECTIVE: Gain a better understanding of how ceramic armors fail and how metal back plates affixed to those armors can mitigate that failure.

DESCRIPTION: Test results indicate that thin metal plates bonded to the rear surface of ceramic armor tiles improve the ballistic performance of those tiles significantly. The goal of this research is to better understand how those metal plates enhance the performance of ceramic armor so as to optimize the ceramic/metal mix or, optimally, design ceramic/cermet tiles which do not require metal back plates. A key concern is minimizing weight.

Phase I: Conduct a study of ceramic failure and how metal back plates affixed to ceramics can mitigate that failure.

Phase II: Develop/employ appropriate analytic tools and confirming experiments to validate theories that are developed.

SB91-153 TITLE: Novel Anti Armor Projectile Defeat Mechanisms

CATEGORY: Exploratory Development

OBJECTIVE: Develop novel methods for defeating anti armor projectiles.

DESCRIPTION: Existing vehicle armor concepts rely on catastrophic material failure to defeat incoming anti armor projectiles. Other concepts involve active projectile intercept. This effort seeks to identify other, novel methods of defeating incoming anti armor projectiles.

Phase I: Develop concept for novel armor system.

Phase II: Perform proof-of-principle demonstration of the armor system or critical components.

SB91-154 TITLE: Hybrid Composites for Ultra light Armors

CATEGORY: Exploratory Development

OBJECTIVE: Develop composite materials at extremely light weights to defeat small arms projectiles and shell fragments using novel materials and combinations of materials.

DESCRIPTION: All of the current solutions for ultra light armors used today are implementing laminates of metals or ceramics backed by high strength polymers. Are there other ways of employing these materials either in combination or individually to achieve a synergistic improvement in their properties for ultra strong, ultra light armors. Methods of fabrication, growth, bonding, inter laminar weave, co-precipitation, etc. should be explored. Combination of materials heretofore unheard of should be tried.

Phase I: Expound an understanding and an exploration of the properties that make components effective. Based upon these properties, apply new materials using these models to obtain new composites for testing.

Phase II: Fabricate new composites and evaluate their properties to confirm the predictions.

SB91-155 TITLE: Innovative Packaging Techniques and Package Models

CATEGORY: Advanced Development

OBJECTIVE: Advance the development and fabrication of packaging structures for digital and analog (microwave and millimeter wave) circuits that result in improved performance characteristics, packing densities and lower cost.

DESCRIPTION: Advanced multi-chip packaging structures and packaging boards containing a number of interconnected (digital) chips (chip-on-board) offer the promise of providing improved overall system performance at a lower cost than is possible with each chip individually packaged in conventional structure. Packaging structures for millimeter wave frequency analog devices are at an embryonic stage of development. New materials and techniques should allow improved performance characteristics at a lower unit cost than is presently available.

Phase I: Select one or more packaging approaches for either digital circuits, millimeter wave frequency circuits or both. Develop one or more approaches for packaging these circuits in a manner that leads to improved overall performance at the lowest possible costs. Describe performance/cost tradeoffs for each approach studied.

Phase II: Develop final designs and fabricate prototype samples of the package structures selected for demonstration. Measure and report upon their performance characteristics. Develop a plan including a description of the necessary equipment and facilities for producing these packages in large quantities.

SB91-156 TITLE: Computer Aided Design and Process Models for Microwave and Millimeter Wave Devices and Circuits

CATEGORY: Advanced Development

OBJECTIVE: Provide models for microwave and millimeter wave frequency solid-state devices and monolithic format circuits that accurately predict actual device and circuit performance over the widest possible frequency range. Emphasis should be placed upon the development of models that predict device/circuit performance from processing parameters. Interface these models with commercially available computer aided design software packages and workstations.

DESCRIPTION: At the present time, reasonably accurate models are available for microwave solid-state devices and circuits that operate in a linear mode within the frequency range from 1 to 20 GHz. Additional work is needed to improve the accuracy of models for operation of devices and circuits in the 20 to 100 GHz range and for operation of active devices in a nonlinear (high power) mode. Devices of particular interest are metal semiconductor field effect transistors (MESFETs), high electron mobility transistors (HEMTS) and heterojunction bipolar transistors (HBTS) fabricated from III-V compound semiconductor materials. Circuits of particular interest are in a monolithic format fabricated from gallium arsenide. Most desirable are models which can be used to tie processing parameters to circuit design parameters.

Phase I: Select one or more devices and/or circuit configurations and develop models which result in accurate prediction of device and/or circuit performance. Provide a clear indication of accuracy and needed improvements. Consideration should be given to how models proposed will extend computer aided design capabilities beyond those afforded by use of currently existing models. Also consider compatibility of models with existing commercially supported software packages and workstations.

Phase II: Complete model development and write an appropriate software description that can be used in conjunction with commercially supported software and workstations.

SB91-157 TITLE: Advanced Testing Techniques for Millimeter Wave Monolithic Integrated Circuits

CATEGORY: Advanced Development

OBJECTIVE: Develop low cost, rapid, accurate, practical methods for nondestructively testing the lid performance of millimeter wave (40 to 110 GHz) integrated circuits.

DESCRIPTION: One of the largest components of the cost to produce millimeter wave frequency (40 to 110 or GHz) integrated circuits is that of testing the performance of the circuits. If rapid methods can be developed to nondestructively and accurately evaluate the performance of these circuits, both packaged and unpackaged, significant savings in overall product cost can be realized. A number of testing techniques are presently in use or under development. These include wafer probing equipment as well as contactless evaluation techniques. Proposed programs should address promising alternative approaches or provide desirable extensions or augmentations to existing equipment or on-going work.

Phase I: Select one or more promising approaches to improving millimeter-wave testing equipment. Provide a detailed discussion and plan for implementing the testing technique(s) selected. Discuss cost, speed and accuracy trade-offs of the approach compared with others either proposed or currently in use.

Phase II: Demonstrate the usefulness of the proposed approach by building the proposed test equipment and demonstrating its ability to accurately evaluate the performance of one or more classes of millimeter wave frequency

monolithic integrated circuits. Provide data on time, cost per unit test and projections for further time, and cost reductions resulting from product refinement.

SB91-158 TITLE: Computer-based Display Design Tool

CATEGORY: Exploratory Development

OBJECTIVE: Develop a computer-based tool for the design of liquid crystal displays.

DESCRIPTION: The interplay of numerous design parameters affects the visual performance of a liquid crystal display. DARPA seeks a tool for optimizing the appearance of a liquid crystal display by analyzing input parameters such as liquid crystal material, color filter properties, polarizer characteristics, plate separation, retarding plate performance, etc. Output of such a tool would be in the form of color gamut and luminance characteristics.

Phase I: Develop the conceptual models and select the platform for such a tool.

Phase II: Code the software to incorporate the model into a design tool.

SB91-159 TITLE: High Temperature Polarizing Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop polarizer materials that can function at temperatures compatible with military requirements.

DESCRIPTION: Polarizers are used in a number of displays. Liquid crystal displays use linear polarizers to develop the image. Cathode ray tubes and electroluminescent flat panels use circular polarizers to enhance contrast. Existing polarizer materials cannot withstand high temperatures. Polarizing materials that can withstand sustained temperatures of 90 degrees Centigrade need to be developed.

Phase I: Identify materials that are good candidates for functioning as high temperature polarizers, and the techniques for fabricating those materials into thin sheets.

Phase II: Prepare prototype samples of high temperature polarizers that can be tested with displays.

SB91-160 TITLE: Color Filter Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop color filter materials that are suitable for liquid crystal displays.

DESCRIPTION: DARPA is developing full color liquid crystal flat panel display technology. Direct view liquid crystal displays (LCD) rely on color filters to achieve color. The filter materials used today can benefit from significant improvement. New low cost, low light loss, sharp cutoff, color filters that are compatible with LCD processing technology are desired.

Phase I: Identify materials that are good candidates for functioning as liquid crystal display color filters, and the techniques for incorporating those materials in liquid crystal displays.

Phase II: Prepare prototype quantities of the filter materials that can be incorporated into displays.

SB91-161 TITLE: Lamps for Use as Display Backlight Sources

CATEGORY: Exploratory Development

OBJECTIVE: Develop high luminous output, high efficiency lamps with broad spectral output for use as display backlight sources.

DESCRIPTION: DARPA is developing full color liquid crystal flat panel display technology. Direct view liquid crystal displays frequently rely on backlights to enhance their usability. Considerable improvement in form factor, power efficiency, and spectral distribution is necessary, in backlights. This is particularly true if the display is to be in a portable application.

Phase I: Develop a lamp design.

Phase II: Fabricate a prototype lamp.

SB91-162 TITLE: Light Sources for Projection Display Systems

CATEGORY: Exploratory Development

OBJECTIVE: Develop high power, high efficiency lamps for use as projection display sources.

DESCRIPTION: DARPA is developing several projection display systems. Projection display systems require high power, high efficiency light sources with an appropriate spectral distribution. Light sources that minimize the need for cooling, do not pose safety hazards, and exhibit a continuous power output over a long life are of particular interest.

Phase I: Develop a lamp design.

Phase II: Fabricate a prototype lamp.

SB91-163 TITLE: Equipment for Testing Liquid Crystal Active Matrix Display Panels

CATEGORY: Exploratory Development

OBJECTIVE: Develop equipment for testing active matrix pixel performance without need for liquid crystal filling.

DESCRIPTION: Active matrix liquid crystal arrays are fabricated in a series of steps. The sooner such an active matrix array can be tested and accepted, repaired or rejected, the less value added labor and materials need to be expended on reject panels. Presently, there is no way to test the active matrix until it is filled with liquid crystal material. At this stage it is essentially a completely fabricated display, and repair is difficult or impossible. It is the intent of this topic to develop and demonstrate the capability to evaluate pixel performance at early stages of the manufacturing process.

Phase I: Design a system that can test pixel performance early in the manufacturing process.

Phase II: Build a prototype that demonstrates the capability to test pixel performance.

SB91-164 TITLE: Automatic Repair Equipment

CATEGORY: Exploratory Development

OBJECTIVE: Develop automatic repair equipment for adding or subtracting material on matrix displays.

DESCRIPTION: A common defect on matrix displays is broken or shorted line. Methods for quickly and economically adding or removing material to repair such defect would significantly enhance yield. Present processes are limited in the types of repairs they can accomplish and require tedious manual efforts. It is the intent of this topic to develop and demonstrate automatic repair equipment for repairing matrix displays by adding or subtracting material.

Phase I: Design the equipment for automatically identifying problem areas in a matrix display. Identify materials and processes that can be used to add or subtract material to repair the defects.

Phase II: Build a prototype that demonstrates the capability to identify and repair defects.

SB91-165 TITLE: Antifuse Process Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop a method based on anti fuse technology for repairing active matrix arrays.

DESCRIPTION: Antifuses are a method for causing two conductors to fuse together to form a connection. This is contrasted with a fuse which when activated causes a conducting wire to open, thereby breaking a connection. Antifuses can be used to build in redundancy into matrix displays which can be activated to bypass open lines. Such antifuse technology must be compatible with materials and processes used in manufacturing flat panel matrix displays. It is the intent of this topic to develop and demonstrate the capability to activate antifuses in matrix displays.

Phase I: Identify materials and processes that can be used to form an antifuse.

Phase II: Fabricate samples that demonstrate anti fuse capability.

SB91-166 TITLE: Modeling of Process Control Sensor Requirements for Electronics and Opto-electronics Manufacturing

CATEGORY: Exploratory Development

OBJECTIVE: Develop models describing the relationships among the variables controlling the manufacture of electronics and opto-electronic devices.

