DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

Submission of Proposals

The responsibility for carrying out DARPA's SBIR Program rests with the Program Management Office. 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/PM/SBIR
Attention: Dr. Bud Durand
1400 Wilson Boulevard
Arlington, VA 22209-2308

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

DARPA has identified 70 technical topics, numbered DARPA90-062 through DARPA90-131, to which small businesses may respond in this the second fiscal year (FY) 1990 solicitation (90.2). Please note that these are the only topics for which proposals will be accepted at this time. The previously advertised solicitation for FY 1990 (Solicitation 90.1) which identified 61 technical topics for DARPA, opened on 1 October 1989 and closed on 5 January 1990. Proposals can no longer be accepted on those previously advertised 61 technical topics. A list of the topics currently eligible for proposal submission is included below, followed by full topic descriptions. The topics originated form DARPA technical offices.

DARPA's charter is to help maintain U.S. technological superiority over, and to prevent technology 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 I's. 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 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. 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.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
FY 1990 Small Business Innovation Research Topics

SB90-062	On-site Inspection Procedures and Techniques for Detection of Underground, Large, Hidden Cavities in Field, Mining, or Other Environments
SB90-063	Techniques for In-Situ Borehold Determination of Gas-filled Porosity to Better Than 1% at 200-1000 Meter Depths
SB90-064	Techniques for In-Situ Dynamic Stress Measurements in Rocks in the 10-300 KBar Range
SB90-065	Seismic Network Concepts for Location of Targets and Events
SB90-066	Development of a Substitute for (Highly Toxic) Arsine Gas for Use in Fabrication of Gallium Arsenide Material
SB90-067	Advanced Microwave and Millimeter Wave Devices and Circuits
SB90-068	Innovative Packaging Techniques and Package Models
SB90-069	Development of Computer Aided Design and Process Models for Microwave and Millimeter Wave Devices and Circuits
SB90-070	Computer Analysis of New Microwave Devices and/or Monolithic Circuit Techniques
SB90-071	Mask Materials (Membranes/Absorbers) for X-ray Lithography
SB90-072	High Brightness X-ray Sources for X-ray Lithography
SB90-073	Photoresists for Optical Lithography at Wavelengths of 250 nm or Less
SB90-074	Fabrication of Micro-optical Components
SB90-075	Fabrication Techniques Related to Monolithic Photonic Transmit/Receive Modules
SB90-076	Fabrication/Materials for Assembly of Laser Diode Arrays
SB90-077	In-situ Process Monitoring for Metal Organic Chemical Vapor Deposition Material Growth
SB90-078	Graphical Displays for Manufacturing Simulation
SB90-079	Simulation and Modeling to Predict Life Cycle Product Costs
SB90-080	Inexpensive Gigabit Local Area Network Technology
SB90-081	Terabit-per-second Local Area Network Technology
SB90-082	Speech Recognition Modules
SB90-083	Acoustic Preprocessor for Speech
SB90-084	Interface Standards for Simulation Systems (i.e. SIMNET to BBS to JESS)
SB90-085	High Definition Video Technology Based Head Mounted Displays for Visualization of Real-Time Systems
SB90-086	Low Cost Portable Computer Generation Image Machines
SB90-087	Low Cost Reconfigurable Generic Computer Workstations for Simulation Research/Development/Analysis
SB90-088	Virtual World Interactions Using Heads-on Displays and Magic Glove Interaction
SB90-089	Low Power Complementary Metal Oxide Semiconductor Design Tools
SB90-090	High Performance Flexible Interconnect Technology
SB90-091	Small Scale, Special Purpose Hardware Accelerators
SB90-092	Rapid Prototyping Techniques and Methodologies
SB90-093	System Level Packaging Design Tools and Interfaces
SB90-094	Technology Independent, Performance Driven Design Tools
SB90-095	Innovative, Ultra Dense, High Performance Computer Input/Output Subsystems
SB90-096	Vision Environment Components
SB90-097	Case-based Reasoning Modules
SB90-098	Nonlinear Signal Processing
SB90-099	Scalable Algorithms and Software Library Modules for Scalable Parallel Computers
SB90-100	New Techniques for Wide-band Video Data Compression
SB90-101	A Requirements Language for Tracking Autopilot Systems
SB90-102	Feature-based Design Methods for Predictive Design Paradigms
SB90-103	Integration of Expert System for Process Planning and Feature-based Designs
SB90-104	Development of a Compact Eye-safe Laser Using Laser Diode Arrays
SB90-105	Development of Passive Q-Switches in the Mid-Infrared Spectral Region
SB90-106	Detection of Chemical Agents by Directed Energy
SB90-107	Development of Nonvolatile Memories Using Thin-film Ferroelectric Materials
SB90-108	Development of Circuit Architectures Using Quantum Well Devices

SB90-109	High Resolution Dopant, Impurity and Defect Spatial Profiling of Compound Semiconductors
SB90-110	Development of New Energetic Materials
SB90-111	Advanced Fouling Control Coatings
SB90-112	Development of New Ceramic Composite Materials
SB90-113	Determination of New Ways of Enhancing the Compressive Behavior of Organic Composites
SB90-114	Application of High Temperature Superconductivity to Electronic Packaging
SB90-115	Unique Applications for Artificial Neural Networks
SB90-116	Nonstandard Control Theory
SB90-117	Spatial Light Modulator Utilizing Deformable Mirror Devices for Infrared Projection for Hardware-in-the-loop Simulation Applications
SB90-118	Applications for Acoustic Charge Transport Technology
SB90-119	Algorithms to Automatically Extract Power Lines from Multi-spectral and Synthetic Aperture Radar Imagery
SB90-120	Micro-machine Concepts and Applications
SB90-121	New Concepts for Detecting, Classifying or Locating Mobile Objects Using Low Cost Acoustic Sensors
SB90-122	Parallel Processing Algorithms for Real-time Combat Simulation of Electronic Warfare, and Command, Control and Communications in Dynamically Scalable Domains
SB90-123	Knowledge Based Tools for Faster Than Real-time, Episodic Campaign Planning for Comprehensively Aggregated Levels of Discrete Simulation
SB90-124	Artificial Neural Network Target Recognition Demonstration
SB90-125	Dynamic Object Extraction Preprocessor Algorithm for Automatic Target Recognition
SB90-126	Wide Dynamic Range laser Diodes for Communications
SB90-127	Generators (Electromechanical Power Supplies) for Miniature Reciprocating Engines (Model Aircraft Size) with Sustained Power Levels from 1 Watt to 1 Kw
SB90-128	Passive (Nonradio Frequency/Nonelectro Optics) Sensors for Application to Low Observable Aircraft
SB90-129	Low Volume, High Efficiency Power Sources for Small Satellites
SB90-130	Innovative Thermal Control Concepts for Small Satellites
SB90-131	Novel Orbital Transfer Concepts

SB90-062 TITLE: On-site Inspection Procedures and Techniques for Detection of Underground, Large, Hidden Cavities in Field, Mining, or Other Environments

CATEGORY: Engineering Development

OBJECTIVE: To develop and test operational on-site field procedures and equipment to detect cavities suitable for nuclear decoupling near quarries, open mines, and drill-sites.

DESCRIPTION: There is substantial research on tunnel detection and on mineral exploitation that is relevant to this subject. In addition, mining engineers and quarry operators may be able to suggest practical clues or means, accounting or physical, of detecting or preventing secret activity. Cavities of interest would range from radii of 10 to 50 meters at depths or at distances from tunnels of up to 1000 meters.

Phase I: Survey the existing literature and experts on this subject. Consult with mining and quarry engineers and operators. Outline suitable procedures and systems and deifne their probable capabilities. Propose suitable experiments for Phase II.

Phase II: Execute experiments in detecting hidden cavities. Evaluate results and propose designs for operational procedures and systems.

SB90-063 TITLE: Techniques for In-Situ Borehold Determination of Gas-filled Porosity to Better Than 1% at 200-1000 Meter Depths

CATEGORY: Engineering Development

OBJECTIVE: To develop an in-situ method for obtaining dry porosity in hard rocks at a depth of 200-1000 meters below the water table and in other rock environments.

DESCRIPTION: Air filled porosity (AFP) reduces the seismic magnitude resulting from underground nuclear tests. The accuracy of current logging methods at the Nevada Test Site for determination of AFP is +/- 5% absolute; that is, if the true porosity is 1% the estimate may be in the range -4% to +6%. What is desired is an operational in-situ technique for determining dry porosity to an accuracy of 1%. If necessary, efficient methods requiring core recovery may be considered. Estimation of AFP below the water table is an important sub-problem.

Phase I: Review existing procedures of determining AFP, both in-situ and in the laboratory. Critically assess the accuracy of the methods, if possible by direct comparison of logging data with the highest quality laboratory data. Plan experiments for Phase II to test improved methods. If possible, execute a few prototype proof-of-principle experiments.

Phase II: Execute experiments designed in Phase I. Implement controls so that absolute accuracy can be definitively evaluated. Use of existing wells, and possible selected existing data, to minimize costs is encouraged.

SB90-064 TITLE: Techniques for In-Situ Dynamic Stress Measurements in Rocks in the 10-300 KBar Range

CATEGORY: Engineering Development

OBJECTIVE: To develop new in-situ methods for obtaining dynamic stress measurements within 2-4 cavity radii of a nuclear explosion.

DESCRIPTION: In-situ stress measurements within 2-4 cavity radii of a nuclear explosion can be of use in determining the yield of underground tests for which the original test layout is not spherically symmetrical. Existing

instruments for making these measurements use the change of resistivity of selected materials as a function of stress and strain. Ease of emplacement and longtime recording capability are current areas of deficiency.

Phase I: Review existing procedures for estimating dynamic stress. Propose one or more new instrumentation designs. Discuss the advantages of the new designs. Build a prototype instrument. Design and estimate costs for suitable experiments to test the system. In estimating experimental costs, be sure to separately estimate costs of drilling since it is possible that these would be government furnished.

Phase II: Execute and evaluate experiments designed in Phase I.

SB90-065 TITLE: Seismic Network Concepts for Location of Targets and Events

CATEGORY: Engineering Development

OBJECTIVE: To design and test, on synthetic data, a prototype date acquisition and analysis system for battlefield seismic data.

DESCRIPTION: Seismic data from an active battlefield will be multi-source transient, multi-phase (i.e., P, S, LR) and broadband in frequency. It is stipulated that only a human analyst could usefully interact with such data, and then only if it were presented to the analyst on a map base nad under his/her command, using intuitive controls similar to those found in video games. Such controls could, e.g., scroll in time, window in frequency and phase velocity, and display at points on the map the product of two array signal amplitudes from those points, with and without forms of automatic gain control.

Phase I: Assemble and test the software required to generate synthetic seismic (and acoustic) data characteristic of a multi-source battlefield as recorded at two arrays. Discuss the generation of realistic synthetic data using this software. Produce a functional design of the hardware and software required to enable an analyst to usefully interact with such data. Specify the computer hardware and software methods required for a system which will respond fluidly to analyst commands.

Phase II: Generate realistic synthetic seismograms for two arrays characteristic of a multi-source battlefield. Program an interactive system to enable an analyst to usefully interact with this data. Train an analyst to use the system and to successfully determine the locations and other characteristics of sources on the synthetic battlefield by gradually developing skills as targets progress from simple to complex. Adjust the system characteristics, including network and array design, in response to remarks from the analyst. Discuss the step of applying this system to real data. Discuss application to acoustic data.

SB90-066 TITLE: Development of a Substitute for (Highly Toxic) Arsine Gas for Use in Fabrication of Gallium Arsenide Material

CATEGORY: Advanced Development

OBJECTIVE: To develop alternatives to arsine which will be readily accepted by existing and future industries using metalorganic chemical vapor deposition (MOCVD) and a gas-source molecular beam epitaxy (MBE) growth system.

DESCRIPTION: MOCVD and MBE are accepted techniques for the growth of epitaxial layers. In particular, use of MOCVD of III-V semiconductor devices has been most successful, and several production facilities are in operation. These include the production of microwave and millimeter wave integrated circuits, laser diodes of compact disk players, photocathodes for night vision goggles, and gallium arsenide (GaAs) solar cells. The principal weakness of current MOCVD methods is reliance on arsine as a Group V source. Arsine is highly toxic and requires the installation of major facilities with expensive monitoring and safety equipment. Even though the technology for handling arsine is well developed, accidental release of a large quantity of arsine remains possible.

Such a catastrophic failure could trigger the temporary or permanent shut-down of all facilities using arsine and interrupt the supply of devices that are critical for defense needs.

Phase I: Determine optimum conditions and parameters for growth of GaAs MOCVD using alternate sources. Study range of acceptable V/III ratios and compare with those presently used for MOCVD material growth. Develop simple test device structure(s) and compare results achieved using alternate sources with those obtained using standard MOCVD sources.

Phase II: Continue device development effort with a concentration on more complex device structures. Demonstrate device capabilities achieved using arsine replacement sources. Develop a prototype growth system utilizing alternative environmentally safe sources as a replacement for arsine gas. Demonstrate prototype alternative source growth system capabilities including the potential for scale-up to large diameter (4 inch) substrates.

SB90-067 TITLE: Advanced Microwave and Millimeter Wave Devices and Circuits

CATEGORY: Advanced Development

OBJECTIVE: To advance the development and fabrication of microwave and millimeter wave devices and monolithic format circuits that will provide performance characteristics not presently available, thus satisfying system requirements that are not adequately met.

DESCRIPTION: Gallium arsenide metal-semiconductor field effect transistors (GaAs MESFETS) are being successfully used in a wide range of microwave applications and many millimeter wave applications. However, these devices and the circuits built using them have performance limitations in terms of noise figure, power output, and efficiency, particularly at frequencies above 50 GHz. This project is desired toward the development of devices and monolithic format circuits from other material combinations (i.e., heterostructures, indium phosphide) that provide performance improvements compared to the present state-of-the-art. Particular emphasis should be placed on developing devices and circuits to meet military system requirements that cannot adequately be met with existing structures.

Phase I: Select one or more devices and/or monolithic format circuits that offer the possibility of performance improvements at microwave and millimeter wave frequencies beyond the present state-of-the-art. Develop a plan for the fabrication of the device and/or circuit structures. Consider approaches that will result in the desired structures being produced at the lowest possible cost.

Phase II: Develop final design and fabricate prototype samples of the device and circuit selected for demonstration. Measure and report upon the DC and microwave (or millimeter wave) frequency performance characteristics.

SB90-068 TITLE: Innovative Packaging Techniques and Package Models

CATEGORY: Advanced Development

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

DESCRIPTION: Advanced multi-ship 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 a 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.

SB90-069 TITLE: Development of Computer Aided Design and Process Models for Microwave and Millimeter Wave Devices and Circuits

CATEGORY: Advanced Development

OBJECTIVE: First, to 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. Second, to 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 form 1 to 20 GHz. Additional work is needed to improve the accuracy of models for operation of devices in the 20 to 100 GHz range and for operation of active devices in a non-linear (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 and to compatibility of models with existing commercially supported software packages and workstations.

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

SB90-070 TITLE: Computer Analysis of New Microwave Devices and/or Monolithic Circuit Techniques

CATEGORY: Advanced Development

OBJECTIVE: To provide computer aided design methods to accurately analyze the predicted performance of new analog device and/or monolithic format circuit structures intended for operation in the 1 to 100 GHz frequency range.

DESCRIPTION: A number of recent device structures have been proposed which may result in superior transmitter and/or receiver performance at microwave and millimeter wave frequencies. In some cases, the basic device structure is not new but the material structure proposed for device fabrication is; in other cases, completely new device structures are under consideration. Similarly, new circuit designs are under consideration that result in performance advantages such as broader-band operation, higher efficiency operation or higher power outputs. These projects will result in the development of computer aided design techniques and models that can be used to analyze the performance and advantages to be gained from incorporation of new devices and monolithic format circuits in microwave and millimeter wave systems.

Phase I: From technical discussions and literature searches, select one or more promising microwave and/or millimeter wave device and/or monolithic format circuit structures for model development. Provide a proposed model with a clear indication of accuracy and needed improvements.

Phase II: Complete modeling and computer aided design software with emphasis upon accuracy and compatibility with existing commercially available computer aided design software and workstations.

SB90-071 TITLE: Mask Materials (Membranes/Absorbers) for X-ray Lithography

CATEGORY: Advanced Development

OBJECTIVE: To develop membrane/absorber combinations compatible with high resolution definition with high structural stability.

DESCRIPTION: X-ray lithography will be used in the future to make semiconductor devices having features of 0.25 micrometers and below. The patterns are defined by proximity printing with x-rays of about one nanometer wavelength. Currently, the mask is made by patterning a thin film of high atomic number, such as gold, onto a thin membrane, such as silicon, and then bonding it to a quartz ring for handling purposes. Structural stability is required because of the extremely critical dimensions in advanced integrated circuits. Distortion, from stress and thermal effects, must be minimized. The materials should be compatible with the processing required to define the small features in the absorber layer. The thin membrane must support a pattern area of greater than 2 cm x 2 cm. Optical transparency of greater than 50% for the membrane is desired. Candidate membrane materials include silicon carbide and diamond; candidate absorber materials include tungsten and tantalum. The totality of mask fabrication will involve a sequence of discrete fabrication steps; any subset that fits reasonably well into an integrated plan will be considered.

Phase I: Select candidate materials and processing steps. Develop a plan for how these may be integrated into a complete mask making process, evaluating effects between the various material properties and processing steps. Evaluate this plan against the many, varied requirements of masks in semiconductor manufacturing.

Phase II: Fabricate prototype samples and characterize. Deliver samples to third parties for independent evaluation. Evaluate projected costs of appropriate subset in the mask fabrication sequence and under anticipated market conditions.

SB90-072 TITLE: High Brightness X-ray Sources for X-ray Lithography

CATEGORY: Advanced Development

OBJECTIVE: To develop x-ray sources suitable for x-ray lithography in the semiconductor manufacturing environment.