DESCRIPTION: Low cost manufacture of electronic and opto-electronic devices requires an understanding of require the relationships among many interrelated process variables, equipment parameters and device performance. These relationships determine the component performance, yield and cost. A complete understanding of the processes used in component manufacturing is essential to achieve a controlled, flexible manufacturing system. Development of the relationships among these variables is an essential precondition to the development of cost-effective component manufacturing.

Phase I: Select electronic and opto-electronic device manufacturing processes for detailed analysis and modeling. Examples include the dry etching of electronic materials, chemical vapor deposition, and epitaxial material growth. Develop the relationships among the various process parameters. The model should include the sensitivity of the product characteristics to changes in process conditions. Use literature references and empirical data to corroborate the results of the model. Develop an outline of the requirements for software implementation of the process model.

Phase II: Develop software to describe the relationships which exist between process parameters and product characteristics. The software should be compatible with controller architectures for the real-time control of electronics manufacturing.

SB91-167 TITLE: Signal Processing for the Sensor-based Control of Electronic and Opto-electronics Manufacturing

CATEGORY: Exploratory Development

OBJECTIVE: Develop the controller architecture, with associated software and signal processing, to integrate the inputs from multiple sensors monitoring the characteristics of electronics manufacturing processes.

DESCRIPTION: Electronic device manufacturing is controlled by complex relationships between multiple process variables. These relationships are described by analytical process models and by empirically established "rules" relating process conditions and environment to device performance. Responding to inputs from sensors interrogating product characteristics, the signal processing architecture must adjust the process to its target value. The signal processing and control architecture must be adaptable to multiple process inputs and respond in real-time, optimizing the manufacturing process to follow a prescribed model. When the information supplied by process control sensors is incomplete, the controller must make decisions based upon previously programmed empirical data.

Phase I: Specify and design a process control architecture with the capability to accept multiple sensor inputs. The architecture should be have the flexibility to compensate for incomplete knowledge of the electronics process parameters. The architecture selected should respond in real-time to changes in process conditions, equipment variations, and material parameters.

Phase II: Select a representative example of an electronics manufacturing process and implement the process control software in a prototype controller. Integrate the process controller into a laboratory demonstration of the controller software responding in real-time to variations in electronics manufacturing.

SB91-168 TITLE: Process Control Sensor Development and Demonstration for Electronic and Qpto-electronics Manufacturing

CATEGORY: Exploratory Development

OBJECTIVE: Integrate sensor-based control of electronics manufacturing with a process controller for real-time control of electronics manufacturing.

DESCRIPTION: Electronic manufacturing is controlled by a set of complex interactions between process variables, the process environment, and material parameters. Each of these must be controlled to eliminate variations in the finished product. Interrogation of the material and device characteristics during the manufacturing process can provide the necessary information about product characteristics to optimize the process to follow an optimum model. The integration of the sensor, controller and software to perform this j task is necessary to control complex manufacturing processes for silicon integrated circuits and compound semiconductor devices.

Phase I: Determine the characteristics of the in-situ sensor for the control of electronics manufacturing, and design a processor architecture compatible with a model describing the electronics manufacturing process. Obtain laboratory evaluations of the electronic and optical material characteristics, which may be employed in manufacturing process control. Determine the sensitivity of the device performance to these material measurements. Develop a plan to utilize these material characteristics in process control for electronics and opto-electronics manufacturing processes such as dry etching, epitaxial growth and vapor deposition.

Phase II: Develop and integrate the sensor technology with a controller with the appropriate software, to be utilized in a manufacturing control application. Conduct a demonstration to validate the design, and develop a plan to transition the technology demonstration to manufacturing equipment.

SB91-169 TITLE: Low-cost Cryogenic Packaging for Infrared Focal Plane Arrays

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative concepts to integrate infrared imaging arrays into a vacuum package operating at cryogenic temperatures.

DESCRIPTION: The packaging of infrared devices into a cryogenic package is a large part of the cost of the infrared sensitive module used in military and industrial applications. Multiple vacuum seals, maintenance of the vacuum integrity over the life of the component, and the low noise integration of the device into the vacuum container are necessary elements of the manufacturing process. New design concepts, including elimination of assembly parts and reductions in manual labor are necessary to reduce the cost of the cryogenic packaging for infrared devices. With the reductions in packaging cost, new applications for high performance, two dimensional infrared imaging are realizable. These include manufacturing, high temperature process control and component inspection.

Phase I: Develop a design for a low-cost cryogenic package for two dimensional imaging infrared sensitive arrays. The design should include the integration of the arrays with low noise drive electronics in a vacuum package, the vacuum seal technology for long operating life, and the capability to meet rapid cool down requirements. Conduct an analysis of the production cost of the design, including assembly labor, material, and special purpose equipment.

Phase II: Construct and test a prototype using the new design, and demonstrate the benefits of the design innovations. The prototype will be evaluated for cool down time, vacuum life, and low noise operation of the imaging infrared array. Develop a plan for the transition of the prototype design to production quantities.

SB91-170 TITLE: Multiple Sensors to Control Chemical Deposition Processes and Plasma Etching of Compound Semiconductors

CATEGORY: Exploratory Development

OBJECTIVE: Develop the sensor technology, with associated signal processing, for real-time control of the process variables effecting the chemical deposition and etching of semiconductors.

DESCRIPTION: The chemical vapor deposition and plasma etching of semiconductors are complex manufacturing processes, requiring the control of multiple parameters to insure the repeatability and quality of the process. Currently, control parameters such as the pressure, temperature, and gas flow rates are set externally to the reactor and are monitored independently to ensure the stability of preset parameters. Conditions within the reactor, where the material is actually processed, are not directly monitored. Also, the sensors within the reactor function independently, without detailed information from other sensors within the reactor. The sensors-based control could be significantly improved with a suite of synergistic sensors. Data from the multiple sensors could be integrated into a processor, guided by an analytical/empirical model, to ensure the process is following the prescribed optimum process.

Phase I: A process model should guide the selection of the process control variables. Evaluate the sensor concepts, with the appropriate signal processor, to determine the optimum sensor/processor combination. Demonstrate the fusion of process control data from multiple sensors in a prototype reactor.

Phase II: Integrate the sensor suite into a production compatible reactor. Demonstrate the improved chemical deposition or etching process. Demonstrate material quality and yield improvements relative to processing without the use of the sensor control.

SB91-171 TITLE: On-chip Processing for Imaging Sensors

CATEGORY: Exploratory development

OBJECTIVES: Develop designs and implement on-chip image processing circuits for integration with the sensor array to reduce the cost of image processing for autonomous vision applications in manufacturing.

DESCRIPTION: State-of-the-art manufacturing inspection requires two dimensional image sensor arrays with the capability for real-time inspection of products. These sensors produce a significant amount of data which must be processed to extract information relevant to defect inspection. The capability of the sensor array to fulfill this requirement is a function of the data processing accompanying the sensor. General purpose processors are available, but real-time processing at the speeds required for manufacturing inspection is costly. This high cost limits the application of machine vision in manufacturing. This problem can be addressed by the introduction of on-chip processing circuitry to preprocess the information. Imaging chips with analog signal and image processing customized for a particular manufacturing inspection application can reduce the cost of real-time image processing for machine vision.

Phase I: Evaluate circuit designs for integration with imaging sensor arrays. Model and analyze the circuit designs for their electronic characteristics, reliability and stability under the operating conditions. Utilize cost models to determine trade-offs in the implementation of image processing chips for machine vision in defense manufacturing. Assess the compatibility of the processing function with general purpose microprocessors. Recommend appropriate processor architecture for each manufacturing application.

Phase II: Integrate the designs, whose feasibility have been established in Phase I, into hardware. Design the chip lay-outs to fulfill the planned processing function. Evaluate the chips in the laboratory and integrate them into the system application.

SB91-172 TITLE: High Speed Sensing Techniques to Determine the Surface Profiles of Materials and Components for Electronic Packaging

CATEGORY: Advanced Development

OBJECTIVE: Develop hardware and techniques for real-time inspection of interconnections used in densely packed integrated circuits for multi-chip electronic modules.

DESCRIPTION: As signal processing and computing functions become more complex, circuits are being implemented in multi-chip modules, reliable interconnection on these modules are essential to be successful implementation of the processing function. Reliable interconnections on these modules are essential to the successful implementation of the processing function. Inspection of the interconnections prior to the integration of the chips into modules is essential to manufacturing the electronic package. From several hundred to one thousand interconnections will be included in a typical processing module. Real-time inspection of these interconnections requires high speed signal processing to assess the spacing, alignment, and in some applications, the shape of each contact prior to the formation of the interconnection. An increase in the speed of the current inspection systems is necessary to achieve on-line evaluation of the electronic interconnections. Improvements in both the sensor array technology and the associated signal processing are necessary to implement a real time high speed i inspection for electronic packages.

Phase I: Assess the various methods of achieving the speed required for real-time inspection of interconnections for electronic packages. Evaluate the preferred approach in a laboratory breadboard before the completion of the Phase I. Make design trade-offs considering the sensor array, processing function, the speed and accuracy required for real-time inspection, and the potential savings in packaging cost.

Phase II: Finalize the prototype design and fabricate a process control system. Integrate the system into a manufacturing environment for the real-time inspection of contacts for electronic packages. Document the performance of the system, including the accuracy, speed and cost savings.

SB91-173 TITLE: In-situ Sensing and Control of High Temperature Manufacturing Processes

CATEGORY: Exploratory Development

OBJECTIVE: Develop noncontact techniques to measure and control high temperature manufacturing processes for semiconductors, composites, and materials formed by rapid solidification processes.

DESCRIPTION: High temperature material synthesis requires the accurate measurement and control of the temperature of the material, including the temperature uniformity material. For real-time process control, temperature measurements must be performed at temperatures as high as 10(XfC-1500oC without disturbing or altering the material growth process. Accurate high temperature measurements under a diverse set of process conditions is essential to the improvement material manufacturing processes for defense applications.

Phase I: Evaluate techniques to measure material at elevated process temperatures. Simulate process conditions for semiconductors, metals and composites to reproduce the manufacturing process. Take temperature measurements and correlate the results with a direct measure of material temperature under the same processing conditions.

Phase II: Integrate the evaluation technique assessed in the first phase into a manufacturing process. Evaluate the influence of the process conditions on the accuracy of the temperature measurements. Document the material properties and cost reductions associated with the incorporation of the improved temperature measurement.

SB91-174 TITLE: Nondestructive Material Evaluation to Determine Structural Defects and Predict Reliability

CATEGORY: Exploratory Development

OBJECTIVE: Develop in-process sensor technology and test methodology for nondestructive, real-time evaluation of material structural properties during manufacturing.

DESCRIPTION: Manufacturing requires the real-time evaluation of materials, both metals and semiconductor crystals, to determine structural properties, including the inspection for latent defects. The evaluation techniques usually require contact to the material during test; furthermore, they often require extensive set-up and evaluation time. For example, X-ray, ultrasonic and optical characterization has proven effective but require off-line evaluations that utilize special facilities-and increase cost. Feedback to manufacturing can be slow, resulting in additional cost. The establishment of real-time, on-line evaluation of material properties as an in-process control, integral to the manufacturing operation, provides a more effective means of reducing manufacturing cost and at the same time improving product quality. The nondestructive evaluation techniques should apply to either compound semiconductors, composites, or electronic materials with defense applications.

Phase I: Initially, determine the feasibility of the nondestructive evaluation techniques and correlate the results to the results of conventional approaches. Select and evaluate material samples from a representative defense manufacturing process to identify material defects that are related to failure modes. Establish material evaluation criterion for qualifying the material for a product application.

Phase II: Apply the evaluation techniques selected applied to defense manufacturing. Demonstrate the cost reduction, and increases in yield and throughput of the manufacturing line.

SB91-175 TITLE: Designs and Concepts for High Performance. Uncooled Infrared Imaging Sensors

CATEGORY: Advanced Development

OBJECTIVE: Develop the technology for an infrared imaging sensor that operates at or near roam temperature with the performance required for target acquisition, surveillance and man-portable imaging system requirements, and has the potential for application as a thermal imaging inspection system for manufacturing.

DESCRIPTION: Infrared imaging sensors operating at cryogenic temperatures with sensitivity in the 3-20 micrometer spectral band have demonstrated the performance to meet imaging system requirements. The cooling required for these arrays often precludes their application in a manufacturing environment. Concepts for uncooled imaging sensors have been proposed and the feasibility of uncooled infrared sensors has been demonstrated for selected applications. However, the performance of the uncooled sensor must be improved before implementation in many applications, including inspection for defects in manufacturing. The sensitivity and resolution of the uncooled sensor must be increased to provide the performance necessary for both imaging and manufacturing inspection applications.

Phase I: Evaluate the performance of the uncooled imaging sensor for both imaging and manufacturing applications. Assess the thermal responsivity, noise and the resolution relative to proposed applications in both thermal imaging and manufacturing. Perform an analysis of the state-of-the-art of uncooled sensors for manufacturing application. Make recommendations for improvements in sensor and signal processor performance, as necessary to meet manufacturing applications.

Phase II: Develop a prototype for both manufacturing and target acquisition applications. Document the performance of the uncooled array and thoroughly describe the cost benefits of thermal imaging inspection system in manufacturing.

SB91-176 TITLE: Designs for Multi-spectral Infrared Imaging Systems

CATEGORY: Exploratory Development

OBJECTIVE: Formulate and evaluate the design of an infrared focal plane array, with the associated signal processor, to detect radiation in multiple bands within the 1-14 micrometer infrared spectral region.

DESCRIPTION: Infrared focal plane arrays can be made sensitive to radiation within a broad spectral band. This can be accomplished with a single material or with different material sensitive to specific infrared bands. The organization of the focal plane for detection of the multiple bands and the signal processing associated with the detection of radiation in multiple bands must be developed.

Phase I: Develop the design of a multi-spectral infrared sensor. Evaluate the design with performance modeling of both the detector and the signal processor. Evaluate improved system performance under various atmospheric conditions and target scenarios.

Phase II: Evaluate the producibility of multi-spectral infrared focal plane designs. Assess the material growth constraints and the signal processing capabilities relative to the current capabilities. Fabricate signal processor chip designs, and perform a laboratory evaluation to verify the performance predictions.

SB91-177 TITLE: Infrared Focal Plane Design with On-focal Plane Signal Processing. for Multiple System Applications

CATEGORY: Exploratory Development

OBJECTIVE: Design an infrared focal plane array with application to a generic family of tactical system applications.

DESCRIPTION: Infrared focal plane arrays (IRFPA) consist of a large number of individual infrared detector elements, organized in a specific configuration to meet particular system requirements. As a result, many configurations are proposed, each with a unique detector configuration and associated signal processor design. Each of these focal plane array designs require custom drive electronics, read-out sequences and interfaces to off-focal plane electronics, which places a substantial nonrecurring design and verification burden on each system application. In addition, the production quantities required of each particular design are not sufficient to achieve the

cost benefits associated with volume production. A family of generic designs has the potential to achieve the production volume to substantially reduce cost.

Phase I: Produce a design for, and model the performance of an IRFP A that meets multiple system requirements within a tactical mission area (e.g., missile seeker, IRST, target acquisition). Evaluate the IRFP A design by modeling sensor performance using suitable parameters for the sensor system for each application. Design and model the performance of modular drive electronic for the generic family of IRFP AS.

Phase II: Develop a breadboard demonstration of the modular drive electronics. Design and build the electronics module and demonstrate the performance for a family of IRFP AS.

SB91-178 TITLE: Virtual Prototyping Tools for Semiconductor Fabrication Equipment

CATEGORY: Advanced Development

OBJECTIVE: Develop an integrated environment to support the modeling and simulation of semiconductor process equipment to determine such characteristics as process response surfaces, mechanical reliability, utilization capability, particulate generation, and controllability prior to physical prototyping.

DESCRIPTION: The development of a new semiconductor manufacturing tool such as a chemical vapor deposition (CVD) reactor or an enhanced cyclotron resonance (ECR) etcher is a complex multi-disciplinary task. While some computer aided design tools have been employed to design mechanical components in the system, the full potential for utilizing computer tools to simplify and improve the development process has yet to be fully exploited. Computer tools are needed to model particle transport and heat transfer within the processing chamber, chemical interactions in the gas flow and on the surface of the wafer, mechanical reliability of the wafer handling system, and the behavior of the control system. Although, many of these tools exist in the university community, few are avai1able commercially or are widely used in the semiconductor manufacturing equipment industry. Furthermore, integration between different tools is necessary to support systems level simulation. Widespread use could greatly reduce the cost of developing new manufacturing tools by allowing the designer to rapidly try out many alternative configurations without physically prototyping the systems.

Phase I: Define a detailed specification of the proposed environment to support modeling and simulation of a class of semiconductor manufacturing tools. Describe new or novel ideas which will provide new modeling and simulation capabilities. Develop a plan for how the utility of this tool will be demonstrated in the design of a new semiconductor manufacturing tool.

Phase II: Develop the prototype environment defined in Phase I and demonstrate its utility in the development of some piece of semiconductor manufacturing equipment.

SB91-179 TITLE: Embedded Control Software for Semiconductor Process Equipment

CATEGORY: Advanced Development

OBJECTIVE: Develop a tool kit and set of reusable software building blocks which will speed the development of intelligent, reliable, embedded control software for complex semiconductor manufacturing equipment.

DESCRIPTION: Embedded control software is often a performance and reliability limiter for complex semiconductor manufacturing equipment. Generic equipment models and other emerging industry standards may facilitate the use of common software building blocks across a wide variety of equipment types and simplify the development of interfaces to modular subsystems, sensors, and factory control systems. Common control software available from third party vendors would allow equipment vendors to focus on value-added capabilities rather than basic functionality. Economies of scale might also allow control software suppliers to provide increasingly

sophisticated and intelligent control systems. Some modules might also be useful for other embedded control applications.

Phase I: Define a detailed specification of the proposed control architecture, software modules, and integration tools. Describe new or novel ideas which will provide new capabilities to equipment developers and users. Develop a plan to demonstrate the utility of this capability in the design of a new semiconductor manufacturing tool control system.

Phase II: Develop the prototype software defined in Phase I and demonstrate its utility in the development of an embedded control system for some piece of semiconductor manufacturing equipment.

SB91-180 TITLE: Novel Computer Aided Design Tools for Hybrid Systems

CATEGORY: Advanced Development

OBJECTIVE: Develop novel systems level design tools which aid in the design of complex systems and their partitioning into reusable components which can be implemented and integrated through a variety of different integrated circuit, packaging, and software technologies.

DESCRIPTION: New tools are needed to aid in the design of complex multi-technology systems. Such tools include but are not limited to performance level simulation, hardware/software and analog/digital partitioning aids, mixed mode and mixed level simulators, packaging design aids, and high level trade-off analysis tools.

Phase I: Define a detailed specification for the new tool or tools to be developed. Describe new and innovative ideas which will provide new capabilities to systems designers. Develop a plan to demonstrate the utility of this capability in the design of an actual system.

Phase II: Develop and demonstrate the prototype software defined in Phase I.

SB91-181 TITLE: Modeling. Simulation and Control of Semiconductor Factories

CATEGORY: Advanced Development

OBJECTIVE: Develop a software environment which integrates both real and simulated factory assets to determine the impact of alternative equipment configurations and scheduling algorithms on asset utilization, work in progress, and throughput prior to implementing those changes.

DESCRIPTION: The design and construction of a new semiconductor fabrication facility can cost many hundreds of millions of dollars and take several years. Achieving profitable operation of such a facility is often limited by asset utilization. Computer tools are needed to aid in the design and operation of cost-effective semiconductor fabrication facilities. These tools should be capable of simulating alternative factory and equipment algorithms, product and process variations, and scheduling algorithms to determine optimum operating conditions and configurations. Once a factory is operational, computer tools should be capable of utilizing real-time factory data to perform what-if analysis on proposed changes in operating conditions to determine their impact on variables such as asset utilization, work in progress, and throughput. Ideally, this system would be integrated with the factory control system, making it relatively transparent to the operator whether he is manipulating real or virtual factory assets. These tools may be useful for performing similar analysis on other types of factories.

Phase I: Define a detailed specification for the new tool or tools to be developed. Describe new and innovative ideas which will provide new capabilities to factory designers and operators. Develop a plan to demonstrate the utility of this capability.

Phase II: Develop and demonstrate the prototype software defined in Phase I.

SB91-182 TITLE: Integrated Technology Computer Aided Design

CATEGORY: Advanced Development

OBJECTIVE: Develop an integrated environment for the design of semiconductor devices and manufacturing processes which incorporates software tools such as circuit and device simulators, physical layout editors, process simulators, reliability analysis, and yield estimators within a framework based on emerging industry standards.

DESCRIPTION: The development of new semiconductor manufacturing technologies is a multi-disciplinary task. Engineers consider electrical, mechanical, thermal, and chemical properties as they develop a device architecture to meet a product requirement and develop the process to fabricate that architecture. This means software tools which were developed by a number of different individuals and companies, run on different platforms, and use proprietary data structures. Examples of technology computer aided design (TCAD) tools include electrical circuit and device simulators, physical layout tools, process (i.e., deposition, etch, implant, etc.) simulation tools, thermal and reliability analysis, and yield estimators. The use of a common support infrastructure or "framework" has been proposed as a way to simplify the integration of those tools into a productive environment. The framework is based on the use of industry standard data models and provides uniform access to services such as data management, tool invocation, communication, user interface, operating system. Such frameworks have already been successfully demonstrated for integrated circuit design environments, but have yet to be applied to TCAD even though many of the requirements are the same.

Phase I: Define a detailed specification for the proposed environment utilizing existing framework, technology and emerging industry TCAD standards. Describe new or novel ideas which will provide enhanced capability over existing environments. Develop a plan to demonstrate this capability.

Phase II: Develop and demonstrate the environment as defined in Phase I.

SB91-183 TITLE: Application Software

CATEGORY: Exploratory Development

OBJECTIVE: Develop education courseware that meets national educational needs in science and math.

DESCRIPTION: Successful development of educational software will require standards that: 1) provide for ease of transfer among potential users; 2) retain a repository easily accessible by users in a common network; and 3) have modularity that permits customization of software consistent with curriculum demands and the needs of the learner. Although the focus of this effort will be courseware, the work must be preceded by a clear definition of how the work product will be distributed and eventually used. The highest priority will be given to courseware that meets educational needs in science and math. All courseware should be modular with a strong graphics orientation. It is recommended that the learning process be highly graphic in content with numeric and alpha characters added in that order, only when absolutely necessary to meet the educational objectives. Collaboration among groups that develop complementary educational material is encouraged. Individual groups of five people or less with varied backgrounds will be expected to produce the most efficient and effective programs.