DESCRIPTION: X-ray lithography will be used in the future to make semiconductor devices having features of 0.25 micrometers and below. Key components of the lithography system include the x-ray source, the mask, the mask-to-wafer aligner, and the resist. In current practice, the x-ray wavelength is in the 0.7-2 nanometer range and the mask is a gold absorber on a thin silicon membrane. The intensity of the x-ray beam, the size of the equipment, and capital investment are significant contributors to the cost-effectiveness of the lithography system. The synchrotron source has appropriate wavelength and intensity, but it has undesirable characteristics of large size, high capital investment, and a lack of granularity, i.e., incremental increase in production or graceful degradation of production with synchrotron failure. To date, conventional anode sources and plasma sources have not demonstrated desired intensity. The source should satisfy a wide range of characteristics suitable for the semiconductor manufacturing environment: intensity, equipment size, reliability, cost, safety, etc. The desired beam characteristics include wavelength, about 1 nm; intensity, greater than 50 milliwatts average power at the wafer; and divergence, less than 1 milliradian.

Phase I: Select a candidate approach. Evaluate this against the projected needs for x-ray lithography. Compare with appropriate characteristics (throughput, size, cost, reliability, environmental, etc.) of current optical lithography equipment.

Phase II: Fabricate a prototype and characterize. Arrange for independent evaluation by interested third parties. Develop a plan for integration with an equipment vendor. Evaluate projected costs of the source subsystem under anticipated market conditions.

SB90-073 TITLE: Photoresists for Optical Lithography at Wavelengths of 250 nm or Less

CATEGORY: Exploratory Research

OBJECTIVE: To provide photoresists capable of high-resolution optical lithography with illumination sources having wavelengths in the 248- to 193-nm range. These resists must be suitable for semiconductor manufacturing with feature sizes from 0.5 to 0.25 microns.

DESCRIPTION: As semiconductor lithography progresses from one-micro feature sizes to 0.5-0.25-micron feature sizes, requirements for photoresist materials shift and become more demanding. In particular, the use of short-wavelength illumination sources – mercury lamps in the 250 nm region, KrF lasers at 248 nm, and ArF lasers at 193 nm, requires new resists that are active at these wavelengths. The resists must also be reproducibly manufacturable and reliable in a rigorous production environment.

Phase I: Establish the detailed criteria for short-wavelength resists for semiconductor manufacturing. Complete this by extensively interacting with producers and developers of next-generation optical lithography systems. Identify candidate materials that have the potential to meet these criteria, and establish a thorough test plan.

Phase II: Evaluate the candidate resist materials and correlate their properties to optical lithography requirements. Fully characterize one or more resists and evaluate them for manufacturing.

SB90-074 TITLE: Fabrication of Micro-optical Components

CATEGORY: Advanced Development

OBJECTIVE: To apply planar processing techniques to the manufacture of micro-optical components.

DESCRIPTION: Achieving the integration of many different device functions (light generation, control, modulation, detection) in a single monolithic or hybrid structure requires a means of efficiently coupling light between the functional centers of the integrated device. In current practice, this is performed using discrete optical components manufactured using scaled-down implementations of traditional optical fabrication procedures (molding, polishing, etc.) and positioned using mechanical manipulation under a microscope. In order to meet anticipated future requirements for size, packaging, and cost, it will be necessary to develop alternative manufacturing technologies. For example, it is possible to apply photolithographic techniques to the fabrication of lenses and other optical elements in such materials as silicon and germanium. Another approach is to perform the necessary optical function in the native material used for lasers and detectors. An example would be the formation of reflecting surfaces to deflect the output of a semiconductor laser, thereby creating a surface-emitting device.

Phase I: Identify candidate devices for fabrication by novel means. Describe potential alternative manufacturing techniques which may lead to cost and performance advantages.

Phase II: Validate both the optical design and the potential value of the manufacturing process identified in Phase I. Fabricate and test one or more of the devices considered using the techniques developed.

SB90-075 TITLE: Fabrication Techniques Related to Monolithic Photonic Transmit/Receive Modules

CATEGORY: Advanced Research

OBJECTIVE: To develop device fabrication technology applicable to integrating the functions required for fiber optic transmission and reception on a single monolithic chip.

DESCRIPTION: The transmit/receive (T/R) module is the device forming the interface between electronic data processing circuitry and the fiber optic transmission line. The functions required of this interface include converting from logic levels to light emitting diodes or laser drive waveforms, coupling to the fiber (bilaterally), and converting received optical signals to logic levels for subsequent processing. Currently, these functions are performed in separate semiconductor chips, fabricated in different material systems, and integrated on a hybrid substrate. Because of the very large number of these devices that will be required in communications, in local area networks, and optical backplane structures for advanced computation systems, the cost, size, and weight associated with hybrid structures cannot be tolerated. Achieving these functions in a monolithic structure will lead to very significant advantages provided that laser, detector, optical coupler, laser driver and limited logic functions can be achieved in a single chip of a single material system. Maximum compatibility with low loss optical fiber would be desirable.

Phase I: Determine the individual device functional performance parameters needed to meet the overall T/R performance objectives. Translate these parameters into specifications for material layer topology and doping. Validate the performance of this design analytically. Identify the preferred material growth and chip processing technologies for producing this design.

Phase II: Fabricate individual chips in the common material system to separately demonstrate the device functions and integration potential discussed above. Measure the performance and compare it with the design goal.

SB90-076 TITLE: Fabrication/Materials for Assembly of Laser Diode Arrays

CATEGORY: Advanced Development

OBJECTIVE: To advance the development and fabrication of solid-state lasers that will have the spectral distribution and power output appropriate for large screen direct projection displays.

DESCRIPTION: Large screen projection display devices based on gas lasers have been designed and built. Such systems, however, are rather large, heavy, require high levels of electric power and are very expensive. Solid state lasers offer an alternative for a much more efficient, compact and less expensive projection system. Solid state laser technology is not yet sufficiently advanced to permit an implementation of a full color projection system. This project is directed toward the development of new material to be used in solid state laser devices for this application. Materials that would lead to a blue laser (ultimate OBJECTIVE: 3 Watts output, CW at 473 nm) are of particular interest.

Phase I: Identify one or more materials that are probable candidates for solid state laser light generation of the appropriate chromaticity and intensity for a projection system. Develop a plan for processing the material as required by the application.

Phase II: Develop final design and fabricate prototype samples of the material. Test the material in lasing configurations. Measure and report the performance characteristics.

SB90-077 TITLE: In-situ Process Monitoring for Metal Organic Chemical Vapor Deposition Material Growth

CATEGORY: Exploratory Research

OBJECTIVE: To develop mercury cadmium telluride metal organic chemical vapor disposition (MOCVD) growth methods which sense material characteristics in the growth reactor and optimize material growth by using real time feedback to adjust growth conditions.

DESCRIPTION: MOCVD of mercury cadmium telluride material is currently controlled by adjusting the reactor parameters, such as temperature, pressure and gas flow rates. Implementation of these controls has demonstrated the feasibility of growing a high quality material over wafers as large as two inches in diameter. However, poor reproducibility of growth conditions and undetected changes in the reactor environment have resulted in a poor material yield and precluded the extension of the growth to larger area wafers. The material is evaluated subsequent to material growth and a detailed analysis of results categorizes the material for specific array applications. This lengthy process of growth, characterization and analysis adds to the cost of the product and increases the time required to complete the cycle from material growth to focal plan array fabrication. Innovative characterization techniques, which do not disturb material properties and have the capability to map material properties over the wafer, are required to qualify the material in-situ and to provide real item feedback for control of material quality as the material is grown. A reactor design incorporating this unique control mechanism will dramatically reduce array cost by improving the yield of high quality material and by providing a measure of the material quality prior to the array processing, where substantial value is added to the product.

Phase I: Demonstrate characterization techniques which have the potential to non-destructively characterize the material and map material properties over the wafer. Integrate the non-destructive characterization technique into a MOCVD reactor design.

Phase II: Implement reactor design incorporating in-situ characterization and control methodology, and demonstrate improvements in mercury cadmium telluride material yield and uniformity.

SB90-078 TITLE: Graphical Displays for Manufacturing Simulation

CATEGORY: Exploratory Development

OBJECTIVE: To develop the technology for improved simulation of the manufacturing process of complex shaped mating surfaces and interfacing components.

DESCRIPTION: Manufacturing process simulation requires the ability to present highly detailed, accurate, moving, three dimensional graphic images. It requires accurate representation of complex shaped mating surfaces and interfaces of components, and how their relationship changes during the manufacturing process. Components representation may have to be changed from opaque to translucent to enable display of hidden views.

Phase I: Design innovative display and related hardware technology that allows the display of computer generated, three dimensional objects with smooth motion and a wide range of color.

Phase II: Demonstrate the proposed technology.

SB90-079 TITLE: Simulation and Modeling to Predict Life Cycle Product Costs

CATEGORY: Engineering Development

OBJECTIVE: To develop and test operational on-site field procedures and equipment to detect cavities suitable for nuclear decoupling near quarries, open mines, and drill-sites.

DESCRIPTION: There is substantial research on tunnel detection and on mineral exploration that is relevant to this subject. In addition, mining engineers and quarry operators may be able to suggest practical clues or means, accounting or physical, of detecting or preventing secret activity. Cavities of interest would range from radii of 10 to 50 meters at depth or at distances from tunnels of up to 1000 meters.

Phase I: Survey the existing literature and experts on this subject. Consult with mining and quarry engineers and operators. Outline suitable procedures and systems and define their probable capabilities. Propose suitable experiments for Phase II.

Phase II: Execute experiments in detecting hidden cavities. Evaluate results and propose designs for operational procedures and systems.

SB90-080 TITLE: Inexpensive Gigabit Local Area Network Technology

CATEGORY: Exploratory Development

OBJECTIVE: To explore alternative approaches and configurations for a local area network (LAN) that can support user data rates up to 1 Gbps.

DESCRIPTION: Designs are sought for Gbps LANs that could be implemented with current technology. These designs must be compatible with future computer and workstation architectures, must provide adequate performance, and must have the potential to lead to relatively inexpensive implementations. It is essential that LAN design be amenable to standardization.

Phase I: Provide a detailed design, including description of hardware and protocols, analysis (and/or simulations) of performance, and cost projections.

Phase II: Construct and test demonstration hardware.

SB90-081 TITLE: Terabit-per-second Local Area Network Technology

CATEGORY: Exploratory Development

OBJECTIVE: To explore alternative approaches and configurations for a local area network that can support aggregate data rates of 1 Tbps (10^{12} bps).

DESCRIPTION: Designs are sought for innovative LANs that will be able to support a mix of many high-speed and very-high-speed devices. The designs should be scalable to data rates higher than 1 Tbps, and they should not depend upon technology that is unlikely to be generally available by the mid-1990s.

Phase I: Provide a conceptual design, including a description of hardware and protocols, an analysis (and/or simulations) of performance, and an explanation of the limitations and the scalability of the architecture.

Phase II: Construct and test demonstration hardware.

SB90-082 TITLE: Speech Recognition Modules

CATEGORY: Exploratory Development

OBJECTIVE: To establish a library of reusable software modules embodying state-of-the-art techniques for speech recognition.

DESCRIPTION: Considerable progress has been made in development of speech recognition techniques, but much government funded technology resides in machine- and site-dependent software. A library of reusable component modules is needed to accelerate the transfer of this technology to potential users. The modules must be written in a standard, high level language and have clean, well-defined interfaces, structures, and descriptions. Complex functions are to be accomplished by combining several lower level modules.

Phase I: Acquire existing speech recognition software from researchers. Develop framework for constructing a library of speech recognition modules. Code and document a few modules.

Phase II: Significantly expand the initial library. Use it to construct a real application. Successfully export the library to other sites.

SB90-083 TITLE: Acoustic Preprocessor for Speech

CATEGORY: Exploratory Development

OBJECTIVE: To develop hardware and software exploiting knowledge of human auditory processing to serve as a robust front-end for speech recognizers.

DESCRIPTION: Recent discoveries concerning the early stages of human auditory processing could be exploited in algorithms to improve the accuracy and robustness of speech recognizers. Sound ideas are needed to create those algorithms, and a hardware implementation is needed for real-time operation. The resulting acoustic preprocessor could either modify the digitized signal or extract features for use by a speech recognizer.

Phase I: Develop and test a software version of an acoustic processor. Sketch out the design for a hardware version.

Phase II: Refine the algorithms as needed. Complete the hardware design. Build several copies of the preprocessor hardware.

SB90-084 TITLE: Interface Standards for Simulation Systems (i.e. SIMNET to BBS to JESS)

CATEGORY: Exploratory Development

OBJECTIVE: To explore techniques for interfacing warfighting simulations for interoperable exercises.

DESCRIPTION: Concepts and ideas are needed to interconnect, both vertically and horizontally, military simulations. The emphasis should be on the communications protocols and the database interchange.

Phase I: Prepare detailed concepts and analyze the potential applications.

Phase II: Execute and test demonstration software and hardware.

SB90-085 TITLE: High Definition Video Technology Based Head Mounted Displays for Visualization of Real-Time Systems

CATEGORY: Exploratory Development

OBJECTIVE: To explore new and innovative approaches and configurations for high definition video head mounted displays.

DESCRIPTION: Concepts are sought for innovative and novel approaches and configurations for high definition video technology based head mounted displays. The approach should consider use of innovative visualization techniques, and include size, weight, power and the need to interface the display to real-time systems in their discussions. New ideas for head mounted display alternatives for potential use in current and future weapon systems are desired.

Phase I: Provide a detailed refinement of the proposed approaches and configurations and conduct a performance analysis of proof-of-principle hardware.

Phase II: Construct and test demonstration hardware.

SB90-086 TITLE: Low Cost Portable Computer Generation Image Machines

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel machines for rendering objects in low cost portable equipment.

DESCRIPTION: Concepts are sought for novel approaches to low cost image generation machines that can be used in portable applications such as heads-up displays and very light weight, high resolution terminals. Approaches should emphasize special purpose hardware for rendering high resolution objects at high speed with low power.

Phase I: Identify and architect the system, demonstrating how the proposed approach significantly advances the state-of-the-art. Augment simulation results by a detailed cost, performance, and power dissipation study.

Phase II: Construct and test the demonstration hardware.

SB90-087 TITLE: Low Cost Reconfigurable Generic Computer Workstations for Simulation Research/Development/Analysis

CATEGORY: Exploratory Development

OBJECTIVE: To explore concepts for rapidly prototyping simulators, simulations, and operational equipment in a testbed environment.

DESCRIPTION: Concepts are sought for creative, innovative, and imaginative ways and means of creating modular (mix and match) workstations for simulation in a research and development environment.

Phase I: Prepare ideas and concepts for presentation in graphic format.

Phase II: Execute, test, and analyze selected concepts.

SB90-088 TITLE: Virtual World Interactions Using Heads-on Displays and Magic Glove Interaction

CATEGORY: Exploratory Development

OBJECTIVE: To explore, in conjunction, novel algorithms and hardware for virtual world interaction.

DESCRIPTION: Concepts are sought for novel approaches to virtual world interaction algorithms and hardware. Approaches that significantly improve the fidelity, usability, responsiveness, or cost-performance of such equipment are required. Low-resolution concepts are not of interest.

Phase I: Design a brass-board system connected to a personal computer or workstation. Optimize “feel” of interface.

Phase II: Address manufacturability and software concerns. Demonstrate prototype in a Military application.

SB90-089 TITLE: Low Power Complementary Metal Oxide Semiconductor Design Tools

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel design tools which minimize power for complementary metal oxide semiconductor (CMOS) circuits.

DESCRIPTION: Concepts are sought for novel approaches to minimizing power consumption in CMOS devices and circuits, even at the expense of circuit size or density. Approaches must be capable of being incorporated into design tools.

Phase I: In detail, refine the concepts from circuit design to layout and provide detailed cost/performance analysis as applied to nominal size circuits. Software module development will be necessary to demonstrate proof of concept, and detailed analysis of its scalability to large circuits is required.

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.

SB90-090 TITLE: High Performance Flexible Interconnect Technology

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel approaches to electro mechanical system design using flexible interconnect technologies.

DESCRIPTION: Concepts are sought for novel approaches to interconnect electrical-mechanical concepts for miniaturized systems. Emphasis should be on high performance system which operate greater than 100MHz, and which minimize power and weight.

Phase I: Provide a detailed refinement of the proposed concepts and develop an optimized design of a system, including thermal analysis. Analyze tradeoffs and compare to conventional techniques.

Phase II: Construct, test, and optimize demonstration of technology. Develop approach, software tools, etc. for applying to larger systems.

SB90-091 TITLE: Small Scale, Special Purpose Hardware Accelerators

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel ideas for computer hardware accelerators which can achieve 1000X over general purpose computing.

DESCRIPTION: Concepts are sought for innovative and novel ideas for computer hardware accelerators which demonstrate at least 1000X performance over general purpose solutions. Concepts must be implemented and described in systems context and include both hardware and software interfaces.

Phase I: Provide a detailed refinement of the proposed concept and develop the detailed design of the accelerator. Describe its simulated performance, its use in conjunction with an existing computer system, and the interfaces required for operation.

Phase II: Construct, test, and optimize the accelerators. Provide detailed analysis of its benefits, benchmark results, and interface specification.

SB90-092 TITLE: Rapid Prototyping Techniques and Methodologies

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel approaches for rapidly prototyping complex electromechanical systems.

DESCRIPTION: Concepts are sought for innovative and novel ideas to cost effectively accelerate the prototype design cycle by at least 20X 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 electromechanical design class. Provide demonstrations for proof of principle.

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

SB90-093 TITLE: System Level Packaging Design Tools and Interfaces

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel approaches for designing electromechanical systems employing different packaging techniques and the design interfaces needed to be realized in alternate technologies.

DESCRIPTION: Concepts are sought for innovative and novel ideas to provide design tools for electromechanical systems in a variety of packaging techniques. New concepts are sought to describe the necessary technical interfaces to realizing subsystems of the designs in a variety of technologies.

Phase I: Provide a detailed refinement of the proposed concept idea and tools. Describe, and demonstrate for proof of principle, interfaces to various technologies.

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.

SB90-094 TITLE: Technology Independent, Performance Driven Design Tools

CATEGORY: Exploratory Development

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

DESCRIPTION: Concepts are sought for innovative and novel ideas to designing systems which optimize a desired performance criteria while maintaining technology independence over a range of integrated circuit technologies. New concepts are sought to describe the necessary technical interfaces to 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. Describe, and demonstrate indicating proof of concept, technical interfaces to various technologies.