Phase I: Develop and demonstrate the methodology for modular software and the tools for modular integration to produce courseware available for general distribution.

Phase II: Provide a set of modules that are available to a distributed community of users with the authoring tool to produce a traditional precollege course such as physics, algebra or biology.

SB91-184 TITLE: Small Vocabulary Tactical Speech Recognizer

CATEGORY: Advanced Development

OBJECTIVE: Develop hardware and software embodying state-of-the-art techniques to recognize speech in tactical environments.

DESCRIPTION: Considerable progress has been made in the development of algorithms for large vocabulary speech recognition in benign acoustic environments. For many tactical applications, a recognizer need only deal with a small vocabulary (20-200 words) and a low (5-10) perplexity grammar, but it must operate well in a broad range of acoustic conditions (including on battlefields and inside vehicles or aircraft) and with speakers who may be under stress. In addition, such a system should require few or no prior samples of the user's speech. Ideally, it would adapt to the speaker and the environment. The purpose of this effort is to develop a prototype tactical speech recognizer by modifying and extending the best techniques currently available.

Phase I: Adapt current algorithms and demonstrate performance under some of the conditions stated above.

Phase II: Refine and extend algorithms. Demonstrate effectiveness in realistic tests. Develop a suitable hardware/software implementation.

SB91-185 TITLE: Semantic Search of Information Databases

CATEGORY: Exploratory Development

OBJECTIVE: Determine how to use a large semantic network to improve database searches.

DESCRIPTION: Many information retrieval systems rely on keyword searches, some on statistical techniques. The former is susceptible to human limitations in selecting appropriate sets of keywords and boolean formulas; the latter, to characteristics of the corpora from which statistical weights are derived. It may be possible to improve the performance (i.e., recall and precision) of either or both approaches by taking advantage of the information encoded in large semantic networks. One likely candidate is Princeton's WordNet, a lexical resource which represents the major semantic relations in human memory (e.g., synonymy, hyponymy, meronymy, antonymy). DoD has supported the development of this resource, which could be made available as an ASCII data file (cf., Beckwith, Fellbaum, Miller, and Miller, "Introduction to WordNet: An On-line Lexical Database." (International Journal of Lexicography.).

Phase I: Determine how database searches could be improved, automatically or interactively, using WordNet. Perform a limited proof-of-concept.

Phase II: Extend and enhance these techniques explored in Phase I. Develop an interface to a significant database (e.g., Defense Technical Information Center) and conduct an extensive test measuring performance differences with and without those techniques.

SB91-186 TITLE: Reusable Knowled1!e Bases of En1!ineering Designs Based on a Standard Ontology

CATEGORY: Exploratory Development

OBJECTIVE: Explore alternative approaches to interactively and automatically capturing designs and design records.

DESCRIPTION: Novel approaches are sought to enable human designers to build corporate memories and to construct design records for large scale engineering problems. The design records should be sufficiently rich to support capture of underlying assumptions, produce explanations, and provide automated input to analysis and simulation programs.

Phase I: Construct a knowledge base using a modem term subsumption knowledge representation language based on an existing engineering data dictionary such as those motivated by the CALS or PDES programs. Develop an approach for capturing design knowledge based on this knowledge base.

Phase II: Construct test cases and demonstrate the approach.

SB91-187 TITLE: Reusable Knowledge Bases

CATEGORY: Exploratory Development

OBJECTIVE: Explore alternative methods to implement a knowledge base library.

DESCRIPTION: Novel approaches are sought to enable the construction of a library of knowledge bases and to build an interlingua and other intelligent services to assist the rehosting of a knowledge base from a repository into another knowledge representation for a specific application.

Phase I: Design an approach and propose candidate demonstration domains.

Phase II: Implement a feasibility demonstration in one or more domains.

SB91-188 TITLE: Use of Object Oriented Databases to Support Knowledge-based Planning

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate knowledge-based planning methods based on object-oriented database techniques.

DESCRIPTION: Novel approaches are sought to enable the builders of intelligent systems to exploit evolving object oriented database technology. One promising area is in operations planning. Presently, operations plans represent time-phased force and deployment data in flat files. Current development programs are converting these representations to relational databases. Object oriented database technology promises even greater functionality.

Phase I: Design a knowledge-based planning system that supports the modification of time-phased planning data with the underlying representation based on an object oriented database.

Phase II: Implement and test the design.

SB91-189 TITLE: Model Interface Conventions for Logistics

CATEGORY: Advanced Development

OBJECTIVE: Develop a set of interface conventions for intelligent integration of logistics models.

DESCRIPTION: Novel approaches are sought to enable the builders of intelligent operations planning systems to provide seamless integration of appropriate models from model libraries. Such integration is dependent on interface conventions.

Phase I: Identify five or more widely used logistics models and define a set of interface conventions.

Phase II: Develop a software library which includes these models and the tool needs to support the integration and use of the models in a demonstratable operation planning and analysis task.

SB91-190 TITLE: Standard Machine Learning Modules

CATEGORY: Advanced Development

OBJECTIVE: Identify, document, and implement in a standard, reusable form, the widely referenced methods of machine learning.

DESCRIPTION: Novel approaches are sought to enable software engineers and system builders to exploit the basic methods of artificial intelligence. Recent successes in applying basic machine learning techniques in databases systems indicates the need to create standard modules of reusable machine learning methods. This effort will identify and document the basic methods. Documentation will include both written descriptions, executable software, and demonstrable test cases.

Phase I: Identify and prepare written documentation on at least 10 machine learning methods. Propose a standard software implementation and a set of test cases.

Phase II: Implement the standard modules and demonstrate them on the test cases.

SB91-191 TITLE: Technology All-Optical Networks

CATEGORY: Exploratory Development

OBJECTIVE: Demonstrate all-optical network technology as useful building blocks for networks.

DESCRIPTION: Technology is sought for all-optical networks. Areas of interest include designs for networks that could sustain an aggregate throughput of at least 1 terabit per second and protocol architectures for supporting applications that would need such networks. This is not a solicitation for device-oriented research.

Phase I: Provide a design for the network or subsystem, including supporting analysis and an approach for integrating the technology in a broader environment.

Phase II: Construct and demonstrate a laboratory version.

SB91-192 TITLE: Personal Multi-media Conferencing

CATEGORY: Exploratory Development

OBJECTIVE: Explore alternative architectures and subsystems for implementing conferencing and collaboration services between workstations.

DESCRIPTION: Designs are sought for conferencing technology for existing workstations to enable teleconferencing and other forms of collaborative work, in either real-time or stored forms. Video and multi- point services are of special interest. The technology should lead to inexpensive implementations, should provide capabilities which are extensible and can be tailored to varying communication capabilities, and should use existing media and network standards where appropriate.

Phase I: Provide detailed hardware and software designs, cost and performance projections. Develop plans and requirements for supporting services.

Phase II: Construct prototypes and demonstrate capabilities.

SB91-193 TITLE: Technology for Switched Multi-megabit Data

CATEGORY: Exploratory Development

OBJECTIVE: Simplify interfaces to emerging switched multi-megabit data service (SMDS).

DESCRIPTION: New services using SMDS technologies may soon be available from public Communications carriers. Low-cost interface technology for workstations and other computers is sought to enable network research using these communication paths. Designs must have clear advantages over alternatives in either cost, speed, capability, or some combination of these factors.

Phase I: Design hardware and software, and perform performance and cost analyses.

Phase II: Construct and test demonstration hardware. Demonstrate compatibility and interoperability with carrier services and other equipment, as appropriate.

SB91-194 TITLE: Technology for Asynchronous Transfer Module-based Internetworking

CATEGORY: Exploratory Development

OBJECTIVE: Explore alternative approaches which allow asynchronous transfer module (ATM)-oriented systems to be constructed from combinations of network types and providers, ranging from dedicated private local area networks (LANs) to long-haul, switched services that may be provided by common carriers.

DESCRIPTION: The basic cell-switching services of ATM will be most useful if connections can be composed of services which may be public or private, switched or dedicated, and which may span different speeds, sizes, and management domains. Designs are sought which explore such integration, including facilities for call setup and routing, resource allocation, resource guarantees and network management functions. Designs should be compatible with emerging standards. While demonstration systems will be small and must be capable of stand-alone operation, they must be capable of operating as an integrated part of a combined ATM internet that can contain gigabit links and which can scale to millions of end-systems.

Phase I: Produce a detailed design of components, including hardware, software, and protocols as applicable. Design must include discussion of scaling issues.

Phase II: Construct and demonstrate prototypes, demonstrating interoperability with other systems as 1 appropriate.

SB91-195 TITLE: Interposition Technology Infrastructure

CATEGORY: Exploratory Development

OBJECTIVE: Explore innovative design tools which can probably reduce the acquisition and life cycle cost of new systems.

DESCRIPTION: Concepts are sought for novel and cost effective approaches to reduce acquisition and life cycle costs. These must be embodied in design tools, complement existing design systems, and demonstrate a measurable methodology to improve the acquisition and life cycle cost.

Phase I: Define in detail the portion of the acquisition cycle to be addressed, provide detailed cost/performance analysis, define the interfaces and data needed to drive the proposed tool, and define the manner employed in the acquisition process. Software module development will be necessary to demonstrate proof-of-concept, and should be developed to adhere to emerging standards such as adopted by the computer aided design (CAD) Framework Initiative.

Phase II: Develop tools, supporting documentation, and test cases which demonstrate and prove the ti- principles. Tools must be designed with an open architecture, transportable between hardware platforms, and able to be integrated into CAD platforms.

SB91-196 TITLE: System Level Modeling Tools and Methodologies that Execute in Multiple Simulation Environments

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel system design tools, including partitioning of electrical, mechanical and software components, which execute in multiple simulation environments.

DESCRIPTION: Concepts are sought for novel approaches to modeling systems which include hardware and software, and developing cost-effective thralldoms for the designer. Approaches must be capable of being incorporated into design systems and operate with different simulation environments.

Phase I: Define in detail the scope of the innovative tool proposed, provide cost/performance analysis, define the interfaces and data needed to drive the proposed tool, and define the manner employed in the design process. Software module development will be necessary to demonstrate proof of concept, and should be developed to adhere to emerging standards such as those adopted by the Computer Aided Design Framework Initiative.

Phase II: Develop tools, supporting documentation, and test cases which demonstrate and prove the principles. Tools must be designed with an open architecture, and be transportable between hardware platforms.

SB91-197 TITLE: Rapid Prototyping Techniques That Augment Existing Design Systems

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel approaches for rapidly prototyping complex electromechanical systems integrated into existing design systems.

DESCRIPTION: Concepts are sought for innovative and novel ideas to cost effectively accelerate the prototype design cycle by at least 20 times over traditional methods. Innovative technologies, tools, or unique application of existing techniques will be considered.

Phase I: Provide a detailed refinement of the proposed concept, idea or tools and provide an analysis of it to a class of electromechanical design. Provide demonstrations for proof-of-principle, and describe interfaces necessary to existing design systems.

Phase II: Construct, test, and implement at least two designs employing the proposed prototyping process, and provide an assessment of its flexibility and application.

SB91-198 TITLE: Interoperable Technology Computer-aided Design (CAD) Tools for Electronic CAD

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel design tools which support the design of very large scale integration (VLSI) devices, processes, or infrastructure, consistent with emerging computer-aided design (CAD) standards.

DESCRIPTION: Concepts are sought for novel approaches to design VLSI devices, processes and infrastructure to support the tools. Approaches should conform to emerging standards, such as those of the TCAD working group of the CAD Framework Initiative.