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.

SB90-095 TITLE: Innovative, Ultra Dense, High Performance Computer Input/Output Subsystems

CATEGORY: Exploratory Development

OBJECTIVE: To explore ultra dense, high performance computer input/output (IO) subsystems for use with embedded computers.

DESCRIPTION: Concepts are sought for novel approaches to ultra dense high performance computer I/O subsystems for embedded applications where issues of size, weight, and power dominate the concerns. Parallel processing systems are of greatest interest.

Phase I: Refine the proposed system in detail. Augment simulation results by a detailed cost, performance and power dissipation study.

Phase II: Address manufacturability and software concerns. Demonstrate prototype in a Military application. Equipment must conform to the specifications of a widely accepted standard.

SB90-096 TITLE: Vision Environment Components

CATEGORY: Exploratory Development

OBJECTIVE: First, to acquire libraries of object models and components using relatively new techniques for building representations of complex physical objects (i.e., natural terrain populated with objects such as roads, bridges, bushes and trees) from sensor data and a prior stored knowledge. Second, to demonstrate the object models utility in recognition tasks.

DESCRIPTION: Substantial progress has been made within DARPA image understanding (IU) community on the basic techniques for interactive and automatic visual modeling and recognition (i.e., effective techniques for describing, storing, and accessing models of natural objects such as rocks, bushes, ravines and cultural objects such as buildings, roads, etc.). For references, see the “Proceedings of the DARPA IU workshops (1987) and (1988)”.

Phase I: In detail, define needed extensions to existing or new object model libraries, to expand their representational descriptiveness needed to perform recognition adequately. Place the emphasis on explaining the rationale for use of an existing vision modeling tool (note that development of a vision tool is not being sought). Explicitly mention in a detailed research plan, examples of expected functionality (i.e., recognition of diverse cultural objects and natural objects from rang and intensity data) and total number of objects expected at six month intervals during Phase II development.

Phase II: Construct and demonstrate new object models and their addition to existing model libraries, using the chosen vision environment tools. Deliver extended model libraries, as required, to designated Military agencies.

SB90-097 TITLE: Case-based Reasoning Modules

CATEGORY: Exploratory Development

OBJECTIVE: To acquire precedent cases and exemplary prototype transformation modules that demonstrate new functionality or new applicability for case-based reasoning (CBR).

DESCRIPTION: The CBR paradigm has shown promise in both reducing the cost of initial knowledge acquisition and transfer of knowledge from an old case to a new problem situation (c.f., Proceedings of DARPA CBR workshops (1987) and (1988)). Nevertheless there remain many open technical questions (i.e., indexing and knowledge representation) as well as considerable need for further exploratory applications. Toward this end, DARPA seeks suggestions for novel ways to extend the technical base of experience in CBR into new functional areas (i.e., recognition of deception, temporal reasoning, adversarial reasoning, etc.), new task domains (i.e., planning/scheduling, diagnosis, etc.) or new application frontiers (i.e., medical law, international treaties, architecture, etc.). Emphasis should be on novelty in the space of functionality/task/application where an existing case base is known to exist and is available for further development.

Phase I: In detail, define needed extensions to existing CBR to expand its representation, etc. for integration into a prototype CBR system. Explain the rationale for use of the plans to extend functionality of an existing CBR tool (note that development of a CBR tool is not being sought). Examples of expected functionality and behaviors expected at six month intervals during Phase II development should be illustrated in the detailed research plan resulting from this phase.

Phase II: Construct and demonstrate new functionality/task/application. Deliver case base and associated transformation modules as required.

SB90-098 TITLE: Nonlinear Signal Processing

CATEGORY: Exploratory Development

OBJECTIVE: To explore new and innovative approaches, algorithms and applications for nonlinear signal processing.

DESCRIPTION: Concepts are sought for innovative and novel approaches for nonlinear signal processing. The approach should include, as a minimum, consideration of the theoretical advantage over linear signal processing, the computational complexity, and potential applications.

Phase I: Provide a detailed refinement of the proposed algorithms and the analysis of expected performance of the algorithms for at least one application.

Phase II: Develop software to implement the proposed algorithms for the application(s) analyzed in Phase I, and demonstrate the actual performance with real data.

SB90-099 TITLE: Scalable Algorithms and Software Library Modules for Scalable Parallel Computers

CATEGORY: Exploratory Development

OBJECTIVE: To explore novel ideas for scalable algorithms and software library modules for scalable parallel computers that can become functioning software on highly parallel multicomputers and multiprocessors.

DESCRIPTION: Concepts are sought for innovative and novel ideas for scalable algorithms and computing software libraries of beta release quality which focus on the use of highly parallel multi-computers and multiprocessors. Concepts must be described at a high enough level to be system independent and have clearly defined and open interfaces.

Phase I: Provide a detailed specification of the proposed software: collection of algorithms, library, or tool. Focus a description of its use in current or developing parallel computing environments. Finally, describe the path or process for obtaining beta release quality.

Phase II: Develop the software module (code for scalable parallel computer): collection of algorithms, library, or tool. Develop a users manual which clearly describes any external interfaces or requirements, how to use the software module, and the system interface. A hardcopy and a magnetic media copy of the code are required. Deliver the magnetic media in ASCII form and in Unix Tar format.

SB90-100 TITLE: New Techniques for Wide-band Video Data Compression

CATEGORY: Basic Research

OBJECTIVE: To identify and exploit techniques for reducing data link bandwidth while still providing the quality and quantity of data needed by unmanned air vehicles (UAV) to perform their tasks.

DESCRIPTION: The Services are developing a family of UAVs, and other systems, that employ video or wide-band sensors to collect data that must be transmitted over an extended range by a radio frequency data link. Increasing a singal's bandwidth increases the signal losses which adversely affects data link range and anti-jamming performance (all other factors being equal). Conversely, reducing the video bandwidth would increase the link's performance in these areas. Therefore, there is a need for a bandwidth compression/decompression system, provided that the quality of the decompressed (reconstructed) video is good enough for the UAV to perform its tasks.

Phase I: Investigate and develop compression/decompression techniques. Develop an experimental approach for empirically assessing performance.

Phase II: Design and fabricate bread board hardware. Integrate hardware into the UAV system, then demonstrate and assess performance.

SB90-101 TITLE: A Requirements Language for Tracking Autopilot Systems

CATEGORY: Basic Research

OBJECTIVE: To standardize specific language which delineates the features and performance parameters of a guidance system which must track a target and guide a vehicle.

DESCRIPTION: There is a need for a standard specification language for tracking autopilot systems from which software and hardware requirements can be automatically extracted. An ideal model should connect graphics and text features of design techniques and provide interfaces for hardware computer aided design (CAD) and software generation.

Phase I: Investigate and catalog standard features of design specifications for tracking autopilot systems, and define a standardized specification language grammar and syntax.

Phase II: Develop a parser to generate, from the design specification language, parameter inputs for hardware CAD tools and software design tools.

SB90-102 TITLE: Feature-based Design Methods for Predictive Design Paradigms

CATEGORY: Exploratory Development

OBJECTIVE: To investigate, develop and demonstrate innovative techniques which utilize feature-based design methodologies in a conceptual design process which is predictive of productivity and manufacturability considerations.

DESCRIPTION: Emerging technologies in artificial intelligence/expert systems have shown great promise as tools for evaluation of conceptual designs for productivity and manufacturability considerations. Although conventional computer aided design (CAD) technologies have no demonstrated the capability to adequately capture and manage the design intent knowledge necessary to allow for prediction or subsequent productivity considerations, feature-based design theory and preliminary efforts have shown the potential of providing a fundamental model for predictive designs.

Phase I: Identify and demonstrate innovative feature-based design methodologies which capture and manage design intent knowledge as a fundamental predictive design model.

Phase II: Develop a feature-based design system which captures or manages the predictive design as a knowledge base suitable for manipulation by a productivity expert system.

SB90-103 TITLE: Integration of Expert System for Process Planning and Feature-based Designs

CATEGORY: Exploratory Development

OBJECTIVE: To investigate, develop and demonstrate innovative artificial intelligence/expert system techniques which integrate feature-based designs and process planning considerations.

DESCRIPTION: Artificial intelligence/expert system techniques have demonstrated the ability to address complex reasoning tasks required for process planning. Feature-based design theory and preliminary efforts have shown the potential of providing a fundamental model for capture and manipulation of design knowledge. However, the two technologies have not been sufficiently integrated to allow design features to automatically influence process planning considerations.

Phase I: Identify and evaluate innovative artificial intelligence/expert system techniques which integrate feature-based design and process planning technologies.

Phase II: Demonstrate promising techniques identified in Phase I.

SB90-104 TITLE: Development of a Compact Eye-safe Laser Using Laser Diode Arrays

CATEGORY: Exploratory Research

OBJECTIVE: To develop coherently coupled laser diode arrays operating in the eye-safe wavelength region beyond 1.54 uM.

DESCRIPTION: Compact eye-safe lasers with good beam quality are needed for numerous tactical applications. High power laser diode arrays operating in the 1.54 uM wavelength region are needed both to pump solid state laser materials and to provide compact laser sources through coherently coupled laser diodes. Laser diode arrays with low output powers have been demonstrated in this wavelength region. The goals of this program are to demonstrate high power surface emitting laser diode arrays in the eye-safe wavelength region.

Phase I: Demonstrate high power laser diodes in the 1.54 uM wavelength region and develop innovative design concepts for coherently coupled two dimensional laser diode arrays.

Phase II: Demonstrate coherently coupled high power laser diode arrays. Typical output powers are 10 watts or greater.

SB90-105 TITLE: Development of Passive Q-Switches in the Mid-Infrared Spectral Region

CATEGORY: Exploratory Research

OBJECTIVE: To develop passive Q-switches in the mid-infrared spectral region.

DESCRIPTION: Q-switched mid-infrared lasers have numerous tactical applications. Passive Q-switching solid state lasers in the mid-infrared eliminates the moving parts making the lasers compact and light weight. The goals of this program are to develop and demonstrate passive Q-switches for mid-infrared solid state lasers.

Phase I: Examine the materials requirement for efficient passive Q-switches in the med-infrared region and demonstrate the Q-switch operation.

Phase II: Demonstrate passive Q-switches at high repetition rates and at high peak powers in the mid-infrared. Address materials development and reproducibility issues.

SB90-106 TITLE: Detection of Chemical Agents by Directed Energy

CATEGORY: Exploratory Development

OBJECTIVE: To develop a portable, compact and light weight directed energy device to detect chemical agents, i.e., ether, illegal drugs, etc.

DESCRIPTION: Current methods of locating illegal drugs and their manufacturing facilities are quite inefficient. Specially trained dogs are used to sniff baggage in customs. The sensitivity of a dog's nose is very good but it deteriorates very quickly after a prolonged period. The development of a compact, remote sensing device using directed energies, such as lasers, particle beams or microwaves for detection of illegal drugs and their manufacturing sites, is desired.

Phase I: Develop the methodology for remote sensing of drugs or drug facilities.

Phase II: Perform a proof-of-principle experiment which can demonstrate the features of Phase I.

SB90-107 TITLE: Development of Nonvolatile Memories Using Thin-film Ferroelectric Materials

CATEGORY: Basic Research

OBJECTIVE: To develop materials, deposition technology or characterization technology for ferroelectric nonvolative memories.

DESCRIPTION: DARPA is seeking innovative approaches to the utilization, deposition, and characterization of thin-film ferroelectric ceramics for nonvolatile memories. Endurance and retention characteristics of the ferroelectric ceramics are extremely important. Techniques which produce single crystalline or highly oriented films are of interest. The ferroelectric thin films must be compatible with either silicon or gallium arsenide integrated circuit technologies.

Phase I: Initiate effort as described above by beginning exploration of novel materials, deposition techniques and equipment, of characterization technology. Clearly demonstrate potential viability of the selected approach(es).

Phase II: Demonstrate the initial concept's applicability. For example, develop equipment for deposition of ferroelectric thin films.

SB90-108 TITLE: Development of Circuit Architectures Using Quantum Well Devices

CATEGORY: Basic Research

OBJECTIVE: To explore and develop circuit architectures of general applicability that use quantum well devices.

DESCRIPTION: Innovative approaches to using quantum well devices in electronic circuits are required. Both analog and digital applications are acceptable. The proposal must address the potential advantages of using quantum well devices in the type of circuit chosen.

Phase I: Devleop circuit architecture using quantum well devices. Address questions about whether the envisioned architecture has individual device performance tolerances that allow good manufacturing yields. Explore the applicability of the chosen architecture.

Phase II: Demonstrate initial concepts developed under Phase I by fabricating and characterizing quantum well circuits. Compare performance, power consumption, circuit density, and potential manufacturability to those obtained by conventional technologies.

SB90-109 TITLE: High Resolution Dopant, Impurity and Defect Spatial Profiling of Compound Semiconductors

CATEGORY: Exploratory Research

OBJECTIVE: As compound semiconductor devices achieve ever higher performance, the exact knowledge of dopant and impurity profiles become increasingly more important. Profiles or dopants and compensating impurities need to be quantified with greater spatial accuracy. The dynamic range for these determinations must also be extended, both to very high concentrations as might exist in heterojunction bipolar device bases, and to low concentrations as found in implant tail regions of field-effect or modulation-doped transistors.

DESCRIPTION: Nondestructive techniques will be preferred; however, all techniques that promise at least 10-nanometer depth resolution and a 10% accuracy in dopant concentration in the range of 10 to the fourteenth to 10 to the twentieth will be considered. Different techniques may be useful for the high and low ranges; thus, proposals that promise to solve the problem for either high or low concentration range, or both, are solicited.

Phase I: Demonstrate the capability of the technique for a limited number of samples. Establish a reasonable degree of confidence in the accuracy and versatility of the proposed scheme.

Phase II: Construct a useful measurement tool that will significantly advance the state of the art of compound semiconductor profiling equipment.

SB90-110 TITLE: Development of New Energetic Materials

CATEGORY: Exploratory Research

OBJECTIVE: To explore the synthesis and formulation of new energetic materials that have both high density and are sufficiently stable to permit possible utilization in explosive and propellants.

DESCRIPTION: New energetic materials that have densities and stabilities greater than HMX (high melting explosive) are needed for performance enhancement in numerous conventional military weapon systems for use as both propellants and explosives. Included would be new chemical methods to synthesize polycyclic nitramines and other energetic species.

Phase I: Emphasize the development of potential synthesis routes, and predict densities and heats of formation.

Phase II: Involve the synthesis of new energetic species, and determine critical properties, including stability and development of formulations that would enable their assessment as potential materials for novel, high performance explosives and/or propellants.

SB90-111 TITLE: Advanced Fouling Control Coatings

CATEGORY: Exploratory Research

OBJECTIVE: To develop fouling control coatings as replacements for toxic and anti-fouling paints.

DESCRIPTION: Certain fluoropolymers and silicones are effective for use as fouling-release coatings, provided hull cleaning practices are adequate. However, it would desirable to have the release characteristics of such coatings sufficiently effective to require little, if any, mechanical cleaning of the hull. Coatings which combine the best properties shown by silicones and fluoropolymers in one polymer type are sought. In addition to fouling release, surface properties are sought which inhibit fouling, e.g. those which would control barnacle settlement.

Phase I: Synthesize fluoropolymers which have release properties more like the silicones, but without their low toughness. Evaluate the best of these in fouling tests on small panels. Carry out morphological, chemical and physical surface analysis to correlate fouling behavior with surface properties.

Phase II: Scale the synthesis reactions toward commercial volume, and in full-scale, evaluate the reactions on hulls.

SB90-112 TITLE: Development of New Ceramic Composite Materials

CATEGORY: Exploratory Research

OBJECTIVE: To synthesize and process fiber reinforced and whisker reinforced ceramic matrix composites, with the goal of increasing room temperature and elevated temperature toughness and strength to values substantially above those for monolithic ceramics.

DESCRIPTION: Ceramic composites are of interest to the Military for a variety of applications: high temperature structural materials for aircraft and missiles, armor, gun barrel liners, and a variety of wear resistant applications. Novel processing techniques to produce net shape low cost composites will be given high priority.

Phase I: Process ceramic composition to dense bodies, determine room temperature toughness and strength, and conduct microstructural characterization.

Phase II: Optimize mechanical properties at both room temperature and elevated temperature.

SB90-113 TITLE: Determination of New Ways of Enhancing the Compressive Behavior of Organic Composites

CATEGORY: Exploratory Research

OBJECTIVE: To investigate the nature of compressive properties of high performance organic composites, and to develop capabilities for significantly improving poor compressive properties through modifications and developments in the fiber, the matrix, and the fiber matrix interface and in the design of the organic composite structure.

DESCRIPTION: Enhancement of the compressive properties of organic composites has and continues to be an elusive goal. Since the utilization of organic composites in military weapon systems is ever increasing, so is the need to enhance compressive behaviors of these widely used materials.

Phase I: Explore the advantages to be gained in the compressive properties of organic composites via an investigation of the properties/behavior of fibers, matrices, interphases and overall structure and design. Also provide qualitative estimates for enhanced compressive behavior.

Phase II: Select one or more key elements (fiber, matrix, interface, and design) and develop an organic composite. Extensively determine and measure compressive properties and behavior, and quantitatively compare this composite with prevalent organic composites.

SB90-114 TITLE: Application of High Temperature Superconductivity to Electronic Packaging

CATEGORY: Exploratory Research

OBJECTIVE: To determine how high temperature (nominally 80K) superconducting materials can be applied to electronic packaging to enhance speed, frequency response, and minimize power dissipation within electronic circuits.

DESCRIPTION: The new (circa 1987) ceramic oxide high temperature superconductors offer the possibility of revolutionary advances in the capabilities of electronic components and circuitry. The initial insertion of this technology into integrated circuits would be the replacement of normal metal interconnects by superconducting leads, allowing circuits to transport signals without dissipation and with reduced dispersion.

Phase I: Conduct an analysis of the advantages to be gained by the insertion of superconducting interconnects into prototypical integrated circuits. Investigate the electromagnetic response of simple packaging geometries for operation of interconnects and semiconductor elements at a temperature of 80K. Consider the mechanical response upon immersion in a cryogenic fluid, and give thought to compensation of the materials properties to assure mechanical integrity.