Phase I: Define in detail the tool to be developed, provide detailed cost/performance comparison to existing tools, define the interfaces and data needed to drive the proposed tool, and any new algorithms or approaches. Software module development will be necessary to demonstrate proof-of-concept, and should be developed to adhere to emerging standards.

Phase II: Develop tools, supporting documentation, and test cases which demonstrate and prove the principles. Tools must be designed with an open architecture, transportable between hardware platforms, and able to be integrated into CAD platforms.

SB91-199 TITLE: High Performance. Low Cost. Multi-chip Module Design Aids that Support Multiple Technologies

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel design tools that support multi-chip module designers across multiple technologies.

DESCRIPTION: Concepts are sought for innovative and novel ideas to support the subsystem designer using multi-chip modules. New concepts are sought to describe the necessary technical interfaces for realizing subsystems of the designs in a variety of multi-chip module technologies.

Phase I: Provide a detailed re-element of the proposed concept" idea 8;fid tools. Technical interfaces to various technologies should be described and demonstrations defined, If applicable, for proof of principle.

Phase II: Develop tools, supporting documentation, and test cases which demonstrate and prove the principles. Tools must be designed with an open architecture, and transportable between hardware platforms.

SB91-200 TITLE: Technology Independent, High Performance Design Tools

CATEGORY: Exploratory Development

OBJECTIVE: Explore novel approaches for designing electronic systems which optimize performance criteria such as speed, density, or power and are able to be used with various integrated circuit technologies.

DESCRIPTION: Concepts are sought for innovative and novel ideas to designing systems which optimize desired performance criteria while maintaining technology independence over a range of integrated circuit technologies. New concepts are sought to describe the necessary technical interfaces for the technology and the innovative class of design rules needed by the tools.

Phase I: Provide a detailed refinement of the proposed concept, idea and tools. Technical interfaces to various technologies should be described, as well as demonstrations indicating proof of concept.

Phase II: Develop tools, supporting documentation, and test cases which demonstrate and prove the principles. Tools must be designed with an open architecture, transportable between hardware platforms, and clearly defined interfaces.

SB91-201 TITLE: Object Oriented Database Implementations Consistent with Emerging ANSI X3/SPARC/OODBTG Open Architecture Interface Standards

CATEGORY: Advanced Development

OBJECTIVE: Develop distributed object oriented database (DOODB) technology.

DESCRIPTION: Current relational database technology fails to seamlessly support the rapid data access ~ requirements of electrical, mechanical, and software computer aided design. The fundamental difficulty is described by the term "impedance mismatch" which describes the translation software requirements which must be included to translate from object oriented programming language types into relational database queries. AQ Currently standardization efforts are underway within the ANSI X3/SPARC/OODBTG communities. This research should

address the following: 1) base level persistent C+ + and CLOS data models including classes, objects, inheritance, message passing, queriable sets of objects, inversionable objects; 2) persistent object stores; 3) object communication, providing remote procedure calls and location-independent access; 4) transactional store; 5) object management; 6) object translation; 7) change management; 8) object query processing; 9) extended transaction management and 10) hypermedia interfaces.

Phase I: Develop software design for DOODB implementation.

Phase II: Demonstrate performance of a working DOODB prototype.

SB91-202 TITLE: Object Oriented Libraries of Worldwide Military Hardware and Civilian Vehicles for Recognition and Evaluation of Image Understanding Algorithms

CATEGORY: Advanced Development

OBJECTIVE: Develop a library of worldwide military vehicle image models for image understanding and environments.

DESCRIPTION: Research in image understanding has led toward the development of object oriented image retrieval mechanisms. In order to support research in this significant technology area, researchers must be provided with robust image libraries for the testing, evaluation and verification of image understanding algorithms. This development should provide image libraries consisting of aircraft, ships, and land combat vehicles.

Phase I: Develop image database schema and indexing strategy.

Phase II: Populate database with multiple images and demonstrate access over various ranges and perspective views.

SB91-203 TITLE: Laboratory Grade Robotic Research Vehicle with Sensor Package and Processing Capabilities Compatible with DoD JUGVPMO Surrogate Semiautonomous Vehicle

CATEGORY: Advanced Development

OBJECTIVE: Develop an indoor mobile research robot with sensor systems and software architecture compatible with the joint unmanned ground vehicles program management office (JUGVPMO) surrogate semiautonomous vehicle (SSV).

DESCRIPTION: The SSV is designed to demonstrate autonomous navigation capabilities in a field rugged vehicle system. The development of navigation software requires an extensive combination of simulation and experimentation. Often, experimentation is conducted in indoor laboratory environments. This development effort seeks to provide a low cost experimental robot with vision, acoustic, odometric, and position locating sensing compatible with the SSV under development for the Joint Robotics Program. This vehicle must be capable of passing untethered through a standard office door in a typical indoor environment.

Phase I: Provide the detailed system design including sensors, actuators, electrical connectors, software architecture, and interface specifications.

Phase II: Demonstrate and deliver a prototype mobile robot.

SB91-204 TITLE: Connector Technologies

CATEGORY: Advanced Development

OBJECTIVE: Provide a common means of connecting electronic military accessories on a person.

DESCRIPTION: Concepts are sought to provide a common mechanical interface for a local area network that would operate on a person. Both high and low-bandwidth networks are contemplated. Connector technologies for a person local area network should be: (1) compatible with military clothing, (2) easy connect/disconnect, (3) small, (4) ultra-reliable, (5) and emit very little radio frequency (RF) radiation.

Phase I: Provide a detailed specification of a proposed design and show how it addresses key environmental, reliability, and signal integrity issues. RF emissions must be minimized.

Phase II: Brass-board design and address manufacturing issues. Commence reliability testing.

SB91-205 TITLE: Memory System

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate low energy dynamic random access memory (dRAM) system.

DESCRIPTION: Demonstrate a dRAM system that exploits lower-voltage operation, refresh as a function of temperature and error rate, and map weak bits.

Phase I: Provide a detailed design and quantitative prediction of benefits of the proposed system.

Phase II: Demonstrate memory system in operation on a UNIX platform and provide data on benefits achieved.

SB91-206 TITLE: Very Large Scale Integration Cell Library

CATEGORY: Advanced Development

OBJECTIVE: Augment the complimentary metal oxide semiconductor (CMOS) cell library at the metal oxide semiconductor implementation service (MOSIS) to include cells designed specifically for micro-power circuits.

DESCRIPTION: Create a low power cell library for MOSIS with parameterized transistors sizes.

Phase I: Design and simulate low power cells. Cells should be either parameterized in terms of drive and load, or generated in a parameterized manner.

Phase II: Test and document library components. Demonstrate use in conjunction with a commercial computer aided engineering system to build micropower application specific integrated circuits.

SB91-207 TITLE: Compiler Controlled Power

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the effectiveness of software to lower the energy required to perform benchmark computations.

DESCRIPTION: Modify a standard compiler to demonstrate a lowering of the average energy dissipation f required to compute a function in a microprocessor system by at least 30 percent.

Phase I: Demonstrate compiler optimizations that will lower the energy required to perform a calculation rather than optimize for minimum time. Use a mainstream computer language and operating system.

Phase II: Measure and improve the compiler to lower power on large benchmark problems. Evaluate the effect of minor hardware changes.

SB91-208 TITLE: Software Tools which Translate Software from Other Languages to Ada

CATEGORY: Advanced Development

OBJECTIVE: Develop an Ada translator which provides more than just a syntactic translation of existing software.

DESCRIPTION: Concepts are sought for innovative and novel ideas for developing an Ada translator which can be combined with re-engineering tools to assist software technology for adaptable/reliable systems (STARS) environments to understand existing systems, translate from existing language implementations and re-engineer that those systems into good Ada systems. Translators which perpetuate bad structure, design, etc., and which do not support real software engineering, nor engineering of that translated software are not desired.

Phase I: Provide a detailed specification (e.g., principles of operation, interfaces, features, etc.) of the ' proposed software. Describe new or novel ideas or concepts.

Phase II: Address the issue of how these tools/products will interface with, coexist with and be compatible with STARS environments.

SB91-209 TITLE: Software Tools which Re-engineer Poor Ada Systems into Optimized Ones

CATEGORY: Advanced Development

OBJECTIVE: Develop re-engineering tools which can transform poor Ada systems into well engineered Ada systems.

DESCRIPTI0N: Concepts are sought for innovative and novel ideas for developing re-engineering tools which can consume poor Ada systems and significantly improve the software engineering and performance aspects of the software. Proposals must indicate how and why the proposed tool will aid in re-engineering, understanding benefits and improving the maintainability of the system. The tools should be able to take as input, the Ada code produced by translations from other languages to Ada.

Phase I: Provide a detailed specification (e.g., principles of operation, interfaces, display features, etc.) of the proposed software. Describe new or novel ideas or concepts.

Phase II: Address the issue of how these tools/products will interface with, coexist with and be compatible with software technology for adaptable/reliable systems environments.

SB91-210 TITLE: Domain Specific Software Architecture Ada Reusable Software Assets Circuits

CATEGORY: Advanced Development

OBJECTIVE: Develop reusable software Ada components along with their software architecture and design, requirements, and rules for use.

DESCRIPTION: Concepts are sought for innovative and novel ideas for developing Ada reusable software. Components should include domain specific software architecture, requirements, and rules for use, which are compatible with software technology for adaptable/reliable systems (STARS) and domain specific software applications (DSSA).

Phase I: Provide a detailed specification (e.g., principles of operation, interfaces, etc.) of the proposed software. Proposals without an "architecture" and an assessment and characterization of the market potential is not acceptable.

Phase II: Address the issue of how these tools/products will interface with, coexist with and be compatible with STARS environments and be part of a commercial market in Ada reusable software.

SB91-211 TITLE: Domain Specific Software Process Automation Technology

CATEGORY: Advanced Development

OBJECTIVE: Develop process technology including process architecture and definitions.

DESCRIPTION: Concepts are sought for innovative ideas for developing software process technology including process architecture and definitions which are compatible with software technology for adaptable/reliable systems (STARS) process thrusts.

Phase I: Provide a detailed specification (e.g., principles of operation, interfaces, etc.) of the proposed software. Describe new or novel ideas or concepts. Describe the prepared software's use.

Phase II: Address the issue of how these tools/products will interface with, coexist with, and be compatible with STARS environments.

SB91-212 TITLE: Software Asset Repository Technology and Composition Tools

CATEGORY: Advanced Development

OBJECTIVE: Reusable technology and tools.

DESCRIPTION: Concepts are sought for innovative and novel ideas for developing reusable Ada software technology and tools, including automating aspects of domain analysis for reuse, identifying available software assets and composing those assets with other software to develop a system.

Phase I: Provide a detailed specification (e.g., principles of operation, interfaces, display features, enabling technology and underlying mechanisms) of the proposed software. Describe new or novel ideas or concepts. Proposals must either be significant innovations or be focused on commercialization. of existing technology. Proposals which are similar to currently operating repository software and asset libraries are not acceptable.

Phase II: Address the issue of how these tools/products will interface with, coexist with and be compatible with software technology for adaptable/reliable systems (STARS) environments.

SB91-213 TITLE: Software Tools For Domain Specific Analysis

CATEGORY: Advanced Development

OBJECTIVE: Explore novel ideas for domain specific software tools.

DESCRIPTION: Concepts are sought for innovative and novel ideas for developing domain specific tools and analysis technology which are compatible with software technology for adaptable/reliable systems (STARS) and domain specific software applications (DSSA).