Phase II: Select a specific integrated circuit (IC) design, develop detailed analyses of the performance characteristics of the complete package with superconducting materials insertion, and define design goals in the production of the next generation electronic packages.

SB90-115 TITLE: Unique Applications for Artificial Neural Networks

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop prototype Artificial Neural Networks (ANNs) for applications for which ANNs provide a unique solution (i.e. applications for which, relative to competing, technologies, ANNs can be demonstrated to be the only technology adequate for the application).

DESCRIPTION: This SBIR solicitation is intended to elicit proposals with outstanding potential to demonstrate particular advantages of artificial neural networks (ANNs) in systems that perform challenging tasks that are at or beyond the limits of capability of conventional information processing systems. Since one important objective of this solicitation is to discover important unusual and under-recognized "niches" for application of ANN technology, proposals to carry out development activities in areas outside the mainstream of conventional and ANN information processing research will receive particularly favorable consideration. Proposals that address simplistic or unimaginative tasks or that promise incremental performance improvements in tasks for which there are well-developed "conventional" solutions are considerably less likely to be supported.

Phase I: Provide a conceptual design and laboratory demonstration of the system with documented evidence that the system will significantly outperform competing technologies.

Phase II: Extend the laboratory demonstration to a compact, prototype system (that may include tailored ANN hardware components) that can be used to demonstrate the uniqueness of the ANN solution.

SB90-116 TITLE: Nonstandard Control Theory

CATEGORY: Exploratory Research

OBJECTIVE: To develop a control theory that is applicable in complicated manufacturing environments.

DESCRIPTION: Formulation of a control theory in environments that are too complicated to be described by the usual feedback techniques. The approach should include the use of local simulation or heuristics to design controls in manufacturing environments that cannot currently be controlled by standard techniques. The proposal should include the detailed discussion of a manufacturing process of current importance.

Phase I: Develop the abstract setting for the control theory.

Phase II: Apply the abstract approach to the control of a manufacturing process.

SB90-117 TITLE: Spatial Light Modulator Utilizing Deformable Mirror Devices for Infrared Projection for Hardware-in-the-loop Simulation Applications

CATEGORY: Exploratory Development

OBJECTIVE: To 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 the Military which utilize imaging IR focal plane arrays (FPAs) for target detection and intercept. Conventional IR projector performance limitations have forced the exclusion of the FPA hardware from the HWIL simulations which are necessary to adequately access 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. Accordingly, they could lead to the development of an innovative IR projection system for application in HWIL simulations.

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

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

SB90-118 TITLE: Applications for Acoustic Charge Transport Technology

CATEGORY: Exploratory Development

OBJECTIVE: To obtain applications of acoustic charge transport devices.

DESCRIPTION: Acoustic charge transport (ACT) technology has evolved in recent years from a basic research activity to the demonstration of ACT devices which are suitable for application 6.2 and 6.3 developmental systems. ACT devices are sampled analog signal processing elements similar in some respects to both charge-coupled devices and surface acoustic wave devices, but without more serious limitations of either of those older technologies. The devices demonstrated to date or under development include digitally programmable transversal filters, fixed and programmable vector processors, correlators, analog memories, convolvers, and various hybrid structures. These devices all offer extremely wide bandwidths and dynamic range, low noise operation, and the advantages of implementation as monolithic gallium arsenide integrated circuits. Ultimately, the integration of ACT devices with digital processing elements on the same chip will provide extremely powerful and compact processor structures. The application areas for ACT devices include radar and radar electronic countermeasures, electronic support measures, and communication systems. The devices allow for enhanced performance of conventional concepts as well as making possible new, innovative approaches. Proposals which address the exploitation of ACT technology and devices for military systems are of current interest to DARPA. Any novel application concept will be considered, ranging from insertion into existing systems to entirely new system or subsystem concepts made potentially feasible because of ACT. Novel ACT device/process architectures and their applications are also of interest, including research in fabrication, production and testing of such devices.

Phase I: Completely describe the proposed application, and identify and justify the required performance characteristics. Describe the proposed ACT based system while including a detailed system design and a description of operation and predicted performance. At this point, include appropriate experimental data or analysis estimated by size and cost, identification of risk areas, specifications for the ACT devices, the underlying tradeoffs, analysis, and options in the design. Document results.

Phase II: Demonstrate the proposed system in hardware. The level of demonstration (e.g. laboratory quality, field hardened, fully integrated, etc.) will depend upon the specific program as described in the Phase II proposal.

SB90-119 TITLE: Algorithms to Automatically Extract Power Lines from Multi-spectral and Synthetic Aperture Radar Imagery

CATEGORY: Exploratory Research/Advanced Development

OBJECTIVE: To develop automated methods for geo-locating power lines and related obstructions from multispectral imagery and/or synthetic aperture radar imagery.

DESCRIPTION: High voltage power lines, power line towers, and related obstructions present a serious hazard to low-flying aircraft. In addition, the paths that these power lines follow provide off-road lines of communication (LOCs) for military vehicles. While these objects are well marked and well documented in friendly areas, knowledge of their exact location in unfriendly regions is often inaccurate, out-of-date, and not easily corrected, updated, or verified. Also, these objects, due to the sparse nature of their structure, are very difficult to find directly in electro optical (E/O) imagery. Techniques for automatically extracting the locations of power lines and related obstructions using multispectral imagery data, including E/O, infrared, and synthetic operture radar (SAR), would facilitate the validation and updating of maps and map data for vast unfriendly areas.

Phase I: Efforts shall concentrate on the design of a program to develop and test techniques for extracting power lines and related obstructions from multispectral and SAR imagery. Suitable data sets must be identified, algorithms designed, and comparative tests described. At least one technique must be developed and demonstrated and results reported. Recommendations and a plan for Phase iI shall be included in the final report.

Phase II: Efforts shall concentrate on the design, development, and test of a prototype system for automatically screening imagery for power lines and related obstructions, and extracting their geographic locations.

Phase III: Potential for integration of this capability with existing automated digital map generation, map verification, or geographic information systems technology shall be demonstrated.

SB90-120 TITLE: Micro-machine Concepts and Applications

CATEGORY: Exploratory Research

OBJECTIVE: To develop an array of interconnected, sub-millimeter electromechanical devices, and the processing system to precisely control bulk movement, shape of the entire array and/or other useful effects.

DESCRIPTION: General micro-machines, micro-motors, and micro-actuators have been developed which are smaller than 1.0 mm to the third in volume, extremely light, and with extremely rapid response times.

Phase I: Develop an innovative applications concept for appropriate individual electromechanical devices, a concept for connecting individual devices into an array, and a concept for the processing control system.

Phase II: Construct a device and perform proof-of-principle experiments.

SB90-121 TITLE: New Concepts for Detecting, Classifying or Locating Mobile Objects Using Low Cost Acoustic Sensors

CATEGORY: Advanced Development

OBJECTIVE: First, to define and document a technical approach toward developing a family of low-cost, atmospheric acoustic sensors for mobile objects. Second, to demonstrate technical feasibility of detecting, classifying, or locating objects through multi-media correlation (including acoustic) technology applications.

DESCRIPTION: Microprocessor technology now permits increasingly sophisticated sensing techniques to be packaged in remotely operated or unattended sensors. Large areas of open water, and smaller landmass areas traversed by mobile objects present opportunities for application of advanced concept sensing technologies. New concepts for expendable devices are required which combine emerging atmospheric acoustic, seismic, and other technologies into a hybrid package.

Phase I: Define, analyze and document an emerging acoustic technology sensor program which may be selected for a proof-of-concept of employment during Phase II. Establish a realistic operational concept of employment for the technology, and evaluate technical risk versus cost/benefits. Develop preliminary design concepts for implementation in Phase II.

Phase II: Implement preliminary design concepts from Phase I into a prototype configuration which can be analyzed for technical performance, manufacturing feasibility, reliability and operational employment effectiveness. Design detail will be sufficient to proceed into a third phase during which an operational prototype system may be evaluated for operational and production requirements. Conduct technical risk assessment of the final design configuration.

SB90-122 TITLE: Parallel Processing Algorithms for Real-time Combat Simulation of Electronic Warfare, and Command, Control and Communications in Dynamically Scalable Domains

CATEGORY: Advanced Development

OBJECTIVE: First, to develop selected software products which will increase the parallel processing effectiveness of dynamically scalable electronic warfare (EW), communications, and command, control and communication (C3) countermeasures (CM) simulations in real-time. Second, to design and develop specialized parallel processing architectures and software compilers which will permit the calculation of radar, infrared, and communication countermeasures effects on an interactive basis within the simulation and modeling domains.

DESCRIPTION: All Military command and control/EW/C3CM simulations and models with human interaction fail to provide near real-time dynamic interaction between the totality of model elements for countermeasures techniques. This initiative is directed toward combining emerging technologies within the specialized countermeasures' disciplines, and creating a parallel processing architecture, methodology and the ancillary software necessary to provide operational interface for selected large-scale simulations, either collocated or positioned in diverse geographical areas.

Phase I: Develop improved program structures of software for advanced parallel array processors which will permit the real-time integration with theater-level models and simulations. Recommend a follow-on development program for Phase II of this initiative.

Phase II: Implement the product of Phase I into a well-structured format and architecture which can be demonstrated within selected large-scale EW and C3CM simulations. Develop an algorithm with a provision for effective human interaction. Simultaneously analyze the combined effects of radar, infrared, and C3 countermeasures at the force level.

SB90-123 TITLE: Knowledge Based Tools for Faster Than Real-time, Episodic Campaign Planning for Comprehensively Aggregated Levels of Discrete Simulation

CATEGORY: Basic Research

OBJECTIVE: To develop a tool for faster than real-time evaluation of campaign plans at the executive command level that employs a knowledge-based system to support single-sided or two-sided conflict resolution.

DESCRIPTION: Current methods for evaluating echelon above wing/cops/battle group campaign plans are slow and cumbersome, relying on hundreds of supporting staff members and days of analysis to achieve minimal resolution of potential conflict situations. Application of knowledge based simulations may have the ability to

support episodic campaign planning and resolve questions regarding large-scale conflicts with minimal staff support. The system envisioned will support one or two-sided operation and allow aggregation of forces and commands. The knowledge base for each of the opposing forces must sufficiently represent the operational art so that inexperienced personnel can utilize the system and stay within appropriate military practices for either force.

Phase I: Develop a preliminary concept and demonstration system. Select an appropriate method of knowledge representation, and develop and implement preliminary knowledge bases of two opposing forces. This system should demonstrate methods for aggregation of forces and commands. Faster than real-time episodic play at wing/cops/battle group level is a desirable goal for Phase I.

Phase II: Expand the operation of the system to include single-sided conflicts. Expand the level of aggregation to echelons above wing/cops/battle group levels and demonstrate faster than real-time episodic play at that level. Also add the capability to store, analyze, playback and restart the campaign analyses.

SB90-124 TITLE: Artificial Neural Network Target Recognition Demonstration

CATEGORY: Basic Research

OBJECTIVE: To investigate, develop, demonstrate, and test innovative, real-time hardware techniques for implementing a new, fundamental and dynamic object extraction algorithm for target recognition.

DESCRIPTION: A basic problem of automatic target recognition is how to classify image pixels for correct grouping into candidate object regions prior to classification of objects into target types. An army-developed algorithm uniquely identifies invariant local features of images based on fundamental object properties. Implementation of this neural network based algorithm requires innovative synthesis of hardware processing techniques. Full details of the algorithm will be furnished as required.

Phase I: Design and demonstrate a candidate hardware approach for implementing the algorithm. Show scalability to full two-dimensional imagery and to real-time operation.

Phase II: Build, as a laboratory demonstration system, a full-scale, real-time hardware system based on the results of Phase I. It should process test imagery of real scenes with actual targets. Determine the quantitative degree of the algorithm's capability to perform object extraction as measured against the known feature parameters of the test imagery.

SB90-125 TITLE: Dynamic Object Extraction Preprocessor Algorithm for Automatic Target Recognition

CATEGORY: Exploratory Development

OBJECTIVE: To investigate, develop, demonstrate and test innovative implementation techniques for real-time hardware embodiment of a new fundamental dynamic object extraction algorithm to be used in future automatic target recognition (ATR) systems.

DESCRIPTION: A basic problem of ATR is how to classify image pixels so that they can be grouped into candidate object regions prior to further classification into type or objects such as targets or non-targets. An Army-developed algorithm uniquely identifies invariant local features of image pixels based on fundamental object properties. Implementation of this algorithm requires innovative synthesis of electronic and/or optical processing systems to develop a real-time hardware system capability to handle the algorithm.

Phase I: Design and demonstrate a candidate hardware approach for implementing the algorithm. Show scalability to full two-dimensional image processing capability and to real-time operation.

Phase II: Build a full-scale real-time hardware system. It should process test imagery of real scenes with actual targets. Conduct tests of performance and measure the quantitative degree of the algorithm's capability to perform object extraction against the known feature parameters of the test imagery.

SB90-126 TITLE: Wide Dynamic Range laser Diodes for Communications

CATEGORY: Exploratory Development

OBJECTIVE: To develop bread board laser diodes linear to better than 1 part in 10,000.

DESCRIPTION: Current laser diodes have very limited dynamic range, usually on the order of less than 1 part in 256. In addition, this linearity is rarely achieved with any reliability and/or repeatability. The goal of this exploratory development effort is to develop laser diodes with a reliable, repeatable dynamic range of better than 1 part in 10,000.

Phase I: Design a laser diode with the following minimum performance specifications:

Linearity: 1 part in 10,000
Bandwidth: 10 MHz
Output Power: 1 watt

Emphasize those aspects which presently limit laser diode linearity and how the Phase I design can potentially overcome them. In addition, address issues related to the reliable and repeatable linear operation of a Phase I device.

Phase II: Fabricate and test the laser diode designed in Phase I.

SB90-127 TITLE: Generators (Electromechanical Power Supplies) for Miniature Reciprocating Engines (Model Aircraft Size) with Sustained Power Levels from 1 Watt to 1 Kw

CATEGORY: Exploratory Research

OBJECTIVE: To demonstrate a rugged, highly reliable, low power electromechanical power supply driven by a very small reciprocating engine (model airplane size).

DESCRIPTION: As electronics become smaller and smaller through miniaturization, our ability to fly useful electronics packages on smaller and smaller vehicles becomes limited by the weight of the required batteries and the lack of generators in the very low power range.

Phase I: Design and demonstrate a prototype of a low power "generator" suitable for use on a small model airplane engine. The power supply range of interest is 10 watts (scalable to a few hundred watts) of DC at 12-15v.

Phase II: Demonstrate installed performance, reliability, and scalability of a small low-power generator on a model airplane engine of suitable characteristics.

SB90-128 TITLE: Passive (Nonradio Frequency/Nonelectro Optics) Sensors for Application to Low Observable Aircraft

CATEGORY: Exploratory Development/Advanced Development

OBJECTIVE: To develop brass board sensor systems for proof-of-concept and demonstration of concept performance and effectiveness.

DESCRIPTION: Current sensor systems on conventional and low observable aircraft exploit infrared and/or radiometric information to provide passive detection of target of interest. Technologies exist to defeat these sensors. Other types of passive systems (i.e. gravity gradiometers, electrostatic detectors, magnetic sensors, etc.) need to be explored/developed as alternatives.

Phase I: Develop system concepts, analyze performance and effectiveness, estimate developmental costs/schedule, and possibly perform a limited sub-component test.

Phase II: Design and test a system or a representative critical sub-component of the system as a proof of concept demonstration.

SB90-129 TITLE: Low Volume, High Efficiency Power Sources for Small Satellites

CATEGORY: Exploratory Development

OBJECTIVE: To analyze and design candidate space-qualified electrical power sources for small spacecraft that have low volume and high efficiency compared to current space electrical power sources.

DESCRIPTION: All spacecraft require some type of electrical power source to operate the spacecraft systems. Spacecraft electrical power needs range from continuous/steady low power levels up to burst/high power levels. Small spacecraft may require tens of watts up to a few kilowatts of power depending on the application. Current spacecraft electrical sources are solar panels and batteries. These systems are presently small scale versions of electrical power source designs created for much larger spacecraft. Designs optimized for small satellites are needed. Novel ideas such as superconducting storage devices are welcome.

Phase I: Identify candidate electrical power sources that promise significant improvements in storage medium energy density and system volume and efficiency, when compared to current designs. Identify and categorize applicable components and architecture, define areas for subsequent trade-off studies, and produce development schedules and risk assessments of various systems.

Phase II: Perform trade-off studies and system architecture analysis of candidate systems that can be space-qualified and optimized for small satellite operations. Areas of concern are: survivability in the space environment, mission requirements and duty cycles, fabrication and testing issues, and development risk.

SB90-130 TITLE: Innovative Thermal Control Concepts for Small Satellites

CATEGORY: Exploratory Development

OBJECTIVE: To develop and evaluate the performance of candidate innovative thermal control systems for small satellites.

DESCRIPTION: An inherent problem with small satellites is the lack of surface area that can serve as thermal radiators for the heat generated by on-board systems. The present situation restricts the power levels of small satellites to the order of hundreds of watts. This prevents small space platforms from being used for such missions as high capacity communications. Thermal control concepts that will allow small satellites to deal with higher power load heating will permit the use of this class of satellite in new areas.

Phase I: Identify alternative approaches, and develop plans for these approaches, to controlling thermal loads on spacecraft and those systems generating the most heat.

Phase II: Develop at least some of the Phase I approaches identified, and analyze their effectiveness. Include computer simulations, bench tests, control system demonstrations, and environmental testing.

SB90-131 TITLE: Novel Orbital Transfer Concepts

CATEGORY: Basic Research

OBJECTIVE: To identify and understand novel concepts for aero-assisted and/or low energy orbital transfers.

DESCRIPTION: there is a need to learn about and understand new methods of performing orbit transfers and how energy orbital transfer concepts extend the on-orbit life of small satellites and enhance overall mission utility. Aero-assisted orbital transfer concepts may facilitate new modes of operating in the earth orbit.

Phase I: Identify alternative concepts for performing orbit transfer maneuvers and provide analysis and performance criteria for subsequent efforts.

Phase II: Evaluate the performance, advantages, and disadvantages of the candidate alternative concepts.