Phase I: Provide a detailed specification (e.g., principles of operation, interfaces, display features, etc.) of the proposed software. Describe new or novel ideas or concepts. Describe its use.

Phase II: Address the issue of how these tools/products will interface with, coexist with, and be compatible with STARS environments.

SB91-214 TITLE: Software Tools to Improve the Interaction between the Buyers and Suppliers of Non-off-the-shelf Software

CATEGORY: Advanced Development

OBJECTIVE: Develop software tools to improve the interaction between the 'buyers and suppliers during the acquisition of non-off-the-shelf software.

DESCRIPTION: Concepts are sought for innovative and novel ideas for developing software tools to improve the interaction between buyers and suppliers during acquisition of non-off-the-shelf software. The intent is to improve the efficiency of the software acquisition process.

Phase I: Provide a detailed specification of the proposed technology to help the buyer and seller interaction, to include, but not be limited to, moving and displaying documentation, etc. and to aid in the interaction between the government and the software developer during the acquisition and logistical phases of large software intensive systems. The technology should be compatible with software technology for adaptable/reliable systems (STARS) environments.

Phase II: Address the issue of how these tools/products will interface with, coexist with and be compatible with STARS environments.

SB91-215 TITLE: Design and Construction of Image Content-addressable Databases

CATEGORY: Exploratory Development

OBJECTIVE: Develop image content-addressable object oriented database.

DESCRIPTION: Image understanding systems which hope to recognize objects in an environmental scene require significant processing in order to characterize and classify the features of an image. Having characterized a new image, current matching strategies for determining similarity factors of new images to stored images are extremely time consuming and error prone. This research effort seeks to provide fast indexing strategies for the determination of candidate images to be considered for fine matching in an image database.

Phase I: Design the database indexing strategy for image content addressable access.

Phase II: Demonstrate and deliver a prototype image content addressable database system.

SB91-216 TITLE: Evaluation Methods and Metrics for Image Processing and Understanding Algorithms

CATEGORY: Advanced Development

OBJECTIVE: Develop evaluation methods and metrics for image processing and understanding algorithms.

DESCRIPTION: Current image understanding research has resulted in the development of alternative hierarchical approaches to solving image understanding functions. At all levels within the image understanding hierarchy (consisting of detection, extraction, decomposition, hypothesis generation and model matching) techniques for evaluating relative performance of alternative algorithmic approaches on both Yon Neumann and to scaleable parallel architectures are currently suggested to exist. This effort will result in the development of detailed metrics to be applied in the evaluation of individual components within the image understanding hierarchy, as well as the development of metrics to be applied in the evaluation of integrated image understanding systems.

Phase I: Develop a candidate set of metrics for evaluating image understanding systems.

Phase II: Use the metrics developed in Phase I to evaluate two or more existing image understanding systems.

SB91-217 TITLE: Standard Model-based Reasoning Modules

CATEGORY: Advanced Development

OBJECTIVE: Identify, document, and implement in a standard, reusable form the widely referenced methods of model-based reasoning.

DESCRIPTION: Novel approaches are sought to enable software engineers and system builders to exploit the basic methods of artificial intelligence. Recent successes in applying basic model-based reasoning techniques in diagnostic systems indicate the need to create standard modules of reusable model-based reasoning methods. This effort will identify and document the basic methods. Documentation will include both written descriptions, executable software, and demonstrable test cases.

Phase I: Identify and prepare written documentation on at least five model-based methods. Propose a standard software implementation and a set of test cases.

Phase II: Implement the standard modules and demonstrate them on the test cases.

SB91-218 TITLE: Standard Decision Analysis Modules for Knowledge-based Planning Support

CATEGORY: Advanced Development

OBJECTIVE: Identify, document, and implement in a standard, reusable form the widely referenced methods of decision analysis.

DESCRIPTION: Novel approaches are sought to enable the builders of intelligent systems to exploit the methods of decision analysis. This effort will identify and document the basic methods. Documentation will include both written descriptions, executable software, and demonstrable test cases.

Phase I: Identify and prepare written documentation on at least five decision analysis methods. Propose a standard software implementation and a set of test cases.

Phase II: Implement the standard modules and demonstrate them on the test cases.

SB91-219 TITLE: User Tailorable Models for Logistics

CATEGORY: Advanced Development

OBJECTIVE: Develop a model component library and support services that enable a user to assemble a customized model.

DESCRIPTION: Novel approaches are sought to enable the builders of intelligent operations planning systems to provide seamless integration of appropriate models from model libraries. An advanced approach would permit a domain expert to assemble a model based on the context of the required analysis. The proposed project will identify twenty or more basic model components in the domain of logistics planning and develop the software tools and support services to integrate all or part of these components into an executable model. A demonstration in the area of operation planning will be performed.

Phase I: Identify five or more widely used logistics models. Derive from these models twenty or more basic model components. Propose a standard model library and the necessary software support tools.

Phase II: Implement the model library and service tools and demonstrate model construction and use in a operation planning example.

SB91-220 TITLE: Replacement Materials for Chlorofluorocarbons

CATEGORY: Exploratory Development

OBJECTIVE: Explore new concepts to replace current ozone depleting chlorofluorocarbons (CFCs) that are widely used by military and commercial entities for the production of printed circuit boards, air conditioning systems, and refrigeration.

DESCRIPTION: Concepts are sought for innovative and environmentally acceptable replacement materials to be used in place of the current CFC cleaning materials used in the production of printed circuit boards. CFCs are also used in refrigeration and air conditioning systems. The Montreal Protocol (16 Sep 87) restricts the generation and use of ozone depleting CFCs. DoD Directive 6050.9 (13 Feb 89) establishes policies to address the restrictions of CFC base materials. Surcharges of $1.37 per pound were imposed on CFCs in Jan 90. This price escalates each year after that. This surcharge converts to $14.31 per gallon. Approaches should address alternate materials that have the performance criteria of cleaning printed circuit boards to military standards and should also investigate these alternate base materials for substitution in refrigeration and air conditioning systems.

Phase I: Investigate the Montreal Protocol in conjunction with DoD Directive 6050.9, identify current methods of CFC printed circuit board cleaning, and prepare ideas and research concepts for alternative base materials to be used for cleaning printed circuit boards.

Phase II: Perform tests and analyze the alternative materials for a best solution (environmental and cost effective) and present results for printed circuit board cleaning. Evaluate these base materials for use in refrigeration and air conditioning applications and present results.

SB91-221 TITLE: Replacement Materials for Halon Fire Extinguishers

CATEGORY: Exploratory Development

OBJECTIVE: Explore new concepts to replace current ozone depleting Halon that is widely used by the military and commercial entities for fire extinguishers.

DESCRIPTION: Concepts are sought for innovative and environmentally acceptable replacement materials to be used in "total flooding fire extinguisher systems. Halon is the material currently used in many portable fire extinguisher systems. The Montreal Protocol (16 Sep 87) restricts the generation and use of depleting chlorofluorocarbons (CFCs). DoD Directive 6050.9 (13 Feb 89) establishes policies to address the restrictions of CFC base materials. Surcharges of $1.37 per pound were imposed on CFCs in Jan 90. This price escalates each year after that. Halon 1211 is the material used in portable fire extinguishers and has an depletion potential (ODP) of 3.0, which is three times that of CFC. Halon 1301 is the material used in total flooding fire extinguishers and has an ODP of 10.0. Halon 2402 has an ODP of 6.0. Approaches should address alternate materials that have the performance criteria of the Halon fire extinguishing characteristics.

Phase I: Investigate the Montreal Protocol in conjunction with DoD Directive 6050.9, identify known properties of Halon, and prepare ideas and research concepts for alternative materials to be used for fire extinguishers.

Phase II: Perform tests and analyze the alternative materials for a best solution (environmental and cost effective) and present results.

SB91-222 TITLE: Simulation of High Strain Rates for Optical Fiber

CATEGORY: Advanced Development

OBJECTIVE: Determine optical fiber strength characteristics and requirements for buffer coating, adhesives, and bobbin materials at the high strain rates achieved during payout of fiber optic guided weapon systems.

DESCRIPTION: When fiber is used as the data link in military nonline of sight systems, the fiber is subjected to very high strain rates. A better Understanding of the characteristics of the optical fiber during payout is required in order to determine the optimal buffer coating, adhesive, and bobbin material.

Phase I: Develop a model to simulate the high strain rates occurring during payout of optical fiber. Include models to characterize winding and Unwinding and the interactions of buffer coating, adhesives, and bobbin materials in the simulation.

Phase II: Complete simulation and determine characteristics of high speed payout.

SB91-223 TITLE: Expert System for Computer Aided Process Planning

CATEGORY: Advanced Development

OBJECTIVE: First, develop an engineering work station based expert systems program for computer aided process planning (CAPP). Second, integrate this program with computer aided design (CAD) and computer aided manufacturing (CAM).

DESCRIPTION: CAPP programs have been written to enhance the computer integrated manufacturing environment. These programs are often mainframe based and cumbersome or personal computer based and not robust. Recent expert system technology can be used to capture the knowledge of the process planner and provide a robust CAPP implementation.

Phase I: Define approach for expert system development and define boundaries of process planning capabilities.

Phase II: Develop expert system for CAPP to include interfaces to CAD and CAM.

SB91-224 TITLE: High Density Connector Technology for Miniaturized Electronic Assemblies

CATEGORY: Exploratory Development

OBJECTIVE: Investigate, develop, and demonstrate innovative methods of reducing electrical connector size and weight to keep pace with the rapid miniaturization of semiconductors.

DESCRIPTION: Vastly reducing the size of military electronic assemblies while increasing processing power is a primary goal of weapons systems designers. Semiconductor technology has made great strides in miniaturization in the past two decades which result in much greater input/output transactions from chip-to-chip and board-to-board. Connector technology has not kept pace with the microelectronics trend, thus becoming a bottleneck in efforts to reduce board size. Much work directed towards miniaturization of connectors concerns wire bump technology and elastomerics. These alternatives have not been proven to withstand military environmental requirements. New materials and innovative connector manufacturing techniques need to be investigated, as well as possibilities for mil-hardening of wire bump and elastomeric technologies.

Phase I: Investigate wire bump and elastomeric technologies. Provide suggestions for advancement and mil-hardening of those technologies. Provide a complete review of new materials and fabrication processes available for state-of-the-art miniature connector fabrication.

Phase II: Optimize and demonstrate the capabilities researched in Phase I via sample connector fabrication.

SB91-225 TITLE: Transmission of 25 Watts of Gallium Arsenide Diode Laser Power Down a Fiber

CATEGORY: Exploratory Development

OBJECTIVE: Efficiently couple laser light from gallium arsenide diode lasers into a fiber optic cable so that 25 Watts of optical power is realized at the fiber exit.

DESCRIPTION: Optical to electrical power conversion is needed to power missile telemetry during electromagnetic effects testing. The laser light is delivered by a fiber optic into the sensitive test environment where it is then converted to electricity by photovoltaic cells. Both gallium arsenide (around 800 nanometers) and alexandrite (755 nanometers) lasers are close to the peak spectral response of the photovoltaic cells. Presently, the required optical power of 25 Watts can only be delivered by the alexandrite laser. However, gallium arsenide diode lasers are much more efficient and are less cumbersome than the alexandrite laser. The typical continuous wave output of a gallium arsenide diode laser is around 1 Watt. Therefore, to use the more attractive gallium arsenide lasers as a method for coupling the output from numerous (greater than 25) diodes into a fiber optic is necessary.

Phase I: Develop and deliver a working model demonstrator capable of coupling sufficient gallium arsenide laser power into a fiber so that 5 Watts of optical power is received at the exit of the fiber optic. The optical coupling and transmission losses should not exceed 20%. Thus, no more than 6.25 Watts of laser input should be required to produce the 5 Watts at the fiber exit.

Phase II: Develop and deliver two working systems each capable of delivering 25 Watts of gallium arsenide laser power to the fiber optic exit. A reasonable optical efficiency of 80 % is required.

SB91-226 TITLE: System for Locating Tank Mounted Guns

CATEGORY: Exploratory Development

OBJECTIVE: Develop locator system to locate hostile tank guns that have no thermal signature (cold).

DESCRIPTION: Any effective technology may be used that could be developed for use in the field. It is preferred that the system use some characteristic unique to gun barrels (long metal tubes 3. to 4. in diameter). The original stated requirements were: scout vehicle optics capable of identifying a tank gun barrel (frontal aspect) that has not been fired for at least six hours, is located within a camouflaged defensive position, and is at least two kilometers (2km) away. The capability to detect but not identify the same target from four kilometers (4km +) is also required. Some early studies indicate that this requirement may be difficult to meet using solely optical means. Therefore, consider any means that promises to do the job. The following example is given to show that no means are ruled out: An acoustical probe wave is launched into the camouflaged area suspected of containing tank with guns. The gun barrels could act like an organ pipe and produce a strong acoustical signature at its resonant frequency. The system could then use microphones to listen (electronically) for the organ pipe resonance. This resonant frequency will depend on the length of the gun barrel but is expected to be in the range of 100 to 200 Hertz. Narrowband filters (bandwidth 1 to 5 Hertz) can be used to enhance the signal to noise ratio. The launch wave could be an impulse such as a gun being fired, or more economically from a commercially made cannon designed to scare blackbirds from strawberry fields. This device is expendable (about $500) and could be located away from the using unit. It could also double for use in psychological warfare; since the enemy would continue to wait for the other shoe to drop, sleep would be difficult. If it were desired to operate more covertly, a one second acoustical burst at 150 Hertz (but tunable) could be launched toward the suspect area. This sound might easily pass unnoticed by the enemy since hearing sensitivity is down 30 db at 150 Hertz as compared to the 1000 to 5000 Hertz. That is a 1000 fold advantage. If the hum were heard, the long wavelength makes it very difficult to perceive the location of the source. The source for this single frequency acoustical energy might be a powerful loud speaker, a motor driven diaphragm, or an air driven trumpet like horn. If gun barrel echoes were received, it is important that it be possible to locate the

source of the echo. : This could be done by having two or more receivers which could time the arrival of the echoes. The arrival time would place the location some where along an ellipse having the sound launcher as one focus and the receiver as the other focus. With two receivers, there would be a second ellipse with a different focus. The gun is located where the two ellipses intersect. With three receivers there would be a confirming ellipse. This is an easy calculation for an ordinary personal computer. It should be noted that the same equipment could be used passively when the enemy fires the guns. The guns can be located even when the muzzle flash is not observed. This would also yield moderately accurate range information. The attenuation of sound may defeat this method at ranges greater than one kilometer.

Phase I: Continue conceptual analysis initiated in house. Make sufficient field measurements to assure that the selected means is feasible and that adequate signal to noise will be available.

Phase II: Design, fabricate, and deliver a prototype locator system. This will be a demonstrator system to show off the capabilities achieved.

SB91-227 TITLE: Development of a Compact Hardened Dye Laser

CATEGORY: Advanced Development

OBJECTIVE: Advance the development of ruggedized, compact, dye lasers with improved efficiency and beam quality in a cost effective package.

DESCRIPTION: Army concepts currently under development utilize lasers to lighten the force and minimize logistical support. Presently state-of-the-art dye lasers commercially available are limited to high-cost laboratory devices. Concept developments within the Army require a rugged device operating in a mobile environment such as a light weight vehicle. Present commercial lasers have low efficiency, poor beam quality and are heavy devices requiring large power sources. Devices of particular interest are visible lasers in the 30 to 300 Joule classes. Present technology supports this power range.

Phase I: Select two or more approaches to proposed improvements. Demonstrate the design improvements through analysis and a breadboard of critical components.

Phase II: Design, fabricate and deliver a fully integrated laser package compatible with the existing mobile platform demonstrator.

SB91-228 TITLE: Spatial Light Modulator Utilizing Deformable Mirror Devices for Infrared Protection for Hardware-in-the-Loop Simulation Applications

CATEGORY: Exploratory Development

OBJECTIVE: Design and fabricate a prototype infrared (IR) projection system which utilizes a spatial light modulator (SLM) based on deformable mirror devices (DMDs) for application in hardware-in-the-loop (HWIL) simulations.

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DoD which utilize imaging infrared (IR) focal plane arrays (FP A) for target detection and intercept. Conventional IR projector performance limitations have forced the exclusion of the FP A hardware from the HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative IR projection techniques are needed to overcome these limitations. Advances in integrated circuit technology have recently made large monolithic DMDs possible. Broadband SLMs appear to be an obvious extension of this technology and accordingly could lead to the development of an innovative IR projection system for application in HWIL I simulations.

Phase I: Provide a conceptual design and laboratory demonstration of an IR projector which utilizes available DMDs as IR SLMs.

Phase II: Extend and upgrade the laboratory demonstration IR projection system to a prototype device .for use in HWIL simulations of imaging IR missile systems.

SB91-229 TITLE: Infrared Signatures For Multicolor Projector Applications

CATEGORY: Exploratory Development

OBJECTIVE: Design and fabricate a prototype infrared (IR) signal combiner which utilizes existing or readily available optical components and significantly reduces signal losses for integration with an IR projector for hardware-in-the-loop (HWIL) simulations.

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DoD which utilize multiple IR wavebands for target detection and intercept. Conventional beam combiner techniques result in large losses in the two projected IR signals. In addition to difficulties in generating the IR signals, these performance limitations have forced the exclusion of the IR detectors from the HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative IR projection techniques are needed to overcome these limitations.

Phase I: A conceptual design and laboratory demonstration of a novel IR signal combiner which utilizes available optical components and materials.

Phase II: Extension and upgrade of the laboratory demonstration IR signal combiner system for use with an IR projector for use in HWIL simulations of multicolor IR missile systems.

SB91-230 TITLE: Infrared Laser Diode Based Infrared Projector

CATEGORY: Exploratory Development

OBJECTIVE: Design and fabricate a prototype infrared (IR) projector which utilizes existing or readily available IR laser diode components for hardware-in-the-loop (HWIL) simulations.

DESCRIPTION: Several weapon systems are currently under development throughout all branches of DoD which utilize multiple IR wavebands for target detection and intercept. Typically linear arrays of detectors with less than 30 total detectors are used in these systems. These are scanning systems with small instantaneous fields of view. As the system optics scans the total field of view the detector elements are read out at extremely high rates. Conventional IR projection techniques cannot support the modulation of the IR signal outputs at the rate required for accurate HWIL tests of these systems. These performance limitations have forced the exclusion of the IR detectors from the HWIL simulations which are necessary to adequately assess weapon system performance. Therefore, innovative fast IR projection techniques are needed to overcome these limitations. Currently, IR laser diodes are available in the short to mid wavelengths which are fast enough to test these systems. However, low output power levels limit their utility. Accordingly, if power levels could be improved and extensions made into the long wavelengths, an IR projector capable of supporting HWIL tests of these systems could be developed.

Phase I: Provide a conceptual design and laboratory demonstration of a novel IR projector which utilizes available laser diodes in the mid wavelengths.

Phase II: Extend and upgrade the laboratory demonstration laser diode projector for use in HWIL simulations of IR missile systems.

SB91-231 TITLE: Ultra Low Cost Fuel Control System for Expendable Turbojet Engines

CATEGORY: Advanced Development

OBJECTIVE: Develop and demonstrate technology that significantly reduces the unit production cost of fuel control systems for expendable turbojet engines utilized in tactical missile systems.

DESCRIPTION: A number of tactical missile systems utilize expendable turbojet engines as the sustainer propulsion system. The fuel control system of such engines is a significant fraction of the overall propulsion system cost. Innovative technology is required to significantly reduce the cost of such fuel controls. A fuel control system is desired for operation with either the Sun stand Power Systems TJ-90 or Williams International P8910 turbojet engines. The fuel control system shall be capable of providing stable control during / pyrotechnic starts, steady-state operation, and transient throttle changes. The fuel control system must be self contained, and include all metering devices and sensors. on-demand engine throttle control is desired. Design emphasis should be placed on low cost, and throttle control flexibility can be sacrificed to achieve this objective. Design must be based on a low pressure fuel supply that is pressurized by compressor discharge air. The design must be adaptable to tactical missile operation. Unique design approaches are encouraged. Mechanical, electrical, hydraulic, pneumatic (or any combination of the above) devices are acceptable.

Phase I: Design, fabricate, and deliver a heavy-wall, breadboard fuel control system for government evaluation testing with an expendable turbojet engine.

Phase II: Design, fabricate, and deliver a flight-weight, flight-ready fuel control system for Government evaluation testing with an expendable turbojet engine.

SB91-232 TITLE: Technologies for Intensifying High Density Charge Coupled Device Detectors

CATEGORY: Advanced Development

OBJECTIVE: DARPA seeks innovative solutions for intensifying high density charge coupled device (CCD) detectors.

DESCRIPTION: High density CCD detectors are available in both (1024xIO24) and (2048x2048) configurations with pixal sizes equal to and less than 9 microns x 9 microns. Specialized low light level applications require that these detectors be intensified. Current generation intensifiers utilize optical fibers approximately 30 microns in diameter and therefore are presently unsuitable for use with high density CCD detectors.

Phase I: Analyze relevant technologies and formulate a concept for intensifying high density CCD detectors. The analysis should include performance, manufacturability and cost assessments of the proposed concept and experiments to confirm key physical assumptions.

Phase II: Demonstrate the concept for intensifying high density CCD detectors.

SB91-233 TITLE: Technologies for Obtaining Real-time Readoff Rates for High Density Charge Coupled Device Detectors

CATEGORY: Exploratory Development

OBJECTIVE: DARPA seeks innovative solutions for obtaining readoff rates of 30 frames per second for charge coupled device (CCD) detectors in (2048x2048) configurations.

DESCRIPTION: CCD detectors in (1024xIO24) configurations are available with real-time read off rates of 30 frames per second. High density CCD detectors in (2048x2048) configurations are available but not with real-time readoff rates.

Phase I: Analyze relevant technologies and formulate a concept for obtaining a 30 frame per second readoff rate for high density CCD detectors in (2048x2048) configurations. The analysis should include performance,

manufacturability, and cost assessments of the proposed concept and experiments to confirm key physical assumptions.

Phase II: Demonstrate the concept for obtaining a 30 frame per second readoff rate for high density CCD detectors in (2048x2048) configurations.

SB91-234 TITLE: Small, Low-cost Fiber Optic and Discrete Sensors for Remote Sensing of Temperature, Smoke, Flame and Concentrations/Partial Pressures of Organic and Nonorganic Compounds

CATEGORY: Advanced Development

OBJECTIVE: DARPA seeks innovative sensor solutions for the monitoring of smoke, flame, and concentrations/partial pressures of selected organic and inorganic compounds.

DESCRIPTION: Small, highly responsive and low cost sensors are required for atmospheric monitoring of potentially unsafe conditions onboard manned vehicles.

Phase I: Analyze relevant sensor technologies and formulate a sensor concept for the detection of temperature, smoke, flame, and concentrations/partial pressures of selected organic and inorganic compounds. The analysis should include performance, manufacturability, and cost assessments of the proposed sensor concept and experiments to confirm key physical assumptions.

Phase II: Demonstrate selected sensor concept.

SB91-235 TITLE: Innovative Electro-optical Sensor Development to Detect From Airborne Platforms, Small Scale Vertical Air Mass Movements and Velocity Gradients in Clear Air

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative airborne sensor systems for the detection of clear air turbulence.

DESCRIPTION: DARPA is investigating advanced technologies for detecting clear air turbulence (CAT) from onboard airborne platforms, both manned and unmanned vehicles. CAT is a physical phenomena characterized by mechanically induced turbulent flow from strong winds flowing over terrain features, as well as from wind shear between air masses moving at different velocities. The horizontal and vertical extent of CAT cells can be on the order of 10s of meters, while having differential velocities of 100's of meters per second. These localized disturbances provide no visible cues to size, location and intensity. Yet the severity of the CAT can degrade mission performance, or even damage and destroy airborne platforms encountering them. Airborne sensing of the CAT prior to transit of the disturbance would provide air vehicles the option of avoiding vice transiting the CAT cell. DARPA is interested in innovative sensor and processing technologies to detect and classify small scale air mass movements and velocity gradients from onboard airborne platforms. Possible approaches could include use of electro-optical emitters and detectors coupled with innovative signal processing techniques. Strong emphasis will be placed on truly innovative concepts that offer the potential for significant improvement in capability, even if there is technological risk. Proposals must include a discussion of how the technology would be operationally utilized.

Phase I: Provide detailed analysis of the proposed CAT detection sensor technique based on physical principles as well as an analytical assessment of any available experimental data. Include a plan for how CAT detection data would be output to be used by its airborne platform.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB91-236 TITLE: Low-cost, Man-portable Real-time Weather Satellite Data Receiving. Processing and Display Technology

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate an innovative, light weight and self-contained capability to receive, process and display real-time data from available weather satellites.

DESCRIPTION: DARPA is investigating advanced technologies and concepts for providing operationally meaningful detailed real-time weather data to decision makers at remote locations. A typical system would be small and light weight, transportable by one person, capable of operation without connection to external power sources. It might utilize rechargeable batteries in conjunction with solar cells. It would have data processing capability to receive, store and display the wide range of weather data available currently from weather satellites, with growth potential for future weather satellite changes and upgrades. It should allow for time-phased "looping" display of sequential data packages (e.g., optical and infrared multi-spectral sensor imagery; vertical or horizontal fields of other parameters including moisture, temperature, desert dust storm and other environmental data recorded by the satellite sensors). The recording media should be solid-state to eliminate problems associated with mechanical systems operating in uncontrolled environments. The data processing software should be contained in plug-in solid-state modules to permit replacement or upgrade of the software. The displays should be full color to adequately represent the variations in parameters being displayed (e.g., variations in cloud cover optical or infrared imagery infer cloud vertical development and strength characteristics). Display resolution should match current and foreseeable future satellite sensor output, within the constraints of realizable data storage techniques. Display processing should provide for "zoom" capability for evaluation of small-scale meterological phenomena.

Phase I: Provide detailed analysis of the functional design of the proposed hardware technologies and requisite software to be incorporated in an innovative, light weight, self-contained capability to receive, process and display real-time data from available weather satellites.

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB91-237 TITLE: Low-cost. Miniature Tactical Jammers

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate innovative light weight, self-contained capability to jam ground radar systems.

DESCRIPTION: DARPA is investigating advanced technologies and concepts for providing tactically useful jamming techniques against ground radar systems. DARPA is interested in innovative, low-cost, disposable, pocket size, miniature jamming systems. One potential candidate for jamming might be very high frequency early warning radars.

Phase I: Provide detailed analysis of the functional design of the proposed technologies to be incorporated in an innovative light weight, self-contained capability for tactical jamming. Include a prediction of the operational utility of the jamming technique (e.g., effective jamming range, number of jammers required to blanket a radar).

Phase II: Develop a feasibility demonstration model of the system concept and demonstrate its performance.

SB91-238 TITLE: Lightweight, High Efficiency, Space Qualified, Flexible Solar Array Technologies

CATEGORY: Exploratory Development

OBJECTIVE: Develop and evaluate the performance of candidate innovative enabling technologies for space qualifiable solar array technology.

DESCRIPTION: Solar power is the energy source of choice for most satellite applications. Traditional rigid solar cells have draw backs in that they are relatively heavy; require complicated and expensive deployment mechanisms; and are susceptible to outages due to crack propagation. Some flexible solar array candidates overcome these problems but suffer from low efficiency and uncharacterized performance in the space environment. Technologies that lead to the space qualification of higher efficiency flexible solar arrays have the potential of significantly increasing the Watts per pound available to all satellites.

Phase I: Identify approaches to improve the efficiency of flexible solar arrays and identify technology developments required to space qualify such arrays. Conduct analyses to determine the most promising approaches. Develop plans for the fabrication and testing of the most promising approaches. Limited fabrication and testing of candidate materials in phase one is desired.

Phase II: Execute plans for fabrication and testing developed in phase one. Areas of concern are: improvement in the wait per pound ratio over conventional techniques; survivability and lifetime in the space environment; and development risk. Deliverable at the end of phase two will be one square foot of solar array that is fully space qualified that represents a significant power to weight efficiency improvement over current rigid array technologies.

SB91-239 TITLE: High Energy-densitv Fuel and Oxidant Storage for Fuel Cell Systems Suitable for Undersea Vehicle Applications

CATEGORY: Advanced Development

OBJECTIVE: DARPA seeks higher energy yield fuel cell power systems than obtainable from liquid hydrogen and oxygen. Innovative solutions are sought.

DESCRIPTION: Unmanned undersea vehicles and swimmer delivery vehicles require high energy-density fuel cell power systems. Mission range and duration are dependent upon the energy density of the fuel and oxidant. For the intended applications, fuel and oxidant storage systems must have a high level of safety, must minimize or eliminate free-surface motion of the fuel during maneuvers of the vehicle, must permit externally commanded control of the flow rate of the fuel and oxidant, must retain the fuel without significant loss for the duration of a mission, must be readily and safely refuelable on-board a Navy submarine or surface ship, and must be designed for hundreds of refueling cycles. Storage should be optimized for a 21 inch diameter vehicle, but the concept should apply to larger sizes. The fuel and oxidant must be compatible with fuel call technologies being developed for DARPA for Navy applications. The fuel cells will be of the proton exchange membrane and possibly one other type.

Phase I: Design system and analyze with experiments to confirm key physical and/or chemical design assumptions.

Phase II: Complete a convincing demonstration.

SB91-240 TITLE: Airborne Sensors for the Detection of Clear Air Turbulence from Sea Level to 100.000 Feet

CATEGORY: Advanced Development

OBJECTIVE: Evaluate the ability to detect turbulence at all altitudes through the application of infrared (IR) or microwave temperature profiles, or laser illumination detection and ranging (LIDAR) and develop a prototype instrument for turbulence detection.

DESCRIPTION: Environmental investigations applied to typical mission profiles of high altitudes long endurance (HALE) vehicles indicate a 50 percent probability of encountering medium to severe turbulence on each mission. Operational limits for theme vehicles could be substantially enhanced if detection and avoidance/countermeasures systems could be included in their design. High altitude turbulence and low level wind shear research had shown a high correlation between temperature profiles and this turbulence. Experiments are ongoing to establish the ability

of microwave and IR temperature pro filers to detect the turbulent conditions. In addition LIDARs have the ability to directly measure the turbulent winds.

Phase I: Evaluate the development of IR radiometers, microwave temperature profilers and LIDAR in the detection of turbulence from sea level to 100,000 ft. Establish the technique most promising for effectiveness, low cost and low weight that should be applied to HALE air vehicles.

Phase II: Finalize the design of the recommended technique and build a prototype system that can be applied to a flight test program.

SB91-241 TITLE: Low Cost. Low Weight Icing Detectors and Anti-icing Devices for Unmanned Autonomous Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: Explore, define and implement concepts for the detection of icing conditions and for the elimination of ice on unmanned autonomous vehicles (UAV's).

DESCRIPTION: Aircraft icing is caused by suspended supercooled water droplets striking the leading edge of components, giving, up their latent heat of fusions and freezing. The type and amount of ice which forms is dependent upon the physical properties of the atmosphere, the geometry of the aircraft, local aerodynamics , conditions and the duration of the encounter. Airframe icing degrades performance by increasing drag and decreasing lift which are particularly harmful on UA V's which have high performance laminar flow surfaces. Years of icing research are beginning to payoff in the ability to model the icing phenomenon and its effect on aircraft. This knowledge can be applied to the design of low cost, low weight instrumentation to detect the potential onset of icing condition so that evasive maneuvers can be taken. Technology investigations have identified new electrical and mechanical methods of removing ice from aircraft wing and tail surfaces. One of the most promising utilizes piezoelectric effects. Use of these technologies will be examined to produce a low cost weight ice detection and deicing system that would permit operation in an icing environment.

Phase I: Evaluate techniques for the detection of icing conditions and for anti-icing systems. Establish the most promising technique for use with UAV's.

Phase II: Develop and test a laboratory model of the icing detection or elimination system.

SB91-242 TITLE: Low Cost. Portable Automatic Landing System for Unmanned Autonomous Vehicles

CATEGORY: Advanced Development

OBJECTIVE: Develop and demonstrate a low cost automatic landing system that can expand the operational capabilities of first generation close range, short range and medium range unmanned autonomous vehicles (UAV's).

DESCRIPTION: The landing requirements of close range, short range and medium range UA V's present operational limitations on their use. Significant reductions are needed in size of landing sites, set-up time and manpower requirements. The cost and weight of the airborne and ground equipments must be minimized. Recent research and advanced developments in manned aircraft automatic landing systems and electro-optical microwave and laser illumination detection and ranging techniques can be applied to this task.

Phase I: Identify and evaluate innovative techniques that can be applied to provide a low cost portable automatic landing system. Develop a plan to develop the most promising system.

Phase II: Develop and demonstrate prototype equipments for the system proposed under Phase I.

SB91-243 TITLE: Manufacturing Methods for Low Cost, High Quality Unmanned Autonomous Vehicle Airframes

CATEGORY: Advanced Development

OBJECTIVE: Identify and demonstrate methods to improve production efficiency and consistency for unmanned autonomous vehicle (UAV) airframes. The long term goal is to lower the per unit cost while improving the quality of production airframes.

DESCRIPTION: UAVs have generally been produced in small quantities, using hand-tooling and other labor intensive methods. This leads to increased unit cost and limits the ability to transition to mass production, both in terms of quantity and quality control. Application of modem manufacturing technologies will improve the efficiency of production and ensure product consistency. This effort will take advantage of methodologies demonstrated through the Manufacturing Technology program and related projects, and will take advantage of the Industrial Modernization Improvement Program, if possible. Promising methodologies will be identified through sources such as the Manufacturing Technology Information Analysis Center. Potential improvements will be examined for cost effectiveness, utility, and ease of implementation. Specific enhancements will be implemented in small scale demonstrations. High payoff techniques will then be applied to production systems.

Phase I: Review relevant methodologies and analyze potential for application to UAV airframe productions in terms of cost effectiveness and utility.

Phase II: Develop laboratory demonstrations to verify the technologies identified.